Essays in Finance and Macroeconomics on the Effects and Resolution of Financial Distress

Inauguraldissertation

zur Erlangung des Grades eines
Doktors der Wirtschaftswissenschaften

durch

die Rechts- und Staatswissenschaftliche Fakultät der
Rheinischen Friedrich-Wilhelms-Universität Bonn

vorgelegt von

Martin Kornejew

aus Berlin

2024

Dekan:	Prof. Dr. Jürgen von Hagen
Erstreferent:	Prof. Dr. Moritz Schularick
Zweitreferent:	Prof. Dr. Farzad Saidi
Tag der mündlichen Prüfung:	24. Juli 2024

Acknowledgments

This dissertation is the fruit of years of intellectual and emotional nourishment by mentors, coauthors, friends and family. My indebtedness goes beyond this short acknowledgment.

I am especially grateful to my supervisors and mentors Moritz Schularick, Farzad Saidi, Christian Bayer and Yueran Ma. Moritz' inspirational ambition and generous support have had a profound impact on my academic development. His grasp of the zeitgeist has been, and continues to be, an essential signpost for my research. Farzad has a wonderful sense for the human nature and I treasure his intuition and advice on all aspects of academic life. Christian formed my understanding of economic theory and I remain grateful for his support since the start of my doctorate. I am indebted to Yueran for her invaluable guidance during the later phases of my doctorate. Her prudent reasoning and humbleness redefined my notion of intellectual virtues.

Research presented in this dissertation and beyond would have been impossible without coauthors that taught me countless things: Rudi Bachmann, Niall Ferguson, Òscar Jordà, Chen Lian, Pablo Ottonello, Diego Perez and Alan M. Taylor.

I was lucky to meet Francisco Amaral, Andrea Amelio, Luis Bauluz, Christina Brinkmann, Dominik Damast, Martin Dohmen, Simon Heiler and Lorenzo Ranaldi during graduate school and to share with them many moments of what matters in life. And I am grateful for many stimulating conversations with Ege Bilgin, Simon Block, Lukas Buhmann, Filippo Cavaleri, Ixart Miquel Flores, Zhiyu Fu, Ricardo Gabriel, Matthias Gnewuch, Alexandros Gilch, Maxi Günnewig, Luca Henkel, Tobias Herbst, Sebastian Hildebrand, Janko Heinecken, Agustin Hurtado, Young Soo Jang, Joachim Jungherr, Valentin Knecht, Chi Hyun Kim, Moritz May, Tim Meyer, Cathrin Mohr, Robin Musolff, Axel Niemeyer, Miguel Risco, Sophie Rotermund, Anna Schulze Tilling, Paul Schäfer, Fabian Seyrich, Lenard Simon, Fabio Stohler, Paolo Varraso, Paulina Vierhoff, Jakob Wegmann, Alexander Winter and Steffen Zetzmann over lunch, coffee or drinks. I remain indebted to Florian Flachenecker, Jun Rentscher and Christoph Trebesch for their special influence on me applying to grad school.

I would like to thank Benny Moldovanu, Silke Kinzig and the staff of the Bonn Graduate School for creating conditions that helped me flourish academically, as well as Amity James at the Chicago Booth PhD Program for her support during my visit. I gratefully acknowledge support from the RTG-2281 funded by the Deutsche Forschungsgemeinschaft.

Research in this dissertation has benefited from valuable comments by Tim Adam, Aleksandar Andonov, Douglas Baird, Ryan Banerjee, Bo Becker, Efraim Benmelech, Ulrich Bindseil, Arnoud Boot, Nina Boyarchenko, Nicolas Crouzet, Barry Eichengreen, Bill English, Fernando

Duarte, Harald Halbhuber, Edith Hotchkiss, Anna Kovner, Andrew Metrick, Eric Monnet, Karten Müller, Stefan Nagel, Florian Nagler, Enrico Perotti, Carolin Pflueger, Noemie Pinardon-Touati, Giogio Primiceri, Linda Schilling, Alp Simsek, Martin Schmalz, Jan Starmans, Amir Sufi, Michael Weber, John Williams, Adam Winegar, Jing Zeng, as well as participants at seminars, workshops and conferences.

Finally, I greatly owe to my parents, Petra and Oleg Kornejew, for stoking my curiosity about society. Their diligence and modesty has been a beacon and I wish that this dissertation will make them, and my brothers, proud. Above all, I thank my fiancée, Michelle, for her love, her backing and her approach to life. This work is dedicated to her.

Contents

List of Figures

List of Tables

Introduction

Economic progress and development requires society to pool resources for investment. To coordinate, we build on a decentralized web of private financial contracts, collectively forming the financial system. These financial contracts allocate rights over cash flows and control of private firms, steering production in modern economies.

But contracting frictions render financial contracts incomplete, so that unforeseen contingencies create a contractual vacuum in which economic outcomes deteriorate (Hart and Moore, 1988; Aghion and Bolton, 1992). For example, recessionary shocks can plunge corporate borrowers into financial distress and stifle economic activity through debt overhang (Myers, 1977). If private contract renegotiation fails, stakeholders have to fall back on costly court interventions that waste and possibly misallocate resources. In the financial sector, weak banks may continue financing insolvent "zombie" firms to hide and delay losses from inefficient debt resolution. And mere doubts about distress in financial markets can trigger creditor runs that choke intermediation, bring down solvent institutions and spiral into financial crisis. Any of these ex-post inefficiencies can discourage financing of desirable investments in the first place.

Well-designed institutions for distress resolution mitigate such economic malaise. Flexible regulation enables contract parties to renegotiate terms swiftly in private. Efficient bankruptcy procedures and expert judges can help overcome coordination frictions and restructure large businesses with complex capital structures. And well-targeted policy interventions can cushion the shock itself and prevent distress from sprawling in the financial system. This dissertation examines the macroeconomic and microeconomic costs of inefficient distress mitigation and explores the promise of institutional improvements.

The first chapter assesses the macroeconomic cost of corporate debt crises and the moderating power of well-designed corporate bankruptcy institutions. It is joint work with Òscar Jordà, Moritz Schularick and Alan M. Taylor. We estimate the impact of recessionary shocks on the macroeconomy conditional on corporate indebtedness. To this end, we apply local projection methods to new panel dataset of total corporate debt covering 150 recessions that occurred in advanced parts of the global economy since 1870. Crucially, we reveal a striking asymmetry across corporate bankruptcy regimes: efficient debt resolution appears to reduce the depth of—and boost recovery from—recessions, suggesting that it can contain debt overhang and loan ever-greening. We measure bankruptcy quality using established proxies from the literature and confirm that our results hold when instrumenting bankruptcy quality by deep-rooted legal features and controlling for other institutional features.

The second chapter highlights a novel trade-off for the design of creditor protection. It builds on the observations that borrowing from capital markets fragments firms' creditor bases and aggravates coordination frictions in future debt restructurings. But coordination matters only to the extent that creditors can actually assert their interests. Within a model, I clarify how this creates a trade-off for the protection of market creditors between i) complicating restructuring ex post and ii) disciplining management ex ante. I test the economic ramifications of an expansion of bond market creditor rights in the US at the end of 2014. I confirm that the ruling complicated the restructuring of bond debt. Healthy firms reacted by cutting bond and increasing loan issuance. But imperfect substitutability depressed net total debt issuance, real investment and firm value. This evidence suggests that market-based lending can suffer from over-protection. However, my theory predicts that effects of similar reforms will differ across countries and time.

The third and final chapter analyzes the dynamic effects of central bank liquidity injections during financial crises. It is joint work with Niall Ferguson, Paul Schmelzing and Moritz Schularick and based on novel panel data detailing central bank balance sheets going back to proto central banks of the 1600s. We use local projections to measure the dynamic macroeconomic effect of central bank balance sheet expansions during financial crises. To circumvent the reverse causality between crisis severity and liquidity support that has plagued the empirical macro literature on the topic to date, we code beliefs of the central bank governor about the desirability of liquidity support as an instrument for the latter. We find that central bank liquidity injections do stabilize output, inflation and investment substantially. But we also find evidence consistent with the concern of moral hazard: over the medium term, interventions are associated with elevated risk of credit boom going bust. A back-of-the-envelope calculation suggests that aggregate economic gains from interventions likely out-weight its long-run cost of financial instability.

Across all three chapters, this dissertation documents sizable macroeconomic and microeconomic effects of inadequate distress resolution. Economic shocks risk to be amplified by the incompleteness of financial contracts. But well-designed public institutions of bankruptcy (Chapter 1), securities law (Chapter 2) and emergency lending facilities (Chapter 3) complement private contracts and can remedy consequences of incompleteness ex post. These policies also change economic decisions ex ante, and I provide evidence on how this can create a trade-off for policy makers. My analysis suggests to examine other economic and financial phenomena through the lens of distress resolution institutions, e.g., the shape of the firm size distribution or features of cross-border financial contracts underpinning international capital flows. Looking ahead, it underscores the promise of exploring the broader economic ramification of other institutions shaping corporate finance.

References

Aghion, Philippe, and Patrick Bolton. 1992. "An incomplete contracts approach to financial contracting." *Review of Economic Studies* 59 (3): 473–94.

Hart, Oliver, and John Moore. 1988. "Incomplete contracts and renegotiation." *Econometrica* 56 (4): 755–85.

Myers, Stewart C. 1977. "Determinants of corporate borrowing." *Journal of Financial Economics* 5 (2): 147–75.

Chapter 1

Zombies at Large? Corporate Debt Overhang and the Macroeconomy

Joint with Òscar Jordà, Moritz Schularick, and Alan M. Taylor

Corporate debt has markedly risen around the world in recent years, especially, but not only, in emerging market economies (Abraham, Cortina, and Schmukler, 2020).[1] In the decade after the global financial crisis, in a time of low interest rates, businesses in many countries have increased borrowing from banks and markets. In the United States, debt levels of the nonfinancial business sector increased by about 20 percentage points in the past 30 years. The COVID-19 pandemic has aggravated this state of affairs. As of 2022, U.S. business debt stands at a historical high of 130% of gross domestic product (GDP) (Board of Governors of the Federal Reserve System, 2020) as emergency lending facilities have pushed business debt ratios higher, potentially amplifying the risks of debt overhang.

Do lessons from the Global Financial Crisis about the economic aftermath of credit booms apply to this business debt boom as well? After 2008, as in previous debt-boom episodes, stressed household balance sheets were key reasons for the crisis, recession, and the slow recovery. Households saddled with mortgage debt needed time to repair their balance sheets following the housing crash. This time around, many observers see potential risks from the corporate debt boom. While some previous studies have suggested lower risks from this form of debt (Jordà, Schularick, and Taylor, 2013; Mian, Sufi, and Verner, 2017), we still lack a detailed understanding of corporate debt booms, their aftereffects, and what distinguishes them from household credit booms. Without a better understanding can we really be sure this time will be no different?

A new body of research, assessing the role of household debt overhang at a macroeconomic level, points to the important role of debt renegotiation and restructuring frictions. As noted by Auclert, Dobbie, and Goldsmith-Pinkham (2019), individual banks can have little interest in

1. Throughout this chapter, we use the terms "business debt" and "corporate debt" interchangeably to refer to the total debt of the nonfinancial corporate and noncorporate sectors. We also refer to debt (the liability) and credit (the associated asset) interchangeably.

restructuring household debt because such policies are beneficial only at the macro level; the problem is aggravated by the recourse nature of most household debt, especially mortgages. Consequently, household bankruptcy and debt restructuring have potentially large macroeconomic effects (Auclert, Dobbie, and Goldsmith-Pinkham, 2019).

Matters are different for business debt, where bankruptcy and restructuring are a routine process. When corporations cannot meet their obligations, debt holders can take over the firm's equity, while limited liability provides little or no recourse. Liabilities are ultimately limited by firm assets. When the value of a firm drops below the market value of its assets, the difference will be erased upon liquidation. Assets will be freed up for other productive ends. Both owners and creditors gain from successful reorganization (see also, e.g., Fama, 1978; Aivazian and Callen, 1980) and have incentives to restructure the debt. Could these differential frictions be a mechanism to explain the contrast between the effects of household and business debt overhang?

To study this hypothesis, we build on Djankov, McLiesh, and Shleifer (2007) and Djankov et al. (2008) to quantify country-level institutional frictions to corporate debt reorganization or liquidation in corporate debt booms since the 1970s. Such frictions relate to coordination issues among dispersed creditors, weak contract enforcement, holdout problems, asymmetric information, and other frictions that can make renegotiation difficult or even prevent it altogether (Gertner and Scharfstein, 1991; Philippon, 2010). The liquidation process too can be more or less efficient. Poor creditor rights' protection, or costly legal procedures can discourage or delay liquidation.

Note that frictions can also affect the behavior of lenders, making them more likely to avoid the losses and keep insolvent "zombie" firms afloat. Inefficient liquidation increases the survival probability of zombie firms and their importance at the macro level (Becker and Ivashina, 2021). Research by Peek and Rosengren (2005) describes the "evergreening" of loans by banks (i.e., rolling over loans of unprofitable firms to avoid formal loss provisioning). Such evergreening may discourage the entry and growth of healthy competitors and eventually undermines productivity growth (Caballero, Hoshi, and Kashyap, 2008).[2] Recent papers also point to the two-way relationship between zombies and loose monetary conditions (Acharya et al., 2020; Hong, Igan, and Lee, 2021) and the role of national bankruptcy regimes in preventing zombification (Andrews and Petroulakis, 2019).

In this chapter, we assess how reorganization frictions modulate the economic costs of corporate debt booms over the business cycle. We assemble a new long-run data set on nonfinancial business sector liabilities (bank loans, corporate bonds, trade credit, and other liabilities) for 17 advanced economies since the 19th century. A contribution in its own right, the new data set is

2. Note how the zombification channel differs from the debt overhang channel along two important respects. Zombification undermines growth through the deterioration of the *quality* of investments, as funds *flow* into unprofitable, highly leveraged firms unable to carry their debt burden otherwise. By contrast, debt overhang impairs growth through depressing the *quantity* of investment as highly leveraged firms are *denied access* to finance, and funds might flow elsewhere.

an enhancement to previous data collected by us.[3] Data before WW2 mainly consist of business loans, though in some cases we were able to augment these with corporate bond market data.[4] Data after WW2 build on bank lending data from the Macrohistory Database (Jordà, Schularick, and Taylor, 2017), hand-collected data from Müller (2018), as well as financial accounts collected by the Bank of International Settlements (BIS) that capture the growing importance of non-bank-lending channels.

Naturally, countries can adapt legislation to their economic experience. Hence, to account for this adaptation, we turn to a local projection instrument variable strategy (Jordà, 2005; Jordà and Taylor, 2016). Specifically, we appeal to the exogenous variation of legal origins in the spirit of La Porta et al. (1997, 1998) and La Porta, López-De-Silanes, and Shleifer (2008). Using legal traditions as an instrument for debt renegotiation costs, we find that where institutions encourage efficient restructuring and liquidation, the drag from business debt booms is small, as previous results have suggested. However, and more interestingly, we find that in countries where frictions due to renegotiation costs are high, the recovery from a business debt overhang can be just sluggish as with household debt overhang.

How do our empirical findings fit with the existing literature? In a seminal departure from the classic Modigliani and Miller (1958) theorem on the irrelevance of the firm's capital structure, Myers (1977) showed that default risk undermines the incentives to invest for indebted firms. Some projects with positive net present value will not be realized as equity holders do not benefit in case of default. Debt overhang may depress any expenditure with delayed returns, such as hiring, training, advertising, or maintenance (Hennessey, 2004). Yet the possibility of underinvestment also provides an incentive for owners and creditors to restructure debt. Underinvestment pushes the value of the firm below its potential, so that both sides could in principle buy out the other party and gain from implementing the efficient investment policy (Fama, 1978). Bergman and Callen (1991) argue that "running down assets" through underinvestment constitutes a credible and effective threat to bring creditors to the negotiation table.

At the microeconomic level, a large empirical literature has mostly focused on documenting mechanisms linking corporate debt and firm-level investment decisions and outcomes. Several papers show the adverse investment effects of debt overhang at the firm level (e.g. Lang, Ofek, and Stulz, 1996; Hennessey, 2004; Kalemli-Özcan, Laeven, and Moreno, 2020; Albuquerque, 2021). These studies suggest that highly levered firms invest less and grow slower. This is especially true when firms are financially vulnerable and dependent on external creditors who perceive investment opportunities to be bleak. Recent studies using European firm-level data, such as Kalemli-Özcan, Laeven, and Moreno (2020) and Popov, Barbiero, and Wolski (2018) find conflicting evidence with respect to investment levels and efficiency effects of high corporate debt. Favara et al. (2017) examine the role of national bankruptcy regimes empirically.

3. Previously collected historical data are available at www.macrohistory.net/database. New data will be added to this database and will be publicly available.

4. In most countries, the share of noncorporate business debt is a small fraction of corporate debt. See Section 1.1.

They show how differences in such regimes affect the investment behavior of firms near default and highlight the role of frictions to debt renegotiation.

It is an open question, however, whether any of these mechanisms matter quantitatively at the aggregate macro level. Firm-level estimates may overstate aggregate effects in general equilibrium. For example, financially constrained firms may leave room for competitors to pick up the slack. Moreover, existing micro evidence appears to be particularly strong for small- and medium-sized firms (Kalemli-Özcan, Laeven, and Moreno, 2020; Kuchler, 2020), which account for only a minor share of aggregate business debt.[5] Thus, via composition effects, the financing decisions of bigger corporations could greatly attenuate the aggregate effects of debt overhang. It remains unclear how these firm-level mechanisms aggregate into macroeconomic forces and shape business cycle fluctuations. Consequently, beyond individual firm-level behavior, we need a better understanding of the macroeconomic effects of corporate debt (Brunnermeier and Krishnamurthy, 2020).This is where our analysis of debt renegotiating and restructuring costs and their business cycle consequences helps clarify this muddy landscape of conflicting forces.

Our analysis brings evidence to this question and carries a straightforward policy implication. Frameworks that efficiently facilitate the restructuring or liquidation of debt reduce the macroeconomic fallout of corporate debt booms. Conversely, legal and regulatory frictions will worsen debt overhang and corporate zombification, impairing productivity growth and slowing recoveries after recessions as emphasized by Caballero, Hoshi, and Kashyap (2008) and Adalet McGowan et al. (2018), among others.

1.1 Data description

The basis for our analysis is a novel long-run data set on business credit, including bond market debt and credit from nonbank intermediaries, covering 18 advanced economies since the nineteenth century.[6] Notably, we have been able to construct separate series for business debt for nine countries in the pre-WW2 period. Data for the United S. start in 1916 and build on the business sector debt data calculated by James and Sylla (2006), from which we deduct debt obligations of financial institutions. For other countries, we calculate bank credit to the nonfinancial business sector based on the assets of specialized commercial banks that provide loans to business and other corporate financing. As an example, for Germany we sum loans and advances extended to nonbanks by joint-stock industrial banks and commercial credit unions. We identify similar proxies for business credit in other countries, as detailed in the Internet Appendix. The new data enhance the long-run data set in Jordà, Schularick, and Taylor (2017), from which we take data on household bank credit as well as a long list of macroeconomic controls, updated to 2019.

5. For example, in the United States more than 80% of firms are—typically small—noncorporate businesses that jointly account for less than 25% of total nonfinancial sector leverage (Pomerleau, 2015; Board of Governors of the Federal Reserve System, 2020).

6. The 18 advanced economies are the United States, Japan, Germany, France, United Kingdom, Italy, Canada, Netherlands, Ireland, Belgium, Sweden, Australia, Spain, Portugal, Denmark, Switzerland, Finland and Norway.

We rely on comprehensive business credit data provided by the financial accounts and the Total Credit Database assembled by the Bank for International Settlements for data after WW2.[7] These include secured and unsecured debt, of all maturities, and from all types of lenders, in addition to conventional bank lending contracts. Financial account data on nonfinancial business liabilities come from the OECD and Eurostat databases and individual publications, for example, Bonci and Coletta (2012) for Italy and Roe (1971) for the United Kingdom. All postwar U.S. data are from the Fed's financial accounts (Board of Governors of the Federal Reserve System, 2020).

As noted earlier, we use the terms "business debt" and "corporate debt" interchangeably throughout the chapter to refer to all debt liabilities of all firms, whether corporate or noncorporate. Whenever available, our series include the debt liabilities of noncorporate businesses as well. Historical sources do not always allow for a clean separation of the two. Corporate debt is the dominant component. In the United States, noncorporate businesses account for only one-third of total nonfinancial business debt outstanding.

In total, there are 1,717 country-year observations for business sector debt, 480 of which correspond to the previously less well-documented pre-WW2 period. The Internet Appendix describes details of the construction and underlying sources, including the materials kindly shared by Müller (2018). The results presented in the chapter always use the entire data set, excluding the wartime years of WW1 and WW2. All findings are qualitatively and quantitatively similar when restricting the data to the post-WW2 period, but, for brevity, we place those robustness results in the Internet Appendix.

In corporate finance, the term "leverage" often refers to the ratio of debt to equity. However, we instead focus on the ratio of corporate debt to GDP. The reason is that several episodes that we investigate involve sudden and dramatic repricing of assets. Thus, both debt and equity could be shifting at the same time, making the traditional definition of leverage more difficult to interpret. For the ratio of debt to GDP, one can think of it as a cash-flow-based measure of *leverage*; hence we will often refer to this ratio as *leverage.*

Figure 1.1 shows the evolution of business debt over the full sample, which starts in 1870. The figure plots the cross-country median and the interquartile range of business credit relative to GDP, that is, our measure of leverage. Historically speaking, business credit has ranged between 50% and 100% of GDP for most advanced countries. The series trends upward in the lead-up to World War I before entering a period of high volatility in the interwar years, followed by a sharp reduction during the 1930s and World War II. Since then, business credit has doubled from about 50% to 100% of GDP today. For this measure, several countries are currently at their highest level over the past 150 years, but not at a level dramatically higher than those seen circa 1900.

Another aspect of our empirical strategy requires that we identify business cycle turning points. Here, we follow Jordà, Schularick, and Taylor (2013) and use the Bry and Boschan (1971) algorithm for all countries. At an annual frequency, and for the United States, this algo-

7. For details on its construction, see Dembiermont, Drehmann, and Muksakunratana (2013).

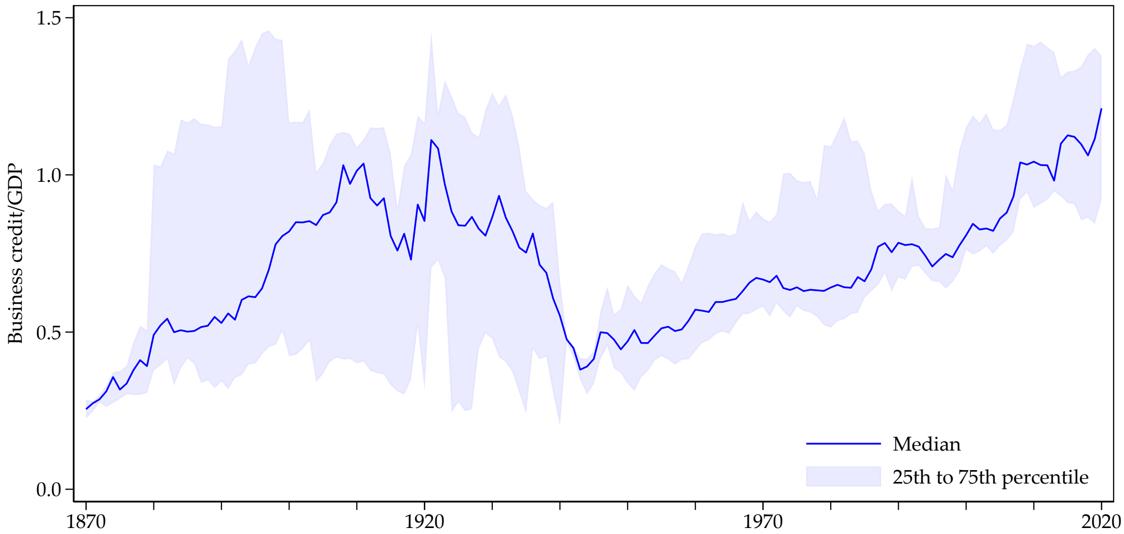


Figure 1.1. Business credit/GDP since 1870

Notes: The figure shows nonfinancial business credit over GDP for our sample of 18 advanced economies. The shaded region represents the range spanned by the first and third quartile.

rithm reproduces almost exactly the NBER's dating. Briefly, the Bry and Boschan (1971) algorithm dates turning points as local maxima and minima of real GDP per capita data in levels. Minima are labeled as troughs and maxima as peaks. Recessions go from peak to trough, and expansions from trough to peak.

We document large amplitudes in business credit cycles alongside a weak synchronization with the boom-bust pattern in real activity. This provides rich statistical variation to be exploited in our analysis: Figure 1.2 displays the distribution of business credit booms in the run-up to recessions. It plots the change in the logarithm of real credit (left panel) and the credit-to-GDP ratio (right panel) over the 5 years preceding any given business cycle peak of our sample. The figure shows a great deal of variation, virtually all of which takes place *within* countries, as accounting for country fixed effects barely affects the standard deviation of these distributions.

Finally, we further separate recessions into two types. We will refer to *financial* recessions as those associated with a financial crisis in a ±2-year window around a peak. The reason is that financial crises sometimes lead to recessions, sometimes recessions lead to financial crises. All recessions not associated with a financial crisis are considered to be *normal* recessions. The financial crisis chronology itself is based on the latest version of the Jordà, Schularick, and Taylor (2017) Macrohistory Database (http://www.macrohistory.net/database).

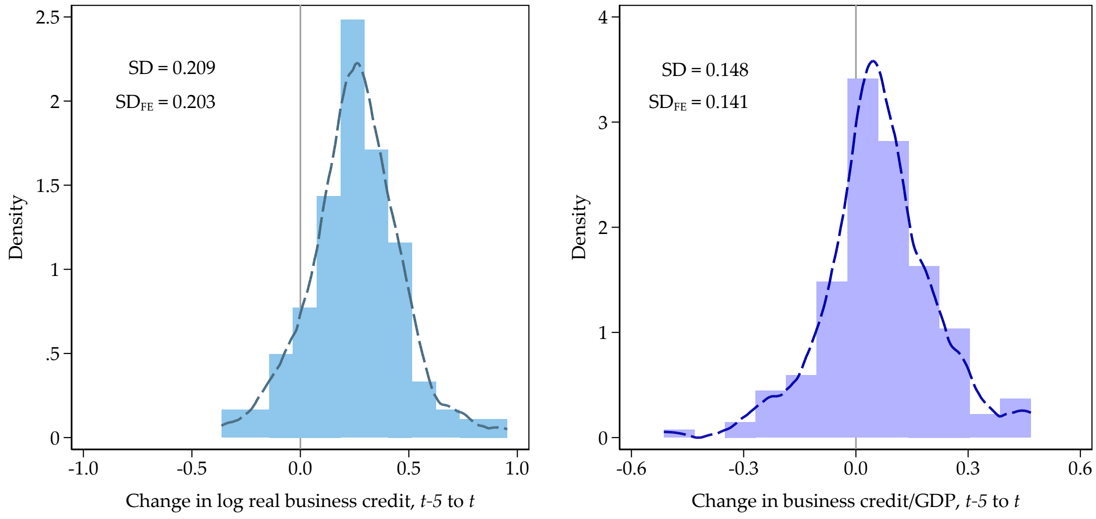


Figure 1.2. Business credit booms in the run-up to recessions, 1870-2020

Notes: This figure shows histogram and kernel density estimates of the distribution of nonfinancial business credit booms unfolding over the 5 years prior to recessions (t denotes business cycle peaks). Empirical standard deviations before and after removing country fixed effects from the distribution appear in the top-left corner.

1.2 Business cycle-business debt disconnect

The literature already highlights some differences between household and business credit booms (Mian and Sufi, 2010; Schularick and Taylor, 2012). Here, we find it useful to first establish some comparable baseline empirical facts with our data and approach, from which we can build out to highlight our new findings. Our analysis provides added values along two dimensions. First, we test the macroeconomic role of corporate debt using new data, stretching further back in time and trying to construct as comprehensive a measure of business liabilities as possible. Second, the theory suggests that business debt becomes problematic when default risk is high. Therefore, conditioning on recession events to obtain the most sensitive test of this proposition is a natural approach.

Consider next evaluating the path of the recession and recovery as a function of how much corporate debt grew leading up to the recession peak, conditional on a rich vector of macroeconomic variables. This can be easily done with local projections of the cumulative change in real GDP per capita from the recession peak year to h periods thereafter, conditional on controls. In particular, let y_{it} denote the logarithm of real GDP per capita multiplied by 100, observed for country i at time t. Our interest on the trajectory of recessions/recoveries means that we will focus on those time periods associated with a peak in economic activity and denoted by $p = 1, \ldots, P$, where the index is understood to be specific to each country and hence it is not expressly indicated to avoid cluttered notation. Hence, $t = t(p)$ denotes the time period associated with the pth recession peak.

Thus, our main outcome variable of interest, $y_{it(p)+h} - y_{it(p)}$, will measure the cumulative (log-form) percentage change in real GDP per capita, h horizons after the peak p, where we will display responses up to 5 years out. Using similar notation, we write $\Delta_5 x^j_{it(p)} \equiv x^j_{it(p)} - x^j_{it(p)-5}$, for $j = B, H$ which denotes the 5-year change in business, B, or household, H, debt measured as a ratio to GDP in the years prior to the peak p. Hence, these debt variables are predetermined once the recession starts. In addition, the vector $\boldsymbol{w}_{it(p)}$ summarizes all other predetermined macroeconomic variables observed before the start of the recession. This vector includes the current plus two lagged values of real GDP growth, inflation, real investment growth, and changes in the investment-to-GDP ratio.

With these variable definitions, we estimate the following local projections for $h = 1, \ldots, 5$:

$$\Delta_h y_{it(p)} = \alpha_h + \alpha_{hi} + \beta^B_h \Delta_5 x^B_{it(p)} + \beta^H_h \Delta_5 x^H_{it(p)} + \gamma_h \boldsymbol{w}_{it(p)} + \epsilon_{it(p)} \tag{1.1}$$

where α_{hi} are country fixed effects normalized to sum to zero so that α_h is the average percentage change in real GDP per capita after a peak since we demean all regressors by their full-sample averages.[8] The coefficients of interest are β^j_h for $j = B, H$, each indicating how the expected future path of real GDP per capita varies with the behavior of credit (in the business and household sectors) during the expansion.

We do not interpret the coefficients β^j_h for $j = B, H$ causally since our interest is in comparing the typical trajectory in a recession/recovery given the behavior of business versus household debt in the preceding expansion. That said, the predetermined nature of our variables of interest and our rich set of controls reduce the chance that unobserved factors could explain the differences.

1.2.1 Baseline results

Table 1.1 presents the estimates of α_h, β^B_h, and β^H_h from our main specification.[9] Based on these coefficient estimates, Figure 1.3 plots predicted trajectories or responses for the average recession as well as recessions preceded by a two-standard-deviation (above mean) change of business debt (about 14.4 percentage points). The peak year is normalized to zero and deviations in subsequent years are measured in logarithm points times 100 (approximate percentage changes). For comparison, we also show the responses for a corresponding two-standard-deviation change of household debt (approximately 34 percentage points).

The table presents formal tests, but Figure 1.3 unequivocally shows that the effects of past corporate credit booms (especially once controlling for other macroeconomic aggregates) are negligible—in the economic and statistical senses—as compared to household credit booms. Recessions preceded by household debt expansions are not only deeper but also followed by

8. This somewhat unusual specification is done to have a direct coefficient estimate of the desired parameter.

9. Table 1.G.6 in the Internet Appendix shows the results omitting the controls. The results are qualitatively similar.

Table 1.1. Credit booms and business cycle responses: Local projections, with macro controls

	(1) $h=1$	(2) $h=2$	(3) $h=3$	(4) $h=4$	(5) $h=5$
Average cycle, α_h	-1.66^{**}	-1.10^{**}	0.35	1.85^{**}	3.89^{**}
	(0.08)	(0.14)	(0.17)	(0.24)	(0.33)
Business credit, $\Delta_5 x^B_{it(p)}$	−0.32	2.49	0.70	1.22	4.01
	(1.29)	(1.41)	(1.62)	(3.17)	(3.57)
Household credit, $\Delta_5 x^H_{it(p)}$	−4.65	-22.15^{**}	-33.09^{**}	-44.44^{**}	-42.10^{**}
	(3.65)	(4.77)	(5.36)	(9.00)	(9.26)
Macro controls, $\boldsymbol{w}_{it(p)}$	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	.247	.000	.000	.000	.000
R^2	.15	.35	.41	.44	.47
Number of cycles	150	150	150	150	150

Notes: The table shows estimates obtained by the within-estimator, with standard errors are clustered on countries shown in parentheses. The dependent variable is the change in real GDP per capita since peak (logarithm × 100). Credit variables denote changes in credit-to-GDP ratio over past five years. ** $p < .01$, * $p < .05$.

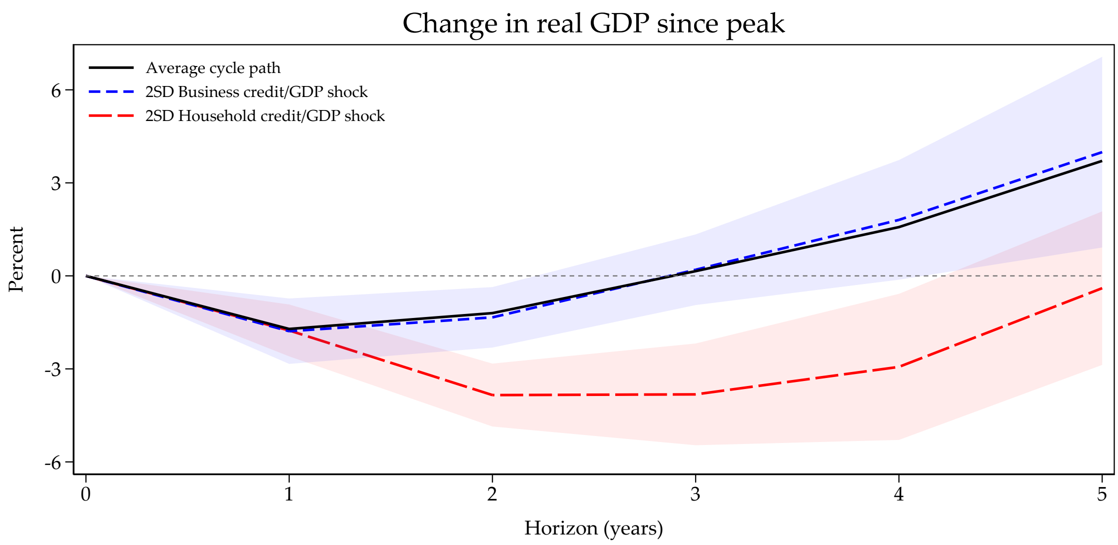


Figure 1.3. Business and household debt, average and +2*SD* responses

Notes: The figure shows the predictive effects on growth of a two-standard-deviation debt expansion in the 5 years preceding the recession for business debt booms (left panels) and household credit booms (right panels). Estimates are based on all business cycles in 18 advanced economies since 1870. Standard errors are clustered at the country level. Shaded areas represent the 95% confidence interval.

significantly slower recoveries. These findings are very much consistent with the existing evidence in Jordà, Schularick, and Taylor (2013) and Reinhart and Rogoff (2014) and Bordo and Haubrich (2017), for example. We cluster standard errors at the country level to allow for nonparametric error-term dynamics. As a robustness check, we can also allow for spatially (and auto)correlated residuals using the procedure of Driscoll and Kraay (1998) in a version that accommodates unbalanced panels and time-series gaps (Hoechle, 2007). Standard error estimates remain very similar to the baseline and are shown in the Internet Appendix Section 1.G.

To provide some context, we note a 10-pp increase in the business credit/GDP ratio in the expansion—a considerable rate of growth by historical standards—is not associated with a slower recovery. After 5 years from the start of the recession, GDP per capita is 4.2% higher compared with 4.0% observed in more normal times. In contrast, a 10 pps increase in household debt in the expansion is associated with dire consequences. The economy barely recovers (−0.1%) the level it had at the start of the recession 5 years later. Formal Wald tests confirm that the coefficients for business and household debt are significantly different from one another starting in year 2.

These results are robust to introducing linear and quadratic time trends as well as to the exclusion of all recessions after 2007, that is, excluding data after the Global Financial Crisis. Moreover, we examine alternative definitions of our measure of credit booms. In particular, we looked at 3- and 10-year changes in credit/GDP (instead of 5-year changes), 3- and 5- year growth of real debt, and the measure proposed by Jordà, Schularick, and Taylor (2013). Across all specifications, we find that business credit during the boom does not affect the depth and length of the subsequent recession.

To go further, we also consider that a firm's default probability increases in the *level* of liabilities relative to cash flow. Extrapolating to the macroeconomy, one may suspect that the level of debt could modulate the aggregate risk confronted by an economy that sees a rapid increase in borrowing. We test this hypothesis by interacting credit booms with the *level* of credit/GDP. Figure 1.G.2 in the Internet Appendix Section 1.G shows this. Interestingly, we do not find evidence that debt levels play an important role. At business credit/GDP levels one standard deviation above the country's historical standards, business credit booms predict recession outcomes, which are statistically indistinguishable from both booms at low levels, and from average recessions.

1.2.2 Corporate debt in financial crises

The baseline business cycle effects reported in previous sections could simply reflect the greater propensity to experience a financial crisis after a household credit boom (Jordà, Schularick, and Taylor, 2013). Would the differences between household and business credit booms survive if we differentiate between recessions associated with a financial crisis and those not associated with one?

We investigate this issue by stratifying recessions into two bins: financial recessions as defined earlier, and all other recessions labeled as "normal". We then examine how each type of

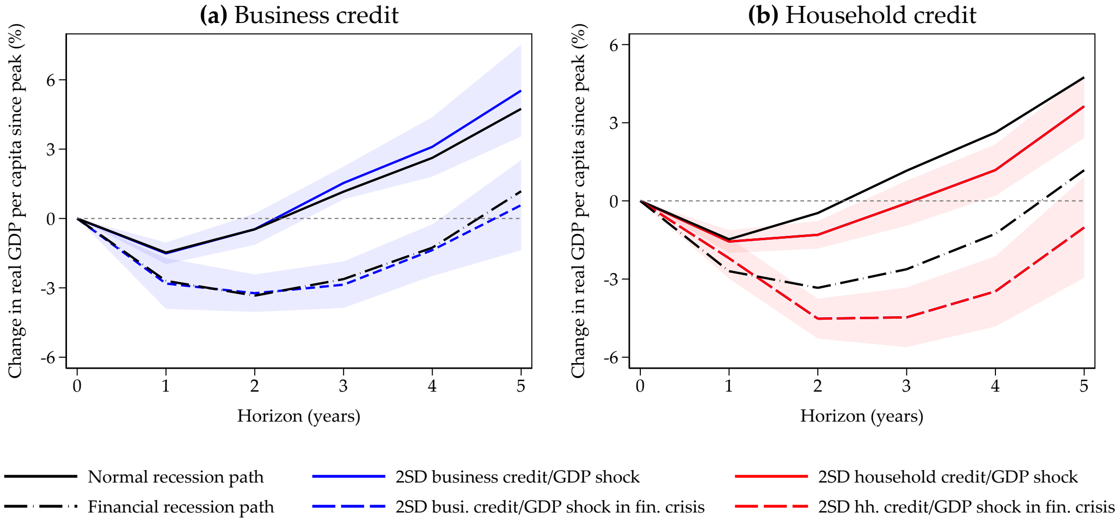


Figure 1.4. Business and household debt, normal versus financial recessions, average and $+2SD$ responses

Notes: The figure presents local projections stratified by type of recession. The left panel displays average and two-standard-deviation business debt growth paths, and the right panel displays the same figure but for household debt. All regressions include the full set of macro controls and country fixed effects. Standard errors clustered by country. Shaded areas represents the 95% confidence interval.

debt build-up, business versus household, affects the subsequent response path in each type of recession.

Figure 1.4 presents the results. Panel A shows the results for business debt, and panel B for household debt. In both cases, as is well-known, financial recessions are deeper and last longer than normal recessions. The effect of a business credit boom (characterized by debt growth two standard deviations above the mean, as before) is essentially zero, economically and statistically speaking. The trajectories do not change one way or the other. In contrast, the effects are very sizable when we look at household debt. A credit boom during the expansion (again, measured by debt growing two standard deviations above the mean) makes either type of recession much more severe economically speaking. The effects even may be somewhat larger in a financial crisis, although the uncertainty bands are large enough to prevent any forceful conclusions on this issue.

1.2.3 Additional tests

We examine a broader set of left-hand-side variables and potential differences in tail risk using quantile local projection methods (see, e.g., Adrian, Boyarchenko, and Giannone, 2019). First, Internet Appendix Section 1.C shows recession paths for various other macro-financial variables. These are consistent with the general equilibrium effects that would lead to the GDP trajectories shown earlier. Next, in Section 1.D, we set up quantile local projections to estimate the predictive effect of business debt booms on the lower tails of GDP outcomes. We find that business debt booms do not appear to increase the fragility of the economy.

1.3 The role of bankruptcy institutions

Is business credit always innocuous? The striking dichotomy between the cyclical implications of household and business credit warrants caution. Many countries have developed a robust legal scaffolding to buttress corporate debt renegotiation and restructuring out of a desire to facilitate the continuation of businesses in bankruptcy that can become profitable again in the future (Brouwer, 2006). By contrast, household debt exemptions and protections tend to be flimsy (Niemi-Kiesiläinen, 1997; Mitman, 2016). In fact, Agarwal et al. (2016) and Auclert, Dobbie, and Goldsmith-Pinkham (2019), among others, have highlighted the potential importance of household debt relief as a tool for aggregate demand management.

Household debt is owed by individuals to smooth consumption whereas businesses lever up as abstract legal entities for the sake of profits (Jensen and Meckling, 1976). As a consequence, the incentives to renegotiate and restructure debt are very different. When default risk rises, the mere possibility of underinvestment incents creditors to renegotiate and restructure debt to preserve the full value of the business as a going concern (e.g., Bergman and Callen, 1991). At the aggregate level, such behavior will tend to attenuate ancillary damage to the economy from lower investment—unless bankruptcy frictions impede corporate debt resolution.

Instead, poorly structured debt renegotiation procedures can aggravate collective action problems such as creditor runs or holdout issues, as well as frictions arising from asymmetric information. For example, creditors will rush to seize and liquidate collateral assets with the concomitant downward spiral on asset prices: a negative feedback doom loop. Moreover, legally burdensome procedures, poor creditor rights, or inefficient bankruptcy outcomes depress expected recovery rates, discouraging creditors from initiating bankruptcy procedures in situations where they would be advisable. Andrews and Petroulakis (2019) find that legal frictions in bankruptcy frameworks stall the liquidation of zombie firms. The resulting market congestion and lock-in of productive resources can be a severe drag on the recovery (Bergoeing et al., 2002; Caballero, Hoshi, and Kashyap, 2008).

These are substantively firm-level arguments, however. It is difficult to know whether they translate one-for-one on a macro scale to quantitatively large aggregate fluctuations. Our goal in this section is to determine empirically whether the data are better characterized by the Myers (1977) perspective based on the high liquidation costs of debt, or the frictionless Modigliani and Miller (1958) benchmark view, where debt overhang and zombie firms would not arise. We put these ideas to work by assessing how measures of debt restructuring and liquidation frictions moderate the impulse responses of business credit booms. That is, for a recession preceded by corporate debt buildup, do frictions impeding business debt restructuring and liquidation deepen the recession or slow down the recovery?

1.3.1 Measuring legal bankruptcy frictions

We draw on two indicators to measure the characteristics of bankruptcy procedures. For the most recent period, we use World Bank survey data collected using the methodology of Djankov et al. (2008). The survey is administered to attorneys and judges practicing bankruptcy law. More specifically, we use the *recovery rate* measure, which determines the share of debt paid to creditors in the event of default. A high recovery rate reflects low frictions in both renegotiations and liquidations.[10, 11]

In addition, we cover the period 1978–2003 using the creditor rights index of La Porta et al. (1997) as expanded by Djankov, McLiesh, and Shleifer (2007). The authors code laws that protect rights of secured creditors in bankruptcy. Well-enforced control and property rights provide the basis for efficient negotiation outcomes, including debt re-negotiations (Coase, 1960). In addition, powerful creditors have more incentives to pull the plug on zombie debtors and can limit borrower's moral hazard and thus improve investment decisions ex-ante. Similarly, creditor influence over bankruptcy procedures can deter socially inefficient sidestepping maneuvers of debtor management.[12]

We combine data on recovery rates (World Bank data based on Djankov et al., 2008) and creditor rights (Djankov, McLiesh, and Shleifer, 2007) into a binary index of bankruptcy frictions, L_{it}. For each of the two components we set a cutoff threshold. Country-year observations *below* the threshold – i.e., with low recovery rates or poorly-protected creditor rights – are defined to be in 'high-friction' regimes. Observations *above* to the threshold are dubbed 'low-friction' regimes. In our baseline, we set the threshold for each measure to its sample median.[13] The resultant binary variable, L_{it}, indicates 'high-friction' regimes and covers years 1978 to 2019, totalling 65 business cycles from all 18 countries.[14]

10. The results are very similar when using other indicators provided by the survey: bankruptcy procedure time, bankruptcy procedure cost, or the "resolution score" summary measure.

11. In the model of Corbae and D'Erasmo (2021), the recovery rate constitutes an economic summary statistic of how various bankruptcy frictions distort behavior of creditors and lenders. Empirically speaking, the European Banking Authority (2020) identified the recovery rate as a prime indicator for nonperforming loans on bank balance sheets across the European Union. Using bank-loan level data, the report documents a positive and statistically significant link between loan-level recovery rates and the strength of creditor rights encoded in bankruptcy regime across borrower types.

12. Different creditor rights may interact differentially with legal and economic context factors. In the Internet Appendix Section 1.G.2, we explore the effect of individual components of the creditor rights index for our main results. No single component of the index affects the main findings reported in a significant manner.

By affecting economic behavior ex-ante of financial distress, creditor rights may also carry adverse implications during phases of macroeconomic stability, e.g., by reducing credit demand, entrepreneurship, or distorting credit allocation (Vig, 2013, for example). However, what matters for resolving severe financial distress during recessions is *ex-post* efficiency. The creditor rights index is positively correlated with recovery rates across countries.

13. Our results are robust to alternative threshold choices as documented in the Internet Appendix Section 1.G.2. They are also robust when mapping indicators into quintiles, deciles, or their sample rank values to obtain harmonized ranges and interpretable step-sizes.

14. Internet Appendix Section 1.E details the coding of L_{it} for each country-year.

1.3.2 Assessing our measure of bankruptcy frictions

Figure 1.E.1 in Internet Appendix Section 1.E displays the series of our newly constructed measure of bankruptcy frictions, L_{it}, for each country. Overall, the classification of countries featuring either a high or low-friction bankruptcy regime is pretty stable over time. On average, countries switch once over the four decades we observe. We note that group of South-European countries, as well as France and Switzerland, stand out for scoring high on the friction index consistently across the entire sample period.[15] The index behavior is more mixed for other countries, such as Scandinavian and Central European countries. Anglo-Saxon law systems are mixed too, but tend to be characterized by lower frictions. The United Kingdom, the Netherlands, and Japan stand out for a low score for most, if not the entire, sample period from 1978 to 2019.

To assess the plausibility of our newly constructed measure, as well as potential identification concerns, we check whether countries with different bankruptcy frictions differ systematically in terms of business credit outcomes. First, one could expect that bankruptcy institutions affect the *quantity* of business debt, that is, that the propensity to experience business credit booms and/or the size of such booms to be larger in low-friction regimes. Internet Appendix Section 1.F plots the distribution of business credit booms—measured by the change in the business credit/GDP ratio over the past 5 years—differentiated by bankruptcy regime. However, we find no relevant differences in first or second moments, neither for the full set of country years nor for our sample of business cycle peaks.

In addition to the level of debt, we consider what happens to the *price* of debt depending on bankruptcy institutions. Figure 1.5 uses data on credit spreads between sovereign and corporate bond yields from Krishnamurty and Muir (2020).[16] The figure shows that credit spreads above 2 percentage points almost exclusively occur in country-year observations with high legal frictions for bankruptcy procedures.

Mean differences become even starker when estimating panel regressions of credit spreads on legal regime, controlling for country fixed effects, business cycle friction bankruptcy regime significantly increases the spread by about 1.1 percentage points. That is, markets seem to price in higher bankruptcy costs, however, without leaving a systematic imprint on the business credit cycle.

1.3.3 Legal frictions and the aftermath of business credit booms

We now revisit the original analysis of how recessions evolve following a business credit boom, while allowing for the legal regime to play a role. Relative to the original specification in Equation (1.1), we now allow an interaction of legal frictions L_{it} with business debt change $\Delta_5 x_{it}^B$, denoted by $x_{it}^{BL} = \Delta_5 x_{it}^B \times L_{it}$. Using this new variable, the resultant local projection is

$$\Delta_h y_{it(p)+h} \quad = \quad \alpha_h + \alpha_{hi} + \beta_h^{BL} x_{it(p)}^{BL} + \beta_h^H \Delta_5 x_{it(p)}^H + \beta_h^B \Delta_5 x_{it(p)}^B + \gamma_h w_{it(p)} + e_{it(p)} \tag{1.2}$$

15. Countries with little (or no) variation in bankruptcy regime do not affect our empirical strategy since we allow for country fixed effects and emphasize the *interaction* with business credit booms.

16. We thank the authors for sharing the data with us.

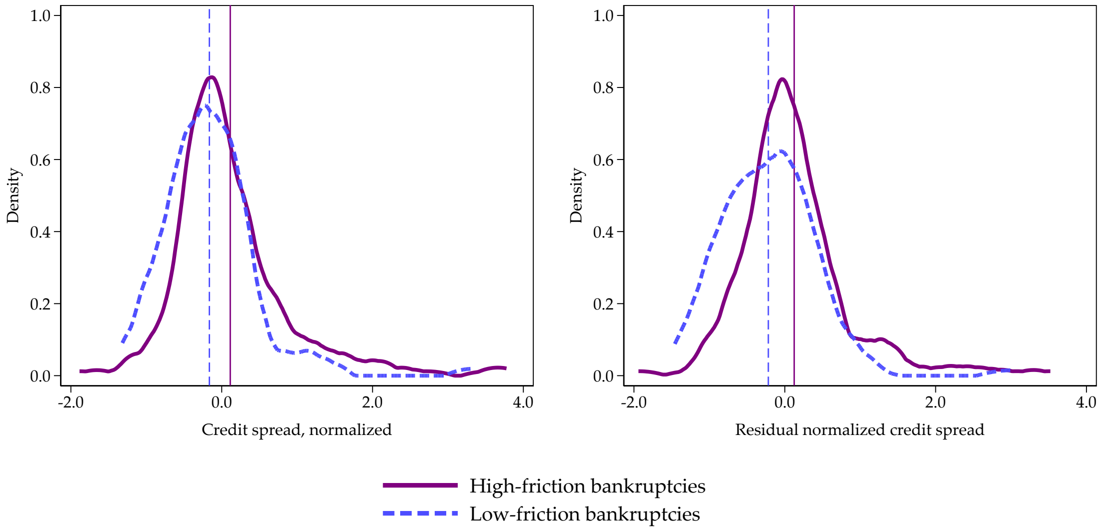


Figure 1.5. Bankruptcy frictions and credit spreads

Notes: The figure presents kernel density estimates of normalized credit spreads between high-yield (corporate) and low-yield (government) bonds (Krishnamurty and Muir, 2020), by friction intensity of legal bankruptcy regime (constructed based on Djankov, McLiesh, and Shleifer, 2007; Djankov et al., 2008). The right panel shows distributions of residuals from a panel regression of credit spreads on country fixed effects and the familiar set of macroeconomic controls. The sample overlap consists of 11 countries, totaling 261 country-years. Vertical lines represent the sample averages.

including the same set of macroeconomic control variables used earlier.

Before discussing the results, we will say a word on identification. Can we interpret estimates of Equation (1.2) causally? One could certainly make the case for "yes", though the next sections will explore this issue in greater detail. First, note that by focusing on recessions and in particular, the build-up of debt during the expansion, we are using the arrow of time to remove potential contamination of our analysis from contemporaneous responses of agents' debt choices to current economic conditions. Second, we condition on an extensive set of macroeconomic controls and their lags so as to ensure that any variation on the shape of the recession and recovery is not explained by well-known economic drivers. Third, legislation and attitudes toward bankruptcy are not fast-moving variables. One can certainly argue that these variables might respond to previous economic outcomes. But changes often follow the slow political cycle more than the fast economic one. Fourth and finally, variation across countries may hide the fact that legal frictions simply measure other features characterizing the economic setup of these countries. While certainly a concern, we note that our regressions contain country fixed effects to sterilize such variation. Moreover, by conditioning on other macroeconomic controls, we greatly reduce (or even eliminate) that possibility. In sum, we follow a *selection-on-observables* identification strategy no different from what is commonly done in the vector autoregression (VAR) literature. But we don't rest here, and the next section probes our results further in a variety of ways, including an instrumental variable approach.

Figure 1.6, which presents the core results, is organized into three panels. The first panel reports the response of real GDP; the second panel the response of real investment; and the third panel the share of zombie businesses (to be discussed momentarily). These estimates are for the full 1978–2019 sample using ordinary least squares (OLS). Within each panel, we display two paths, depending on whether legal bankruptcy frictions are high ($L_{it} = 1$), or low ($L_{it} = 0$). Recall that the setting evaluates the recession path when corporate debt during the expansion grows at a rate that is two standard deviations above the historical mean.

Real GDP and investment are from the JST data set that we used earlier. The share of zombie businesses is based on data from Banerjee and Hofmann (2018), which are based on World-Scope financial statements from about 32,000 listed firms in 14 advanced economies from 1985 to 2017. The authors classify a firm as a corporate zombie if: (*i*) its interest coverage ratio has been below unity for at least three consecutive years; (*ii*) its age is 10 years or older; and (*iii*) its assets-market value relative to replacement costs (Tobin's q) is below the median within the firm's sector in any given year. The first two conditions follow the literature (Adalet McGowan, Andrews, and Millot, 2017). The third exploits the fact that their data only cover public firms. Zombie firms receive subsidized credit (Caballero, Hoshi, and Kashyap, 2008; Acharya et al., 2020). However, authors focus on symptoms of low profitability relative to market rates (i.e., condition *i*), because their data do not provide for a reliable distinction between credit subsidies, risk premia and financial frictions. This approach is reasonable insofar as low profitability is a necessary precondition for credit subsidies while criteria of age and Tobin's q rule out that their measure picks up on firms burdened by large investment expenditures. [17]

The figure illustrates what we suspected: the more frictions there are, the deeper and longer is the recession following a business credit boom. In fact, countries with inefficient bankruptcy regimes experience recoveries that resemble those generated when the economy experiences a household credit boom during the expansion. When frictions are low, the recession bottoms out in the second year. By the fourth year, the economy is above its prerecession level. When frictions are high, the recession takes an additional year to bottom out, and the recovery of the previous level is not visible in the 5 years displayed. Institutional frictions in tandem with business credit booms can therefore have substantial macroeconomic effects.[18]

Investment follows an even more pronounced pattern, in line with the findings of the business cycle literature (see, e.g., Zarnowitz, 1992). In addition, when frictions are high, investment declines over the entire 5-year period displayed in the middle panel of Figure 1.6. By year 5 investment is about 25% lower than it was entering the recession whereas in a low friction environment, investment has already begun to recover and is only about 5% below the peak.

17. The zombie share regressions are augmented by controls for the zombie share at business cycle peak and the 2 preceding years. Because of to the reduced sample coverage in these LPs, we cut the laglength of the auxiliary macro controls to contemporaneous values and one lag only.

18. These results are qualitatively unchanged when restricting the sample to 2003, that is, using variation in creditor rights only and excluding the Global Financial Crisis. Restricting the analysis to the post-2003 sample, however, does not yield enough business cycle observations to estimate all parameters.

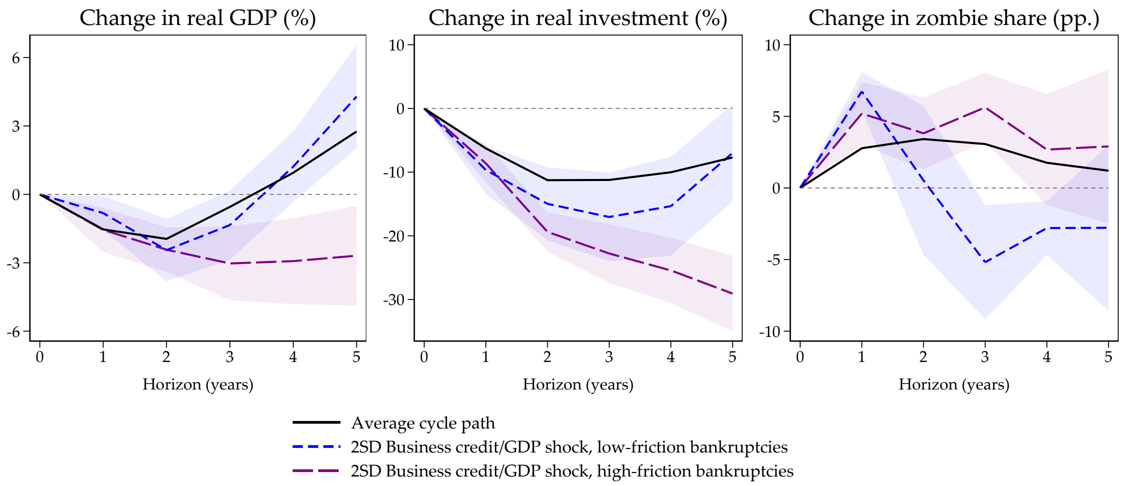


Figure 1.6. The aftermath of business credit booms, by legal regime

Notes: The figure presents the path of the recession predicted when business debt grows at 2 standard deviations above the historical mean in the 5 years preceding a peak. The long-dashed purple line represents high legal bankruptcy friction regimes ($L_{it} = 1$). The short-dashed, blue line corresponds to the low-friction regime instead ($L_{it} = 0$). All other covariates in Equation (1.2) evaluated at their country-specific sample averages. Estimates for zombie shares further condition on the level and the annual change of the zombie share at business cycle peak. Standard errors are clustered at the country level. Shaded areas represents the 90% confidence interval. See text.

Finally, we turn to examine the role that frictions play in preventing liquidation of bad businesses and therefore expanding the corporate zombie share. As Caballero, Hoshi, and Kashyap (2008) and Andrews and Petroulakis (2019) argue, a large population of nearly defunct businesses depresses industry dynamism and investment, which, as we have seen, takes a big hit when frictions to renegotiation and restructuring are present. As the right-hand-side panel of Figure 1.6 shows, during the first year of the recession, the zombie share jumps by about 5% regardless of whether legal frictions are high or low. However, whereas this share tends to remain elevated for over 5 years when frictions are high, the share drops quickly after the second year when frictions are low and remains mostly below the value at the peak.

1.4 Threats to identification

The aggregate results reported in Figure 1.6 very much agree with the several micro-level mechanisms discussed in the literature. Moreover, the nexus between considerable declines in investment and increases in the share of nearly defunct business kept alive by frictions to restructuring of these businesses is consistent with the literature. However, beyond our *selection-on-observables* identification strategy, one could imagine some potential threats to identification that we address in this section.

1.4.1 Robustness to confounders of bankruptcy institutions

Figure 1.6 shows that the recession and recovery trajectories following business credit booms have been very heterogeneous. Economies where bankruptcy is inefficient have markedly slower recoveries after equally deep recessions. On average, these episodes were also accompanied by an investment slump and an elevated share of corporate zombies among listed companies.

However, conclusions that legal bankruptcy reforms could thus alleviate problems of debt overhang and zombification after business credit booms need to be stress-tested. Variation of bankruptcy frictions across countries and time is, after all, never quite random as legal systems evolve alongside society and respond to a country's economic experience. Certain features of bankruptcy laws will occur in tandem with other characteristics of economic institutions, such as labor market regulations or tax codes. These institutional confounders, in turn, will also influence recession trajectories. Their confounding effects might not be fully captured by country fixed effects and our extensive control set.

The first in a series of checks on the robustness of our results consists in evaluating whether our legal friction indicator has any predictive power on the recession trajectories themselves. Moreover, we introduce additional controls to rule out alternative explanations. First, La Porta et al. (1997) and Djankov, McLiesh, and Shleifer (2007) document broader and deeper capital markets—measured as private debt relative to GDP—in places with better creditor rights' protections. Better-developed capital might moderate the aftermath of business debt booms for various reasons, for example, providing well-functioning secondary markets for toxic assets that restore intermediation capacity. Second, bankruptcy frictions might more often than not go along with poor financial regulation, with the latter being the true reason why corporate debt—that is, nonperforming loans—can slow recovery from recessions. Reassuringly, we find the interaction effects of bankruptcy frictions and corporate debt to be robust in all those specifications, which we report in the Internet Appendix Section 1.G.[19]

19. We expanded the baseline specification in Equation (1.2) with the frictions indicator in the regression to account for a possible connection between credit booms and the legal framework as follows:

$$\Delta_h y_{it(p)+h} = \alpha_h + \alpha_{hi} + \beta_h^L L_{it} + \beta_h^{BL} x_{it(p)}^{BL} + \beta_h^H \Delta_5 x_{it(p)}^H + \beta_h^B \Delta_5 x_{it(p)}^B + \boldsymbol{\gamma}_h \boldsymbol{w}_{it(p)} + e_{it(p)}\,, \tag{1.3}$$

and doing so does not affect our conclusions. Figure 1.G.5 in Internet Appendix Section 1.G plots trajectories for each legal regime, with and without credit booms.

Similarly, the direct predictive value of our friction indicator on investment and zombie shares is small compared to the business credit boom scenario shown in Figure 1.G.5 in Internet Appendix Section 1.G. Hence, for latent factors to invalidate causal interpretations of the role played by bankruptcy institutions, they would have to *interact* with the extent of business leveraging during expansions.

Such interactions are not impossible but seem unlikely in view of the literature. In fact, using the same coding of creditor rights underlying our bankruptcy index, La Porta et al. (1997) and Djankov, McLiesh, and Shleifer (2007) document broader and deeper capital markets—measured as private debt relative to GDP—in places in which outside investors are legally better protected against inside management. In addition, bankruptcy frictions might occur in tandem with poor financial regulation and well-governed financial systems are presumably more resilient and capable to deal with a business credit boom turning into a pile of nonperforming loans.

We check these caveats by introducing additional controls proxying for the depth of private debt markets—the 11-year centered moving average of total bank lending to the nonfinancial private sector relative to GDP, mapped

1.4.2 Instrumenting bankruptcy frictions by legal origins

In thinking about a possible instrumental variable, we follow an established literature that distinguishes between traditions of *civil law* and *common law* and that has demonstrated their relation to bankruptcy frictions, notably investor rights protection (La Porta et al., 1997, 1998; La Porta, López-De-Silanes, and Shleifer, 2008). Civil law traditions originate in Roman law, but they then morphed into different European varieties under the influence of gradual or drastic changes, such as the French Revolution. By contrast, the British common law tradition is associated with legal principles of private dispute resolution with less public control (La Porta et al., 1998; Glaeser and Shleifer, 2002). The adoption of either civil or common law dates back to the 17th and 18th centuries, when revolution, colonization, and Napoleonic conquest laid the foundations of legal principles across Europe and America. In Japan, a version of German civil law was adopted during extensive reforms under Emperor Meiji at the end of the 19th century (Djankov, McLiesh, and Shleifer, 2007).

Most importantly for us, civil and common law traditions differ markedly in their handling of bankruptcy. La Porta et al. (1998) were the first to show empirically that (French) civil law traditions were associated with much weaker legal protection of investors' interests, including creditor rights in the case of default. Djankov, McLiesh, and Shleifer (2007) and Gamboa-Cavazos and Schneider. (2007) document that civil law systems rely on frequent interlocutory appeals, leading to bankruptcy procedures that are more intricate and costly than those under common law.

Based on the coding of legal origins in Djankov, McLiesh, and Shleifer (2007), we instrument the variable x_{it}^{BL} with the interaction of the business debt buildup variable, $\Delta_5 x_{it}^{B}$ and the legal origin dummy, d_{it}^{LO}, which is defined to be $d_{it}^{LO} = 1$ for common law economies, and is $d_{it}^{LO} = 0$ otherwise. Hence, the instrument is for $x_{it}^{BL} = \Delta_5 x_{it}^{B} \times L_{it}$ is constructed similarly as $z_{it} = \Delta_5 x_{it}^{B} \times d_{it}^{LO}$.

Table 1.2 shows the first stage regression of $x_{it(p)}^{BL}$ on $z_{it(p)}$ and the controls previously used for our sample of business cycle peaks. The results presented in the table suggest that our instrument is strong, with an F-statistic above 10. The sign of the coefficient is significant and consistent with our hypothesis, that is, that common law countries tend to have more efficient systems today for the resolution of corporate financial distress.

As noted in the literature, a country's legal origin likely affects various other legal aspects, or it might be correlated with cultural factors that have (La Porta et al., 1998; Stulz and Williamson, 2003). Such channels pose a threat to the instrument's exclusion restriction. Since

---

into within-year cross-sectional percentiles to obtain a stationary variable—and an index of banking supervision quality obtained from Abiad, Detragiache, and Tressel (2010). We introduce each variable in levels and as interactions with our measure of business credit booms. Reassuringly, estimates for predicted trajectories by legal regime remain qualitatively unchanged, as shown in Figure 1.G.6 in Internet Appendix Section 1.G.

Finally, confounders might be dynamic in nature. For instance, large-scale legal reforms might comprise changes to bankruptcy law alongside shifts in economic institutions that also influence the broadening and deepening of business debt markets. To rule out such dynamic interactions more generally, we resort to the instrumental variable strategy that will be described next.

Table 1.2. Explaining legal frictions in debt resolution by legal origin

	$x^{BL}_{it(p)}$
Instrument, $z_{it(p)}$	0.76**
	(0.23)
Business credit, $\Delta_5 x^B_{it(p)}$	−0.20
	(0.21)
Household credit, $\Delta_5 x^H_{it(p)}$	−0.18
	(0.13)
Macro controls, $\boldsymbol{w}_{it(p)}$	Yes
F-statistic	10.45
R^2	.75
Number of cycles	65

Notes: The table shows the first stage results for LP-IV estimation with the interaction term $x^{BL}_{it(p)}$ as dependent variable, conditional on baseline macro controls. Credit is measured as change in the credit-to-GDP ratio over the past five years. Estimates are obtained using the within-estimator. Standard errors are clustered on countries and shown in parentheses. ** $p < .01$, * $p < .05$.

we have just-identification, obviously we cannot formally test for violations of the exclusion restriction. However, we can characterize the sign of the potential bias that may exist.

Simple instrumental variables algebra suggests that

$$\hat{\beta}^{BL}_h \xrightarrow{p} \beta^{BL}_h + \theta_h \frac{E(z^2_{it})}{E(\Delta_5 x^B_{it} z_{it})}, \tag{1.4}$$

where the coefficient θ_h captures the direct effect of the instrument on the outcome. Note that the right-hand-side fraction is positive since the numerator refers to a squared variable and the denominator, by the first-stage regression in Table 1.2, is also positive.

Next, we can speculate about the sign of θ_h. Most common law countries (the United States and the United Kingdom being the two clearest examples) fared better during the recent financial crisis than civil law economies (such as Spain). This would suggest that any spillovers, θ_h, if present, are probably positive. Since the β_h are presumably negative (because they refer to the effect on recession and its recovery), potential spillovers from the legal origin instrument would then tend to attenuate our estimates. In fact, our IV results below compared to the selection-on-observables results reported earlier are quite similar, so, if anything, potential spillovers would reinforce our findings.

While definite proof is elusive, extensive robustness checks documented in Section 1.4.1 and Section 1.G in the Internet Appendix make us reasonably confident that major confounding baseline channels running through any auxiliary institutions, as well as interaction effects stemming from financial development or banking regulation, are not sufficiently correlated with

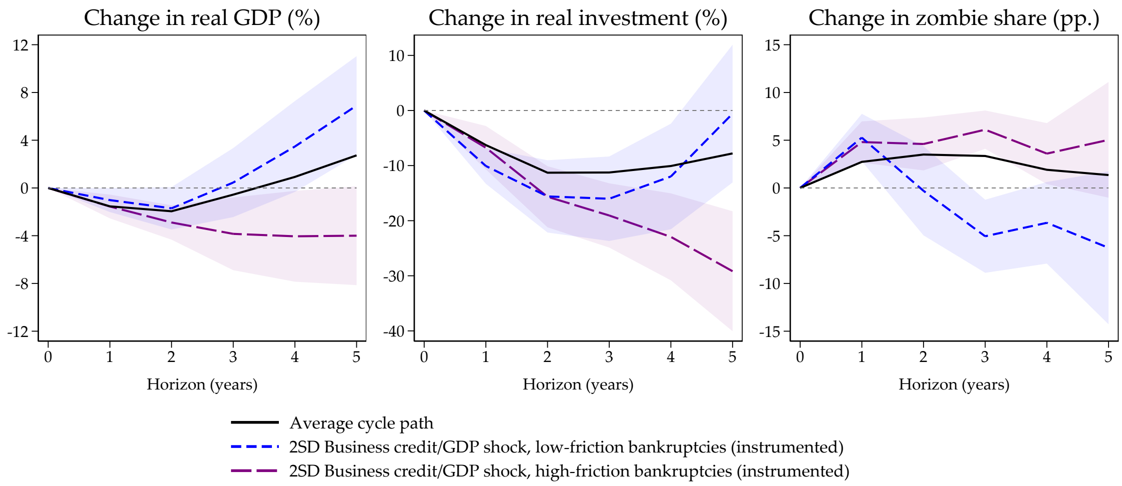


Figure 1.7. Instrumenting frictions to debt resolution by legal origin

Notes: This figure shows the predicted recession paths from the peak stratified by whether bankruptcy frictions are low, $L_{it} = 1$, or high, $L_{it} = 0$ and instrumented using the legal origin instrument described in the text. We assume a 2-standard-deviation corporate credit/GDP boom in the 5 years leading up to the recession. All estimates are conditional on the same set of controls detailed in the text. Estimates for zombie shares further condition on the level and the annual change of the zombie share at business cycle peak. The estimates include country-fixed effects. Standard errors are clustered at the country level for nonparametrically adjustment for residual serial correlation. Shaded areas represents the 90% confidence interval.

bankruptcy frictions to be latent drivers behind the predictions presented earlier. However, financial institutions still might be a determinant of recession trajectories, while being influenced by legal origins. Hence, for the subsequent analysis we add the familiar control of private debt market depth, measured at business cycle peak.

Figure 1.7 shows the results based on estimating Equation (1.2) with local projection instrumental variables (LP-IV). The results confirm the findings from Figure 1.6; although the estimates are slightly less precise, the path differences are even starker. As before, frictions impeding restructuring and liquidation aggravate the effects of corporate financial distress to the point of making the recession trajectory resemble the typically much more adverse path associated with a household credit boom seen earlier. In contrast, efficient institutions are associated with recession trajectories that resemble normal recession trajectories, even when there is a preceding large buildup of corporate debt. The differences between the “high-friction” and “low-friction” trajectories are statistically significant at the 5% level.

In sum, we think that history has important lessons to offer. Institutional factors profoundly affect how efficiently the financial aftermath from business credit booms can be resolved. In line with theory, debt overhang becomes costly when frictions impede a quick resolution and reallocation of resources. It makes one wonder if similarly frictionless debt resolution procedures were available to individuals, whether household credit booms then also would be associated with milder recessions.

1.5 Conclusion

Debt overhang can lead to underinvestment by firms. Following Myers (1977), a large theoretical literature has explored the idea that investment shrinks for such indebted firms because the existing debt holders, not new investors, would be the main beneficiaries from new investment. Similarly, the risk of zombie lending increases in the exposure of bank balance sheets to corporate debt. Ever-greening of loans keep unprofitable firms in the market, likely undermining future productivity growth. In practice, the strength of these effects depends on departures from the canonical Modigliani and Miller (1958) theorem. How large these departures are in practice and how strong their macroeconomics repercussions, are largely empirical questions.

At the aggregate level, our results show that neither corporate debt overhang nor zombie lending has played an economically or statistically significant role historically on average. However, the aftereffects of business credit booms become more problematic when debt restructuring and liquidation become more costly, as the data also show. In this situation, zombie firms are more likely to emerge and persist, as high costs of liquidation increase incentives for banks to "extend and pretend" instead of liquidating.

We used institutional proxies for the costs of balance sheet reorganization to delineate different institutional environments that make debt reorganization more or less efficient. In those places where and times when reorganization and restructuring is inefficient and costly, corporate debt overhang is an important macroeconomic force that has measurably negative effects at the business cycle frequency.

References

Abiad, Abdul, Enrica Detragiache, and Thierry Tressel. 2010. "A new database of financial reforms." *IMF Staff Papers* 57: 281–302.

Abraham, Facundo, Juan J. Cortina, and Sergio L. Schmukler. 2020. "Growth of global corporate debt: Main facts and policy challenges." World Bank Policy Research Working Paper 9394.

Acharya, Viral V, Matteo Crosignani, Tim Eisert, and Christian Eufinger. 2020. "Zombie credit and (dis-)inflation: Evidence from Europe." NBER Working Paper, Working Paper Series 27158.

Adalet McGowan, Müge, Dan Andrews, and Valentine Millot. 2017. "Insolvency regimes, zombie firms and capital reallocation." OECD Economics Department Working Paper 1399.

Adalet McGowan, Müge, Dan Andrews, Valentine Millot, and Thorsten Beck. 2018. "The walking dead? Zombie firms and productivity performance in OECD countries." *Economic Policy* 33 (96): 685–736.

Adrian, Tobias, Nina Boyarchenko, and Domenico Giannone. 2019. "Vulnerable Growth." *American Economic Review* 109 (4): 1263–89.

Agarwal, Sumit, Gene Amromin, Itzhak Ben-David, Souphala Chomsisengphet, Tomasz Piskorski, and Amit Seru. 2016. "Policy Intervention in Debt Renegotiation: Evidence from the Home Affordable Modification Program." *Journal of Political Economy* 125 (3): 654–712.

Aivazian, Varouj, and Jeffrey L. Callen. 1980. "Corporate leverage and growth the game-theoretic issues." *Journal of Financial Economics* 8 (4): 379–99.

Albuquerque, Bruno. 2021. "Corporate credit booms, financial constraints, and the investment nexus." Working Paper.

Andrews, Dan, and Filippos Petroulakis. 2019. "Breaking the shackles: Zombie firms, weak banks and depressed restructuring in Europe." ECB Working Paper 2240.

Auclert, Adrien, Will S. Dobbie, and Paul Goldsmith-Pinkham. 2019. "Macroeconomic Effects of Debt Relief: Consumer Bankruptcy Protections in the Great Recession." NBER Working Paper 25685.

Banerjee, Ryan N., and Boris Hofmann. 2018. "The rise of zombie firms: Causes and consequences." *BIS Quarterly Review* March: 67–78.

Becker, Bo, and Victoria Ivashina. 2021. "Corporate insolvency rules and zombie lending." ECB Forum on Central Banking.

Bergman, Yaacov, and Jeffrey Callen. 1991. "Opportunistic underinvestment in debt renegotiation and capital structure." *Journal of Financial Economics* 29: 137–71.

Bergoeing, Raphael, Patrick J Kehoe, Timothy J Kehoe, and Raimundo Soto. 2002. "A decade lost and found: Mexico and Chile in the 1980s." *Review of Economic Dynamics* 5 (1): 166–205.

Board of Governors of the Federal Reserve System. 2020. "Financial Accounts of the United States – Z.1." Accessed September 16, 2020. https://www.federalreserve.gov/releases/z1/.

Bonci, Riccardo, and Massimo Coletta. 2012. "Italy's Financial Accounts since 1950." Working Paper, Bank of Italy.

Bordo, Michael D., and Joseph G. Haubrich. 2017. "Deep Recessions, Fast Recoveries, and Financial Crises: Evidence from the American Record." *Economic Inquiry* 55 (1): 527–41.

Brouwer, Maria. 2006. "Reorganization in US and European bankruptcy law." *European Journal of Law and Economics* 22: 5–20.

Brunnermeier, Markus, and Arvind Krishnamurthy. 2020. "The macroeconomics of corporate debt." *Review of Corporate Finance Studies* 9 (3): 656–65.

Bry, Gerhard, and Charlotte Boschan. 1971. *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs.* New York: NBER.

Caballero, Ricardo J., Takeo Hoshi, and Anil K. Kashyap. 2008. "Zombie lending and depressed restructuring in Japan." *American Economic Review* 98 (5): 1943–77.

Coase, Ronald H. 1960. "The problem of social cost." *Journal of Law and Economics* 3: 1–44.

Corbae, Dean, and Pablo D'Erasmo. 2021. "Reorganization or liquidation: Bankruptcy choice and firm dynamics." *Review of Economic Studies* 88 (5): 2239–74.

Dembiermont, Christian, Mathias Drehmann, and Siriporn Muksakunratana. 2013. "How much does the private sector really borrow - a new database for total credit to the private non-financial sector." *BIS Quarterly Review* March: 65–81.

Djankov, Simeon, Oliver Hart, Caralee McLiesh, and Andrei Shleifer. 2008. "Debt enforcement around the world." *Journal of Political Economy* 116 (6): 1105–49.

Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer. 2007. "Private Credit in 129 Countries." *Journal of Financial Economics* 12 (2): 77–99.

Driscoll, John C., and Aart C. Kraay. 1998. "Consistent covariance matrix estimation with spatially dependent data." *Review of Economics and Statistics* 80: 549–60.

European Banking Authority. 2020. "Report on the benchmarking of national loan enforcement frameworks." Response to Call for Advice (CfA) from the Commission on Benchmarking of National Loan Enforcement Frameworks, Report EBA/Rep/2020/29.

Fama, Eugene F. 1978. "The Effects of a Firm's Investment and Financing Decisions on the Welfare of its Security Holders." *American Economic Review* 68 (3): 272–84.

Favara, Giovanni, Erwan Morellec, Enrique Schroth, and Philip Valta. 2017. "Debt enforcement, investment, and risk taking across countries." *Journal of Financial Economics* 123 (1): 22–41.

Gamboa-Cavazos, Mario, and Frank Schneider. 2007. "Bankruptcy as a legal process." Working Paper, Harvard University.

Gertner, Robert, and David Scharfstein. 1991. "A theory of workouts and the effects of reorganization law." *Journal of Finance* 46 (4): 1189–222.

Glaeser, Edward L., and Andrei Shleifer. 2002. "Legal origins." *Quarterly Journal of Economics* 117 (4): 1193–229.

Hennessey, Christopher A. 2004. "Tobin's Q, debt overhang, and investment." *Journal of Finance* 59 (4): 1717–42.

Hoechle, Daniel. 2007. "Robust standard errors for panel regressions with cross-sectional dependence." *Stata Journal* 7 (13): 281–312.

Hong, Gee Hee, Deniz Igan, and Do Lee. 2021. "Zombies on the brink: Evidence from Japan on the reversal of monetary policy effectiveness." Working Paper, International Monetary Fund.

James, John A., and Richard Sylla. 2006. "Debt and flow of funds." In *Historical Statistics of the United States,* edited by Susan B. Carter, Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright, 774–6. Cambridge UK: Cambridge University Press.

Jensen, Michael, and William H. Meckling. 1976. "Theory of the firm: Managerial behavior, agency costs and ownership structure." *Journal of Financial Economics* 3 (4): 305–60.

Jordà, Òscar. 2005. "Estimation and Inference of Impulse Responses by Local Projections." *American Economic Review* 95 (1): 161–82.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2013. "When Credit Bites Back." *Journal of Money, Credit and Banking* 45 (2): 3–28.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2017. "Macrofinancial History and the New Business Cycle Facts." In *NBER Macroeconomics Annual 2016,* edited by Martin Eichenbaum and Jonathan A. Parker. Chicago: University of Chicago Press.

Jordà, Òscar, and Alan M. Taylor. 2016. "The time for austerity: Estimating the average treatment effect of fiscal policy." *Economic Journal* 126 (590): 219–55.

Kalemli-Özcan, Sebnem, Luc Laeven, and David Moreno. 2020. "Debt overhang, rollover risk and corporate investment: Evidence from the European crisis." Working Paper, ECB.

Krishnamurty, Arvind, and Tyler Muir. 2020. "How credit cycles across a financial crisis." Working Paper, Stanford University.

Kuchler, Andreas. 2020. "Leverage, investment, and recovery from a financial crisis: The role of debt overhang." *Studies in Economics and Finance* 37 (1): 143–59.

La Porta, Rafael, Florencio López-De-Silanes, and Andrei Shleifer. 2008. "The economic consequences of legal origins." *Journal of Economic Literature* 46 (2): 285–332.

La Porta, Rafael, Florencio López-de-Silanes, Andrei Shleifer, and Robert W. Vishny. 1997. "The legal determinants of external finance." *Journal of Finance* 52 (3): 1131–50.

La Porta, Rafael, Florencio López-de-Silanes, Andrei Shleifer, and Robert W. Vishny. 1998. "Law and finance." *Journal of Political Economy* 106 (6): 1113–55.

Lang, Larry, Eli Ofek, and Rene M. Stulz. 1996. "Leverage, investment, and firm Growth." *Journal of Financial Economics* 40 (1): 3–29.

Mian, Atif, and Amir Sufi. 2010. "Household leverage and the recession of 2007–09." *IMF Economic Review* 58 (1): 74–117.

Mian, Atif, Amir Sufi, and Emil Verner. 2017. "Household Debt and Business Cycles Worldwide." *Quarterly Journal of Economics* 132 (4): 1755–817.

Mitman, Kurt. 2016. "Macroeconomic effects of bankruptcy and foreclosure policies." *American Economic Review* 106 (8): 2219–50.

Modigliani, Franco, and Merton H. Miller. 1958. "The Cost of Capital, Corporation Finance and the Theory of Investment." *American Economic Review* 48 (3): 261–97.

Müller, Karsten. 2018. "Credit Markets around the World, 1910–2014." Working Paper, NUS Business School.

Myers, Stewart C. 1977. "Determinants of corporate borrowing." *Journal of Financial Economics* 5 (2): 147–75.

Niemi-Kiesiläinen, Johanna. 1997. "Changing directions in consumer bankruptcy law and practice in Europe and USA." *Journal of Consumer Policy* 20: 133–42.

Peek, Joe, and Eric S. Rosengren. 2005. "Unnatural selection: Perverse incentives and the misallocation of credit in Japan." *American Economic Review* 95 (4): 1144–66.

Philippon, Thomas. 2010. "Debt Overhang and Recapitalization in Closed and Open Economies." *IMF Economic Review* 58 (1): 157–78.

Pomerleau, Kyle. 2015. "An overview of pass-through businesses in the United States." Special report. Washington, D.C.: Tax Foundation.

Popov, Alexander, Francesca Barbiero, and Marcin Wolski. 2018. "Debt overhang and investment efficiency." Working Paper, ECB.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2014. "Recovery from Financial Crises: Evidence from 100 Episodes." *American Economic Review* 104 (5): 50–5.

Roe, Alan. 1971. *The financial interdependence of the UK economy 1957–66*. Londong: Chapman & Hall.

Schularick, Moritz, and Alan M. Taylor. 2012. "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008." *American Economic Review* 102 (2): 1029–61.

Stulz, René M., and Rohan Williamson. 2003. "Culture, openness, and finance." *Journal of Financial Economics* 70 (3): 313–49.

Vig, Vikrant. 2013. "Access to collateral and corporate debt structure: Evidence from a natural experiment." *Journal of Finance* 68 (3): 881–929.

Zarnowitz, Victor. 1992. *Business cycles: Theory, history, indicators, and forecasting*. Chicago: University of Chicago Press.

Appendix 1.A Business cycle peaks

As described in the text, we date business cycle peaks using the algorithm of Bry and Boschan (1971). Moreover, we characterize the ensuing recession to be “financial” when the peak falls into a ±2-year window around a financial crisis dated by Jordà, Schularick, and Taylor (2017). Table 1.A.1 shows business cycle peaks followed by normal recession and not falling into any war episode. Table 1.A.2 shows business cycle peaks followed by financial recession and not falling into any war episode. Both types of peaks are also visualized in Figure 1.A.1.

Table 1.A.1. List of business cycle peaks followed by normal recessions

Australia	1961, 1973, 1976, 1981, 2008
Belgium	1957, 1974, 1980, 1992, 2011
Canada	1891, 1894, 1903, 1928, 1953, 1956, 1981, 1989, 2007
Denmark	1880, 1887, 1931, 1962, 1973, 1979, 1992, 2011
Finland	1957, 1975, 2008, 2011
France	1905, 1907, 1926, 1933, 1974, 1992, 2011
Germany	1898, 1905, 1908, 1966, 1974, 1980, 1992, 2001
Ireland	1955, 1974, 1982
Italy	1974, 2002, 2011
Japan	1973, 2001, 2007
Netherlands	1957, 1974, 1980, 2001, 2011
Norway	1876, 1881, 1885, 1893, 1902, 1957, 1981, 2007, 2012
Portugal	1973, 1982, 1992, 2002, 2010
Spain	1927, 1952, 1958, 1980, 1992
Sweden	1876, 1881, 1883, 1885, 1888, 1890, 1899, 1901, 1904, 1924, 1980, 2011
Switzerland	1875, 1880, 1886, 1890, 1893, 1899, 1902, 1906, 1933, 1951, 1957, 1974 1981, 1994, 2001, 2011
UK	1896, 1899, 1902, 1907, 1925, 1929, 1951, 1957, 1979
USA	1926, 1953, 1957, 1969, 1973, 1979, 1981, 1990, 2000

Table 1.A.2. List of business cycle peaks followed by financial recessions

Australia	1989
Belgium	2007
Canada	1907
Denmark	1883, 1987, 2007
Finland	1989
France	1929, 2007
Germany	1890, 2008
Ireland	2007, 2010
Italy	1992, 2007
Japan	1997
Netherlands	2008
Norway	1897, 1930, 1987
Portugal	2008
Spain	1925, 1929, 2007
Sweden	1879, 1907, 1930, 1990, 2007
Switzerland	1929, 1990, 2008
UK	1889, 1973, 1990, 2007
USA	1929, 2007

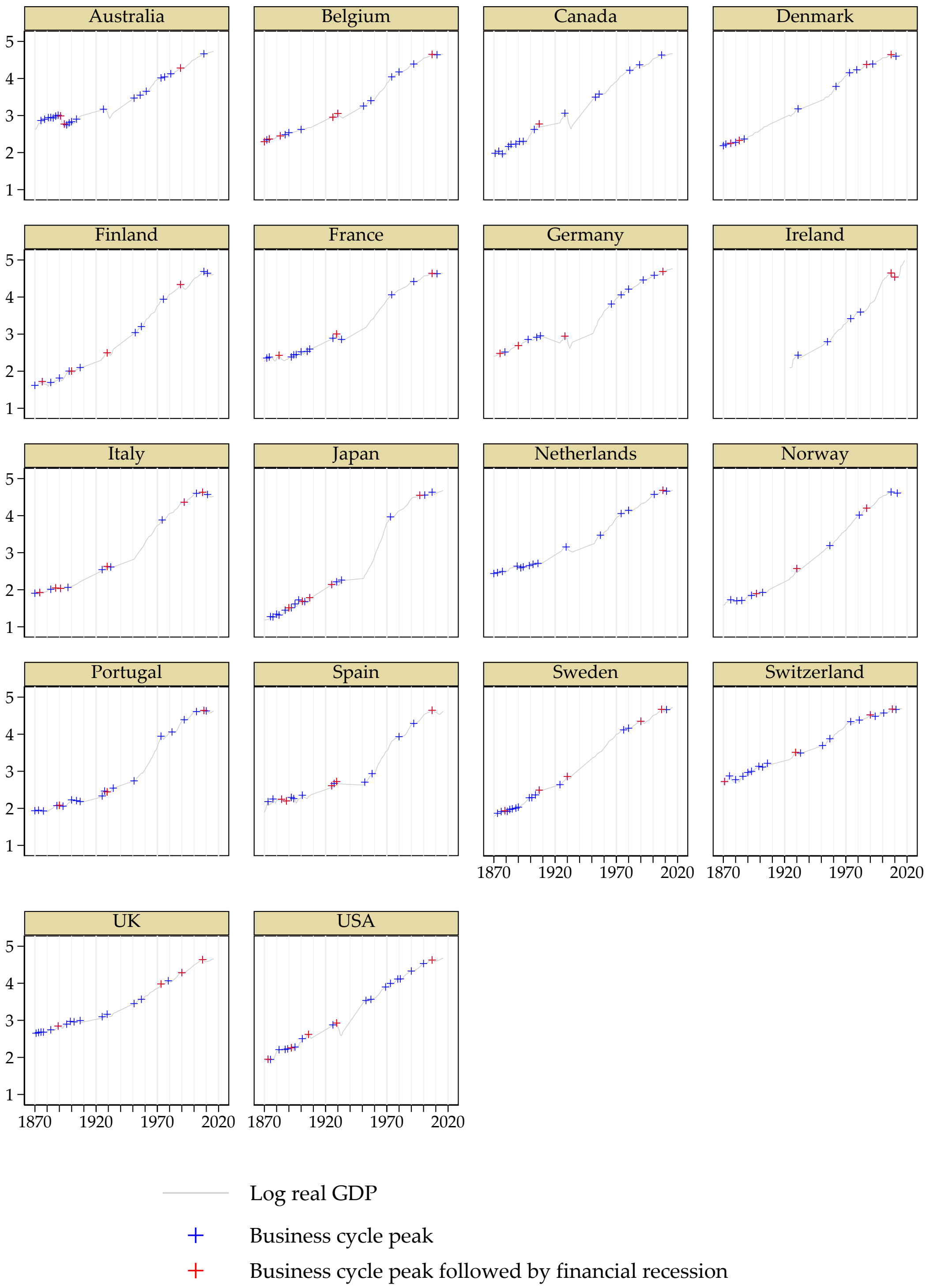


Figure 1.A.1. Business cycle peaks followed by financial and normal recessions

Table 1.B.1. Real business credit growth over the business cycle, 1870-2020

	Full sample	Sub-samples		
		Pre-WW2	Bretton Woods	Modern Globalisation
Full cycle	4.61 (8.94)	4.51 (11.06)	7.76 (8.29)	3.05 (7.12)
Boom years	5.29 (8.61)	5.04 (10.84)	8.28 (8.06)	3.71 (6.97)
Recession years	1.56 (9.64)	3.09 (11.54)	0.77 (8.25)	0.03 (7.06)

Notes: Subsample averages of annual changes in log real business credit, standard deviations thereof in parentheses. Excluding World War I and II and the Spanish civil war.

Appendix 1.B Corporate debt over the business cycle

Table 1.B.1 decomposes real business debt growth by business cycle phase and time period. Business debt grew strongly during the years of reconstruction after World War II. Across all periods, average real debt growth has been positive even during recessions. These averages, however, mask large swings in debt growth. The stock of outstanding business debt declined in real terms at several instances in our sample when the economy was in expansion and vice-versa. This indicates that cycles in GDP and business debt have not always been synchronized.

Next, using the same Bry and Boschan (1971) algorithm, we date business debt periods of expansion and recession. We find that only around a fifth of all business cycle peaks coincided with peaks in real business debt, as shown in Figure 1.B.1. Contrast this lack of synchronicity with the right-hand panel of the figure. This panel shows shows estimates of the coincidence of real GDP and real investment peaks, documenting a much stronger cyclical link. Also on an annual basis, growth rates in real GDP and investment are much stronger correlated ($\rho = 0.60$) and than real GDP and real business credit ($\rho = 0.23$). There is a weak offset pattern for business credit, though: the probability of real business credit peaking at the year before or after the business cycle is notably higher than at other horizons off the GDP peak. By contrast, the peak probability shift is much sharper for investment.

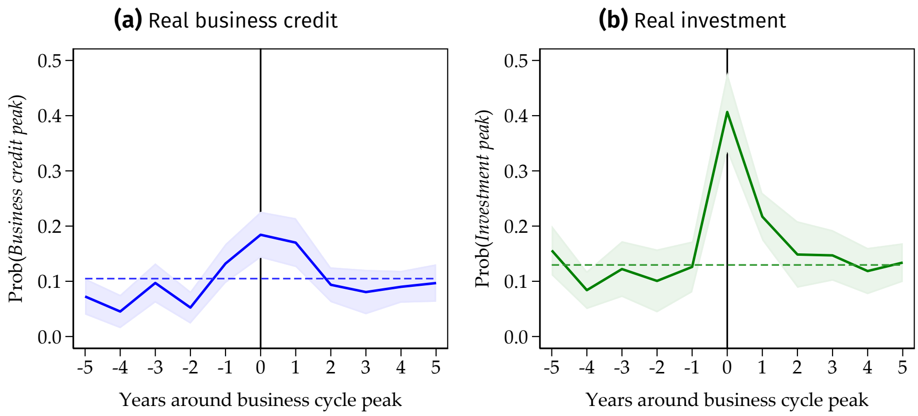


Figure 1.B.1. Cycle synchronisation of business credit and real GDP is relatively weak

Notes: Event study estimates using dummies for peaks in real GDP, real business credit and real investment. Estimates are purged of country fixed effects; standard errors are clustered on the country level. The dashed lines mark unconditional baseline probabilities.

Appendix 1.C Other macroeconomic aggregates

We confirmed that business credit booms have on average no predictive power for the recession path of GDP. Here, we investigate a variety of other macro-financial variables. This should give us a better sense of the underlying channels.

Using a similar approach to Figure 1.3, in Figure 1.C.1 we display the responses of other key indicators, as follows. Panels (a) and (b) of Figure 1.C.1 show the responses of real consumption and real investment per capita, two important components of GDP. Panels (c) and (d) display the responses of unemployment rate and inflation, respectively, two key variables in any analysis of monetary policy. Panels (e) and (f) display the responses of real household and business debt to get a sense of frictions that may impede the recovery and hence justify the dynamics that we observe for GDP. Finally, panels (g) and (h) show the responses of asset prices.[20]

Generally speaking, business credit booms do not depress aggregate demand—whether consumption, or more interestingly, investment. This is in stark contrast to a household credit boom, whose effects are particularly visible in investment. A possible explanation as to why investment is relatively insensitive to a corporate boom is that firms may shift to other internal sources of financing, i.e., equity instead of debt. Covas and Den Haan (2011) document that for large firms, equity issuance is countercyclical while debt take-up is procyclical. Another alternative explanation is that, although business debt declines (as shown in panel (e)), lower business debt may simply reflect debt restructurings and haircuts since our data are aggregated.

The effects on the unemployment rate and inflation are consistent with the behavior of consumption and investment, though they are measured more imprecisely. Nevertheless, a household credit boom generally results in higher unemployment and lower inflation than in the average recession, though, of the two, the inflation response is less clear cut. Thus, a recession that follows a boom in household debt appears to require stronger monetary support. These same features are not apparent in business credit booms.

Panels (e) and (f) of Figure 1.C.1 show the aftermath in debt markets. Echoing Jordà, Schularick, and Taylor (2013), household credit booms are followed by a long period of household deleveraging, which in turn is consistent with depressed aggregate demand, as panels (a) to (d) indicate. Business debt also grows significantly slower after business credit booms, requiring a similar period of financial repair. And this is true even if the boom takes place in the household sector. The same cannot be said as strongly for household debt. A business credit boom has much less effect on it, and it recovers more rapidly.

Finally, we investigated asset price behavior, reported in panels (g) and (h). We find that both house and stock prices are more negatively affected after household credit booms as compared to business credit booms. Declining housing wealth and falling residential investment seem to have been an important catalyst for the toxic general equilibrium spiral of household debt reported by Mian and Sufi (2010) for the U.S. after 2008.

20. All local projections underlying the figures are presented in tabular form in the Internet Appendix. They include the full set of macro economic controls. The left-hand side variable, as before, refers to the cumulative change since the cycle peak. All experiments refer to a credit boom 2 standard deviations above the historical mean.

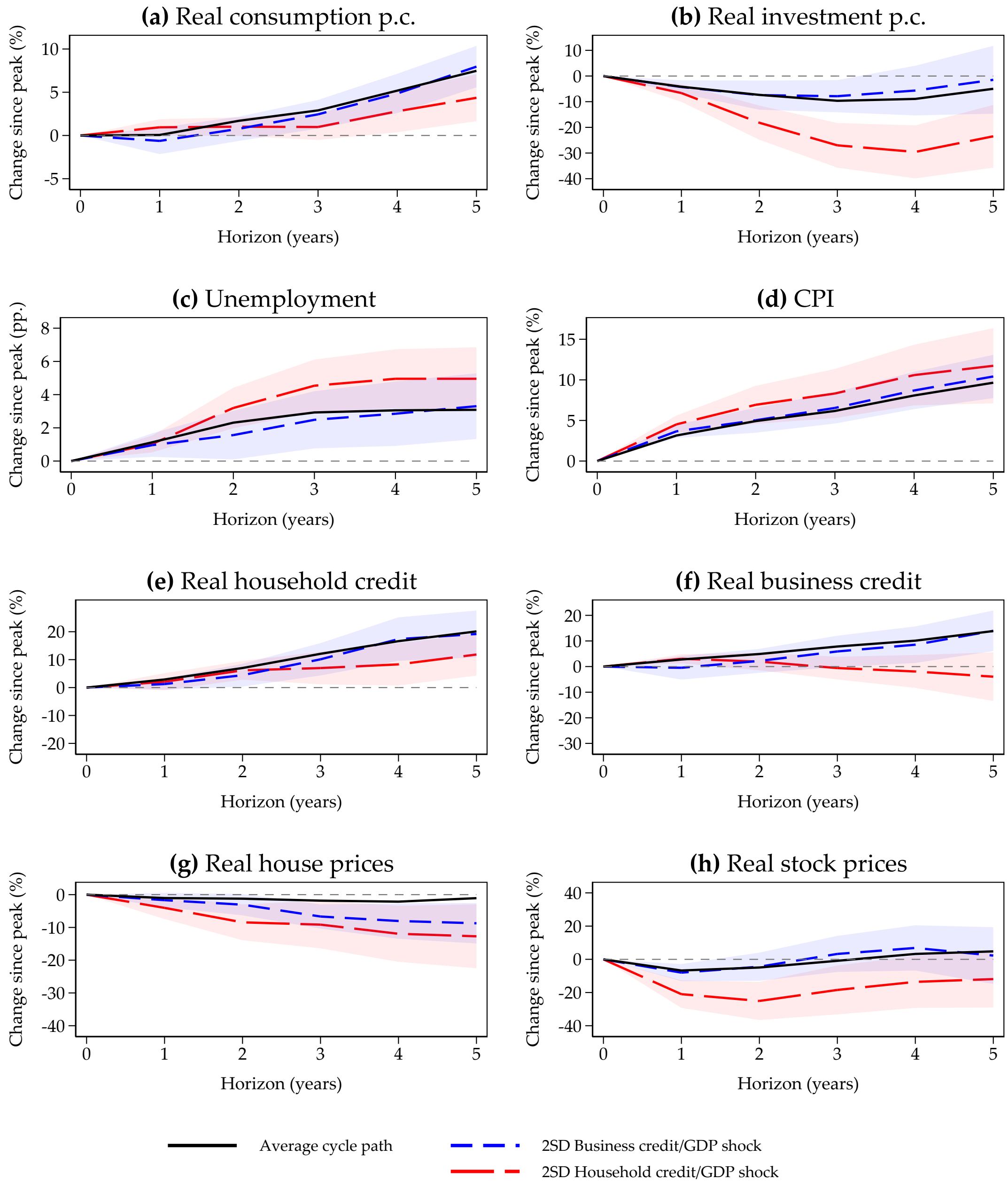


Figure 1.C.1. Business and household debt, responses of various macro-financial variables

Notes: The figure shows responses to a two-SD debt expansion in the five years preceding the recession for business credit booms on the left and household credit booms on the right of each panel. The sample includes all business cycles in 18 advanced economies since 1870. Standard errors clustered at the country level. Shaded areas denote the 95% confidence interval. See text.

Table 1.C.1. Change in log real consumption

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	−0.01	1.52**	2.78**	5.24**	7.47**
	(0.18)	(0.15)	(0.19)	(0.29)	(0.29)
Business credit $\Delta_5 x^B_{it(p)}$	−2.79	1.22	−0.97	−1.94	−2.02
	(1.93)	(2.00)	(2.62)	(2.84)	(3.88)
Household credit $\Delta_5 x^H_{it(p)}$	−1.14	−13.77*	−22.22**	−35.88**	−42.96**
	(3.93)	(5.64)	(4.95)	(7.81)	(7.43)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.725	0.024	0.001	0.002	0.000
R^2	0.23	0.29	0.42	0.38	0.36
Cycles	150	150	150	150	149

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

We also show regression tables for the plots above.

Table 1.C.2. Change in log real investment

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	−4.09**	−6.66**	−8.45**	−7.11**	−3.15*
	(0.36)	(0.71)	(1.08)	(1.24)	(1.48)
Business credit $\Delta_5 x^B_{it(p)}$	3.24	5.36	9.59	10.12	12.46
	(5.28)	(7.97)	(11.02)	(13.21)	(14.14)
Household credit $\Delta_5 x^H_{it(p)}$	−16.33	−75.14*	−122.73**	−144.57**	−133.24**
	(12.12)	(26.25)	(37.97)	(35.32)	(33.35)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.133	0.011	0.006	0.002	0.002
R^2	0.28	0.37	0.35	0.43	0.46
Cycles	150	150	150	150	149

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Table 1.C.3. Change in unemployment rate

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	1.21**	2.23**	2.88**	2.87**	2.94**
	(0.28)	(0.41)	(0.51)	(0.69)	(0.88)
Business credit $\Delta_5 x^B_{it(p)}$	0.28	−0.40	−0.80	−0.86	−1.04
	(0.99)	(2.50)	(3.40)	(3.98)	(4.22)
Household credit $\Delta_5 x^H_{it(p)}$	−0.42	5.74	12.50	16.17	14.47
	(3.06)	(6.44)	(7.98)	(8.36)	(8.47)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.837	0.410	0.177	0.126	0.141
R^2	0.39	0.23	0.35	0.35	0.34
Cycles	112	113	113	113	112

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Table 1.C.4. Change in log real household credit

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	3.47**	8.19**	13.67**	18.41**	22.23**
	(0.23)	(0.45)	(0.52)	(0.69)	(0.97)
Business credit $\Delta_5 x^B_{it(p)}$	−13.96**	−32.54**	−43.08**	−38.77*	−36.26*
	(3.68)	(9.53)	(11.00)	(16.44)	(15.67)
Household credit $\Delta_5 x^H_{it(p)}$	−15.40	−32.50	−83.22	−137.02*	−166.99**
	(15.63)	(34.43)	(40.81)	(49.08)	(43.73)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.938	0.999	0.420	0.109	0.023
R^2	0.28	0.29	0.37	0.33	0.40
Cycles	149	149	149	149	146

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Table 1.C.5. Change in log real business credit

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	3.06**	5.47**	7.73**	10.30**	15.06**
	(0.28)	(0.46)	(0.58)	(0.78)	(1.04)
Business credit $\Delta_5 x^B_{it(p)}$	−17.69**	−24.80*	−24.26	−34.27	−43.87
	(4.30)	(11.17)	(18.74)	(23.86)	(31.79)
Household credit $\Delta_5 x^H_{it(p)}$	7.18	−22.71	−73.91*	−117.26**	−185.43**
	(10.81)	(19.12)	(27.49)	(36.57)	(42.91)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.055	0.930	0.173	0.093	0.026
R^2	0.39	0.35	0.27	0.28	0.31
Cycles	149	149	149	149	148

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Table 1.C.6. Change in log CPI

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	3.00**	4.70**	5.92**	7.77**	9.33**
	(0.10)	(0.22)	(0.31)	(0.39)	(0.50)
Business credit $\Delta_5 x^B_{it(p)}$	0.15	−0.31	1.76	4.60	4.73
	(2.03)	(4.27)	(6.19)	(7.16)	(7.67)
Household credit $\Delta_5 x^H_{it(p)}$	0.47	2.99	1.79	−9.30	−22.31
	(4.33)	(10.97)	(13.84)	(16.99)	(19.22)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.941	0.749	0.999	0.454	0.209
R^2	0.75	0.71	0.68	0.66	0.67
Cycles	150	150	150	150	150

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Appendix 1.D Tail risks: quantile local projections

The possibility remains, that corporate debt has no visible mean effects, while carrying considerable tail. Recent research by Adrian, Boyarchenko, and Giannone (2019) make a similar point for household debt, whereas and Jordà, Schularick, and Taylor (2020) suggest that the economy exhibits fat-tailed behavior, that is, the lower quantiles of the GDP growth distribution contain potentially extreme losses. Thus, to investigate whether corporate debt makes the worst recessions have very extreme declines, we estimate quantile local projections (see, e.g., Linnemann and Winkler, 2016; Adrian, Boyarchenko, and Giannone, 2019; Stolbov and Shchepeleva, 2020). Specifically, we examine how corporate debt affects the distribution of GDP per capita growth *conditional* on observables.

Denote $\Delta_h y_{it(p)+h} = y_{it(p)+h} - y_{it(p)}$, that is, the approximate cumulative growth rate of GDP per capita using the same notation of the previous section. Let $\boldsymbol{X}_{it(p)}$ collect the debt growth variables defined earlier ($\Delta_5 x^j_{it(p)}$, $j = B, H$), as well as the vector of macro controls, $\boldsymbol{w}_{it(p)}$, the constant, and the fixed effects. Given this setup, quantile local projections can be estimated based on

$$\begin{aligned}\hat{\boldsymbol{\theta}}_{h,\tau} \;&=\; \underset{\boldsymbol{\theta}_{h,\tau}}{\operatorname{argmin}} \sum_{1}^{t(P)} \Big(\tau\, \mathbf{1}(\Delta_h y_{it(p)+h} \;\geq\; \boldsymbol{X}_{it(p)} \boldsymbol{\theta}_{h,\tau}) |\Delta_h y_{it(p)+h} - \boldsymbol{X}_{it(p)} \boldsymbol{\theta}_{h,\tau}| \\ &\quad + \;(1-\tau)\, \mathbf{1}(\Delta_h y_{it(p)+h} \;<\; \boldsymbol{X}_{it(p)} \boldsymbol{\theta}_{h,\tau}) |\Delta_h y_{it(p)+h} - \boldsymbol{X}_{it(p)} \boldsymbol{\theta}_{h,\tau}| \Big)\,, \end{aligned} \tag{1.D.1}$$

where $\mathbf{1}(\cdot)$ denotes the indicator function and $\tau \in (0,1)$ indicates the τ^{th} quantile. The quantile of $\Delta_h y_{it(p)+h}$ conditional on $\boldsymbol{X}_{it(p)}$ is then given by

$$Q\big(\Delta_h y_{it(p)+h} | \boldsymbol{X}_{it(p)}\big) \;=\; \boldsymbol{X}_{it(p)} \boldsymbol{\theta}_{h,\tau} \;\equiv\; q^h_{\tau,t}\,. \tag{1.D.2}$$

The coefficients $\boldsymbol{\theta}_{h,\tau}$ measure the effect of the right-hand side variables on the τ quantile of the conditional distribution of $\Delta_h y_{it(p)+h}$. Specifically, using notation analogous to that in Equation 1.1, the coefficient $\beta^B_{h,\tau}$ will measure the effect of a business credit boom on the conditional distribution of $\Delta_h y_{it(p)+h}$, and similarly for household debt with the coefficient $\beta^H_{h,\tau}$. Hence, note that these coefficients will vary depending on the quantile τ selected.

Our approach to calculating quantile local projections is completely parallel to the way one usually computes local projections at the mean, as we did in Equation 1.1. The only difference is that we are now dealing with a nonlinear model so the marginal effect of a change in corporate (household) debt has to be evaluated accordingly. However, this simple setup admits these nonlinear effects in an unspecified, flexible manner.

Figure 1.D.1 shows how we apply these methods to our data. In particular, we focus on the 20^{th} percentile of the conditional distribution of GDP per capita growth to investigate tail events. We did not choose a smaller quantile so as to have a reasonable data sample size for estimation. The figure displays quantile local projections alongside typical local projections evaluated at the mean. We display two cases, one for corporate debt, and one for household credit booms. These are defined as before, comparing the debt growth at the historical mean against growth at a rate two standard deviations above the historical mean. Consider first the figure associated

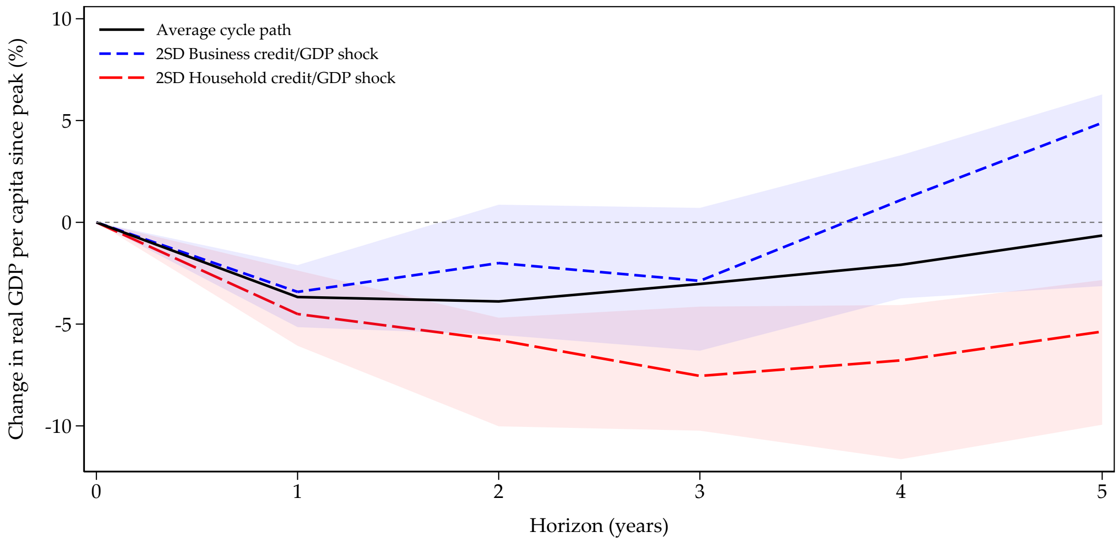


Figure 1.D.1. Business and household debt, responses at 20th percentile of real GDP per capita growth

Notes: Figures show the predictive effects on growth of a two-SD business/household debt buildup in the five years preceding the recession based on a LP series of quantile regressions. Business credit booms shown in the left-hand side panel and household debt booms shown in the right-hand side panel. Shaded areas denote the 95% confidence interval based on bootstrap replications. See text.

with a business credit boom. The marginal effect of a business credit boom on the recovery path is the same whether considering the average growth path or the path of the 20th percentile worst recessions. In contrast, a household credit boom of a similar magnitude affects the worst 20th percentile recession paths very differently than the mean path: household credit booms increase the risk of experiencing a bad recession. These results therefore align well with Adrian, Boyarchenko, and Giannone (2019).

Appendix 1.E Legal index of bankruptcy frictions

Figure 1.E.1 plots the index of legal frictions to bankruptcy reform constructed based on the work of Djankov, McLiesh, and Shleifer (2007) and Djankov et al. (2008). After inverting each underlying index to interpret the resultant measure in terms of *frictions*, we split each index at its median to separate country-year observations into those with "high" and "low-"friction bankruptcy regimes. By construction, swings in the creditor rights index running until 2003 (Djankov, McLiesh, and Shleifer, 2007) are induced through legal reforms. By contrast, the latter part – measuring the recovery rate as obtained from expert surveys (Djankov et al., 2008) – may also be moved by more subtle institutional changes.

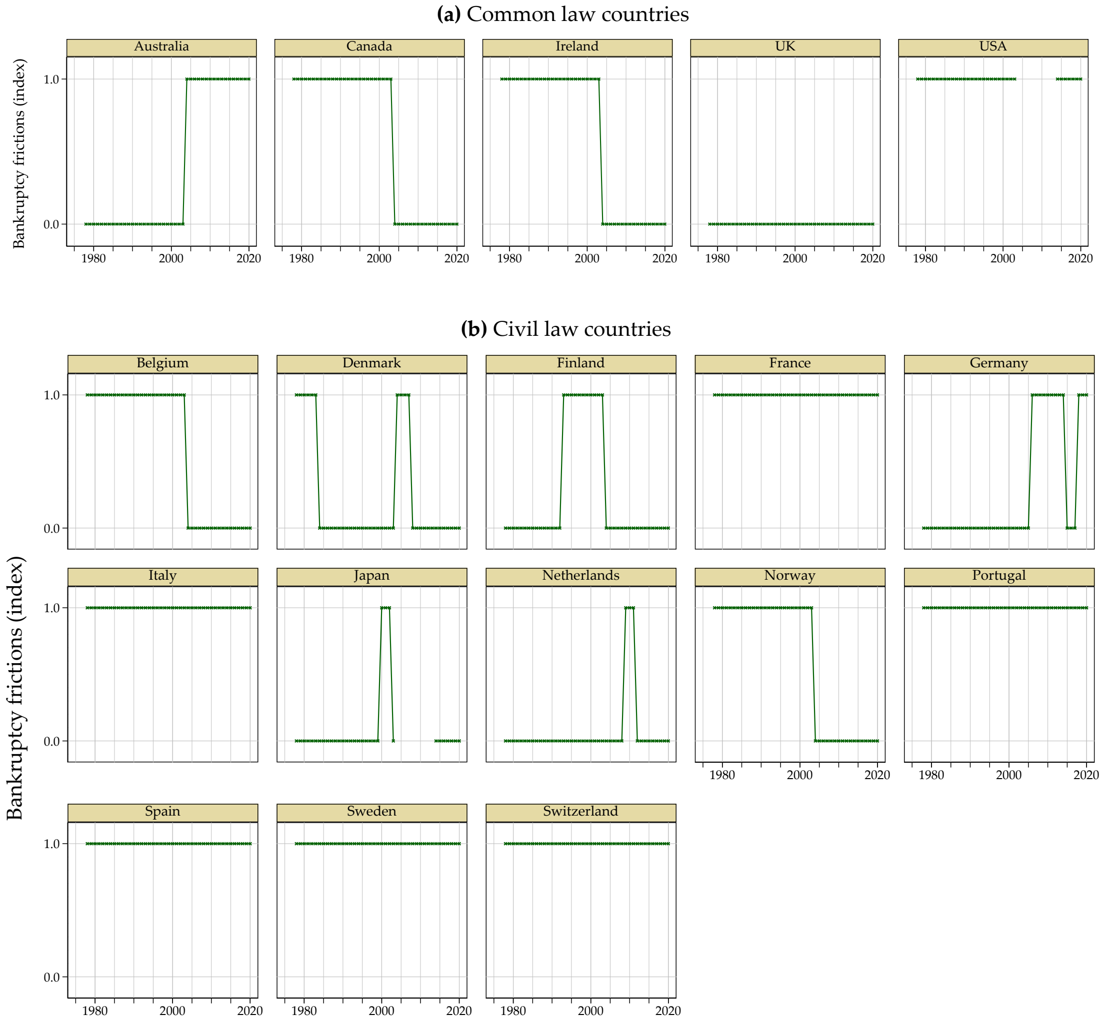


Figure 1.E.1. Legal index of bankruptcy frictions for all counties

Notes: Time series of the legal index for frictions to liquidation and restructuring in business insolvency cases.

Appendix 1.F Bankruptcy frictions and business credit booms

We found indicative evidence that bankruptcy frictions are associated with differences in credit spreads across countries and time. Do they beyond that also affect the amplitude or likelihood of credit booms? Figure 1.F.1 shows various distributions of business credit boom measures, distinguished by legal bankruptcy regime. Overall, we find limited evidence that bankruptcy regimes affect credit booms *quantitatively*. On average, business credit does not grow notably stronger during booms when frictions are low, nor does the business credit cycle exhibit different amplitudes over the whole business cycle (e.g. as measured by the full-sample standard deviation of five-year changes) under high-friction bankruptcy regimes.

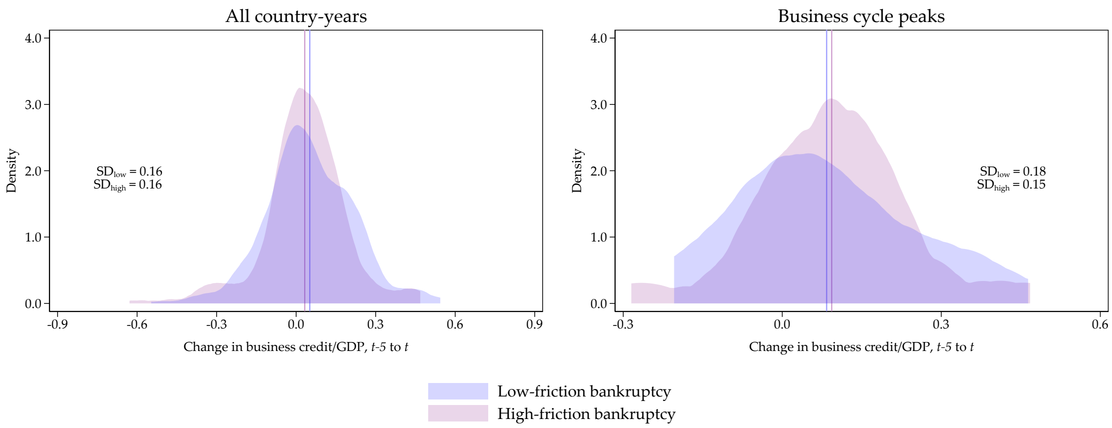


Figure 1.F.1. Business credit booms and legal frictions

Notes: Kernel density estimates of the change in business credit/GDP from $t-5$ to t, by bankruptcy regimes. Straight coloured lines indicate mean values.

Appendix 1.G Robustness

We test different specifications for our main model and expose it to a battery of robustness checks. Results are documented below. Across all variants, our main conclusions indeed remain unchanged.

1.G.1 Robustness checks for baseline result

Figure 1.G.1 shows our baseline specification with Driscoll-Kraay standard errors in a version that accommodates unbalanced panels and gaps in time series (Driscoll and Kraay, 1998; Hoechle, 2007). Moreover we introduce linear and quadratic time trends (Table 1.G.1), exclude all recessions from 2007 onwards (Table 1.G.2) and test alternative measures of debt overhang (Table 1.G.3, Table 1.G.4, Table 1.G.5). We also report unconditional estimates in Table 1.G.6. Finally, we test whether the effects of business credit expansions show up only at particularly high or low levels of business debt levels. We introduce an interaction term of 5-year changes in business credit/GDP with the level of business credit/GDP at peak and condition on the usual set of macro controls, country fixed effects and a linear and quadratic time trend. Figure 1.G.2 plots the effects of credit expansion interacted with credit/GDP level.

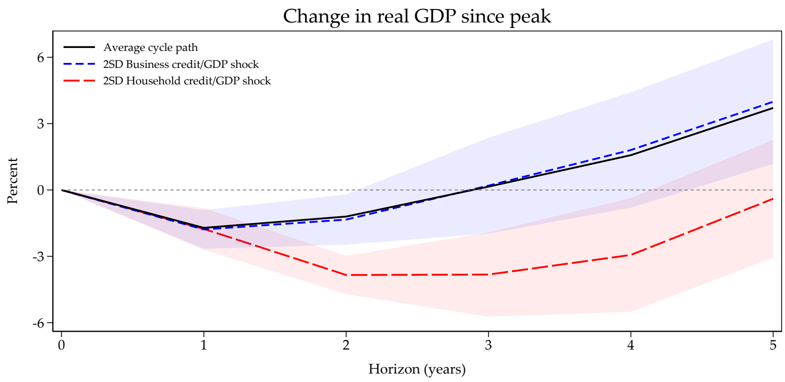


Figure 1.G.1. Driscoll-Kraay Standard Errors

Notes: The figure shows the effects of a two-SD credit expansion in the five years preceding the recession for household credit booms (lhs) and business credit booms (rhs). Shaded areas mark 95% CIs based on standard errors which are robust to autocorrelated and spatially correlated residuals. The estimations rely on all business cycles in 18 advanced economies since World War II.

1.G.2 Robustness checks of the role of bankruptcy institutions

For our results in the main text, we defined *high-friction bankruptcy* observations using the median of the underlying indices as cut-off. Figure 1.G.3 presents result for predicted trajectories when choosing the 33$^{\text{th}}$, 40$^{\text{th}}$, 60$^{\text{th}}$ or the 67$^{\text{th}}$ percentile instead. Results are qualitatively robust in all specifications. When cutting at the 67$^{\text{th}}$ percentile, estimates shift more notably in quantitative terms, but still remain qualitatively unchanged.

Different components of the creditor rights index of Djankov, McLiesh, and Shleifer (2007) might shape liquidation or reorganization procedures in varied ways. Figure 1.G.4 explores the relative importance of each component for our results. We re-estimate local projections of Equation 1.2 after dropping a selected creditor rights component from the construction of our bankruptcy friction index, repeating

Table 1.G.1. Introducing linear and quadratic time trends

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	-1.60^{**}	-0.85^{**}	0.57	1.85^{**}	3.58^{**}
	(0.13)	(0.23)	(0.35)	(0.41)	(0.50)
Business credit $\Delta_5 x^B_{it(p)}$	0.96	0.69	−0.35	−0.63	−2.37
	(1.12)	(1.47)	(1.90)	(2.80)	(3.31)
Household credit $\Delta_5 x^H_{it(p)}$	−1.00	-13.59^{**}	-19.76^{**}	-21.27^{*}	-23.45^{*}
	(3.29)	(4.01)	(5.75)	(9.65)	(11.03)
Time trend, linear	−0.71	1.86^{*}	2.78^{*}	5.10^{*}	6.06^{*}
	(0.72)	(0.79)	(1.29)	(2.14)	(2.59)
Time trend, quadratic	0.00	-0.00^{*}	-0.00^{*}	-0.00^{*}	-0.00^{*}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.563	0.008	0.008	0.068	0.089
R^2	0.11	0.35	0.42	0.43	0.40
Cycles	150	150	150	150	149

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

the procedure for each creditor right. The general pattern remains unchanged. The exercise reveals that automatic stay and bankruptcy filing constraints, like minimum dividends or creditor consent, appear to be particularly relevant for the effectiveness of resolving widespread financial distress.

Figure 1.G.5 compares predictions by based on legal regimes *and* by business credit boom. These predictions are based on re-estimating Equation 1.2 augmented by a level control of the bankruptcy friction index. In fact, legal frictions to bankruptcy barely affect predictions in the absence of business credit booms.

Figure 1.G.6 re-estimates Equation 1.2 augmented by controls for (a) private credit market development and (b) quality of financial sector regulation. In each specification, the variable enters both as level and as interaction with business credit boom. Referring to Djankov, McLiesh, and Shleifer (2007), private credit sector depth is measured as the centered five-year moving average of total bank lending relative to GDP. To measure financial sector regulation quality, we use the index of bank supervision quality constructed by Abiad, Detragiache, and Tressel (2010). Note that the latter covers data until 2003, reducing degrees of freedom ($N = 38$) and making estimation of the zombie share regression impossible altogether ($N = 21$). LPs underpinning the zombie share predictions in the right panel of (b) thus omit country fixed effects and macroeconomic controls.

Table 1.G.2. Omitting recessions post 2006

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	−1.65**	−0.50**	1.01**	2.66**	4.76**
	(0.08)	(0.16)	(0.24)	(0.30)	(0.40)
Business credit $\Delta_5 x^B_{it(p)}$	1.77	1.20	−0.05	0.48	−0.12
	(1.25)	(1.50)	(2.15)	(3.40)	(3.78)
Household credit $\Delta_5 x^H_{it(p)}$	0.60	−9.53*	−20.34**	−22.50	−24.23
	(3.04)	(3.36)	(6.84)	(11.44)	(11.87)
Macro controls	Yes	Yes	Yes	Yes	Yes
$\beta^B_h = \beta^H_h$ (p-value)	0.739	0.017	0.014	0.086	0.085
R^2	0.16	0.30	0.37	0.37	0.35
Cycles	121	121	121	121	121

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Table 1.G.3. Expansion measured by 3-year change in credit/GDP

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	−1.77**	−0.40	1.33**	3.04**	5.70**
	(0.13)	(0.25)	(0.31)	(0.43)	(0.60)
Business credit $\Delta_3 x^B_{it(p)}$	0.53	−2.36	−4.19	−7.45	−14.59*
	(2.26)	(2.67)	(3.38)	(4.84)	(6.47)
Household credit $\Delta_3 x^H_{it(p)}$	2.66	−20.19**	−28.88**	−30.10*	−36.14*
	(3.62)	(5.43)	(8.62)	(13.30)	(16.31)
Macro controls	Yes	Yes	Yes	Yes	Yes
R^2	0.104	0.295	0.380	0.375	0.389
Cycles	155	155	155	155	154

Notes: Credit measured as 3-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Table 1.G.4. Expansion measured by 10-year change in credit/GDP

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	-1.81^{**}	0.01	2.04^{**}	3.40^{**}	5.76^{**}
	(0.20)	(0.41)	(0.46)	(0.55)	(0.81)
Business credit $\Delta_{10}x^B_{it(p)}$	1.13	−0.53	−1.48	−1.99	−4.23
	(1.08)	(1.25)	(1.32)	(1.87)	(2.80)
Household credit $\Delta_{10}x^H_{it(p)}$	−0.94	-11.40^{**}	-16.41^{**}	-17.80^{**}	-18.83^{**}
	(1.63)	(2.41)	(2.97)	(4.88)	(5.39)
Macro controls	Yes	Yes	Yes	Yes	Yes
R^2	0.127	0.244	0.341	0.344	0.356
Cycles	133	133	133	133	132

Notes: Credit measured as 10-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Table 1.G.5. Expansion measured by real credit growth

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	-2.01^{**}	−0.40	1.31	2.79^{*}	5.54^{**}
	(0.39)	(0.54)	(0.72)	(1.13)	(1.39)
Business credit $\Delta_5 l^B_{it(p)}$	0.01	−0.01	−0.02	−0.03	−0.04
	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)
Household credit $\Delta_5 l^H_{it(p)}$	0.00	−0.01	−0.01	−0.00	−0.01
	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)
Macro controls	Yes	Yes	Yes	Yes	Yes
R^2	0.109	0.229	0.306	0.302	0.283
Cycles	150	150	150	150	149

Notes: Credit measured as 5-year change in log credit. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

Table 1.G.6. Unconditional

	(1) $h = 1$	(2) $h = 2$	(3) $h = 3$	(4) $h = 4$	(5) $h = 5$
Average cycle	-1.70^{**}	-0.91^{**}	0.80^{**}	2.55^{**}	4.40^{**}
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Business credit $\Delta_5 x^B_{it(p)}$	0.13	−1.31	−2.85	−2.27	−1.48
	(1.65)	(1.68)	(2.58)	(3.55)	(5.87)
Household credit $\Delta_5 x^H_{it(p)}$	0.43	-18.04^{**}	-26.57^{**}	-29.97^{**}	-35.96^{**}
	(2.54)	(3.80)	(5.32)	(8.13)	(8.78)
$\beta^B_h = \beta^H_h$ (p-value)	0.929	0.001	0.003	0.012	0.009
R^2	0.00	0.11	0.11	0.09	0.10
Cycles	158	158	158	158	157

Notes: Credit measured as 5-year change in credit-to-GDP ratio. Within-estimator, standard errors clustered on countries in parentheses. ** $p < 0.01$, * $p < 0.05$.

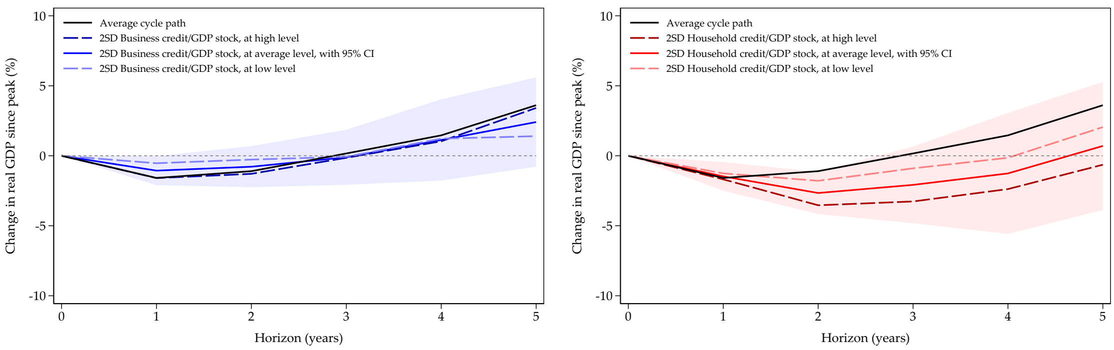


Figure 1.G.2. Interacting expansions and levels

Notes: The figure visualizes the effects of credit expansions when interacted with credit-to-GDP levels. It plots predictive effects on growth of a two-SD credit expansion in the five years preceding the recession when at the business cycle peak credit-to-GDP levels stand at i) country-specific historical averages, ii) one standard deviation above country-specific averages or iii) one standard deviation below country-specific averages. The usual set of controls are included. To make sure that credit level trends do not spuriously drive estimates, we include a linear time trend for the pre-WW2 period and—to account for the structural break on credit-to-GDP series—a dummy and separate time trend for the post-WW2 period. Estimates based on all business cycles in 18 advanced economies since 1870. Standard errors are clustered at the country level.

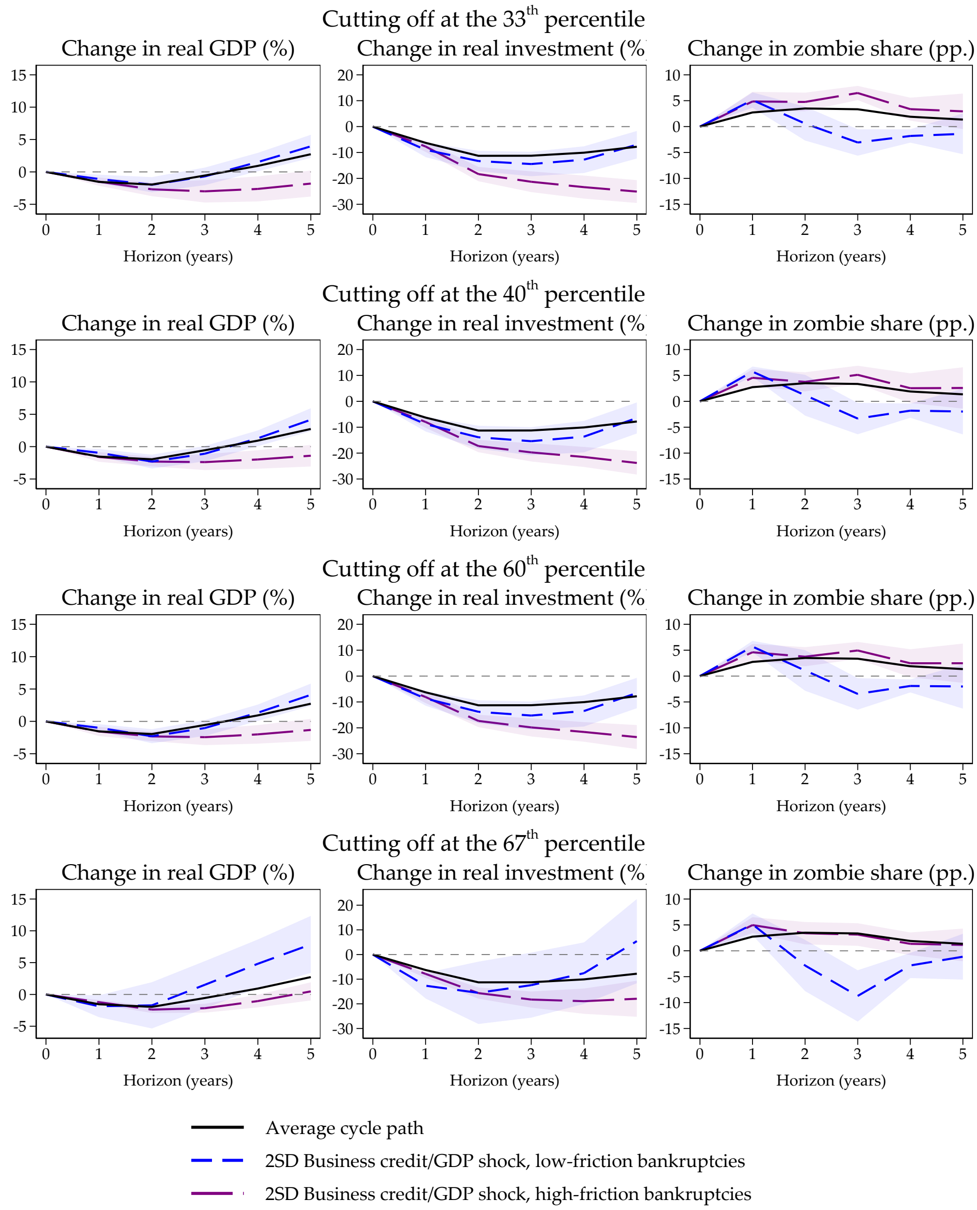


Figure 1.G.3. Using alternative threshold percentiles to define "high-friction" observations

Notes: Predictions from a 2-SD expansion in business credit/GDP in the five years preceding a recession under legal regimes posing many frictions to bankruptcy and restructuring procedures ($L_{it} = 0$) and low-friction regimes ($L_{it} = 1$), respectively. All other covariates are at their country-specific sample averages. All estimates are conditional on the same set of controls detailed in the text. Estimates for zombie shares further condition on the level and the annual change of the zombie share at business cycle peak. Standard errors are clustered at the country level. Shaded areas denote the 90% confidence interval.

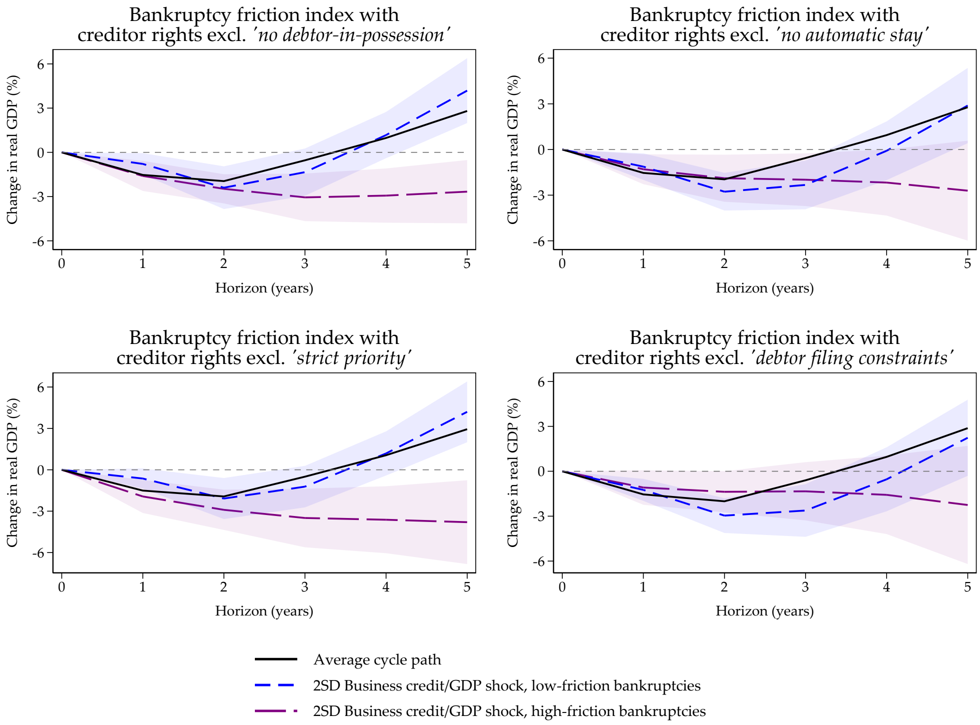
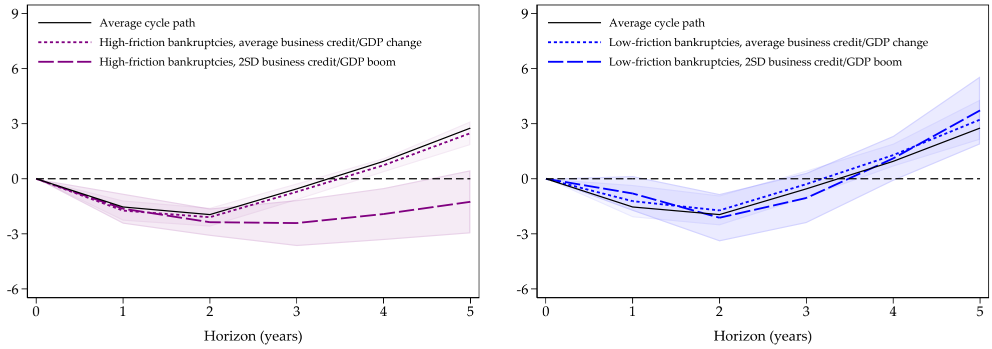


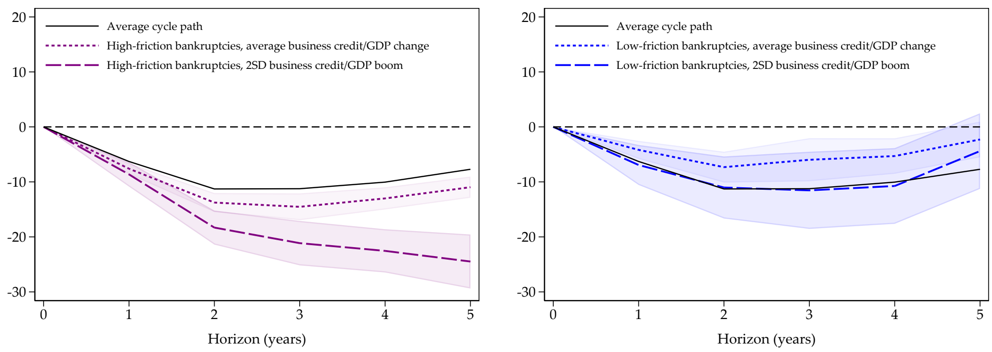
Figure 1.G.4. Alternative composition of creditor rights

Notes: Predictions based on local projections of Equation 1.2, where the bankruptcy friction index uses an alternative selection of creditor rights. The original index of Djankov, McLiesh, and Shleifer (2007) aggregates four components: (1) the dismissal of debtor management, (2) the absence of automatic stay, (3) the priority of secured creditors over other claimholders and (4) constraints on debtor's ability to file for restructuring. Each panel shows results from estimations of Equation 1.2 that drop a selected creditor right component when composing the bankruptcy friction index. As usual, figures show predictions from a 2-SD expansion in business credit/GDP in the five years preceding a recession under legal regimes posing many frictions to bankruptcy and restructuring procedures ($L_{it} = 0$) and low-friction regimes ($L_{it} = 1$), respectively. All other covariates are at their country-specific sample averages as in the other evaluations. All estimates are conditional on the same set of controls as detailed in the text. Shaded areas denote the 90% confidence interval.

(a) Change in real GDP (%)



(b) Change in real investment (%)



(c) Change in the zombie share (pp.)

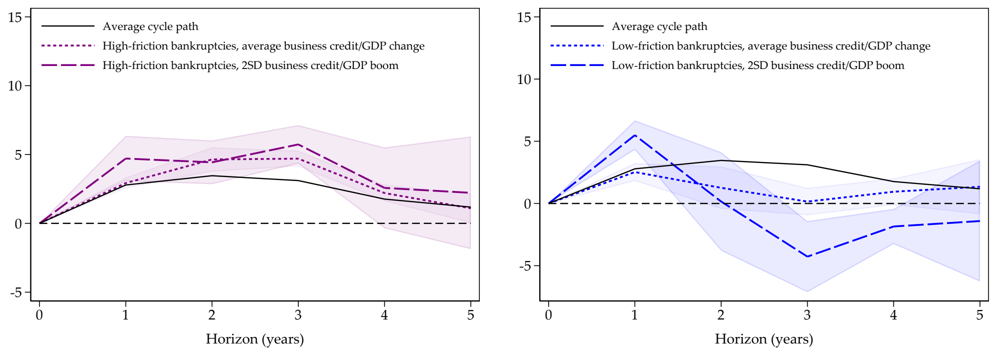
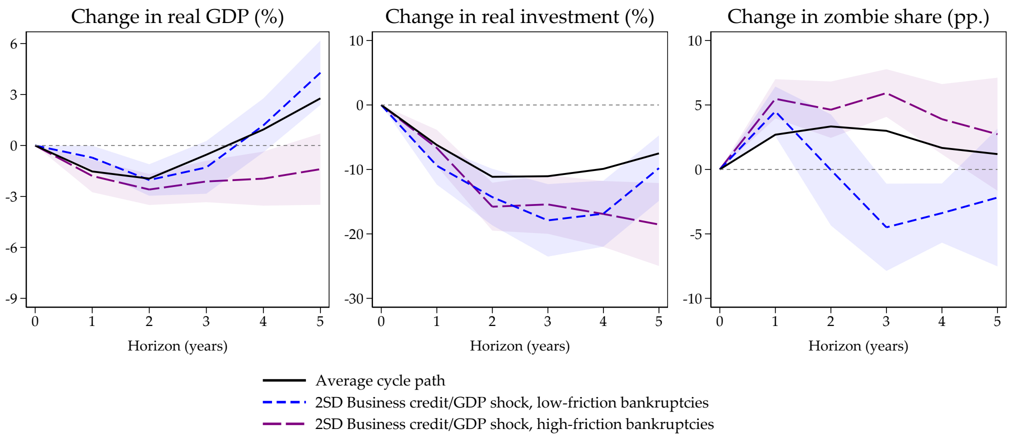


Figure 1.G.5. Effects of legal frictions with and without business credit booms

Notes: The figure shows predictions for real GDP, real Investment and the aggregate zombie share (from Banerjee and Hofmann, 2018) under high and low legal frictions, with and without business credit/GDP booms. Conditional country fixed effects and on the same set of controls as detailed in the main text. 90% CIs shaded based on standard errors clustered on countries.

(a) Controlling for levels and interactions of private credit market development



(b) Controlling for levels and interactions of quality of financial sector regulation

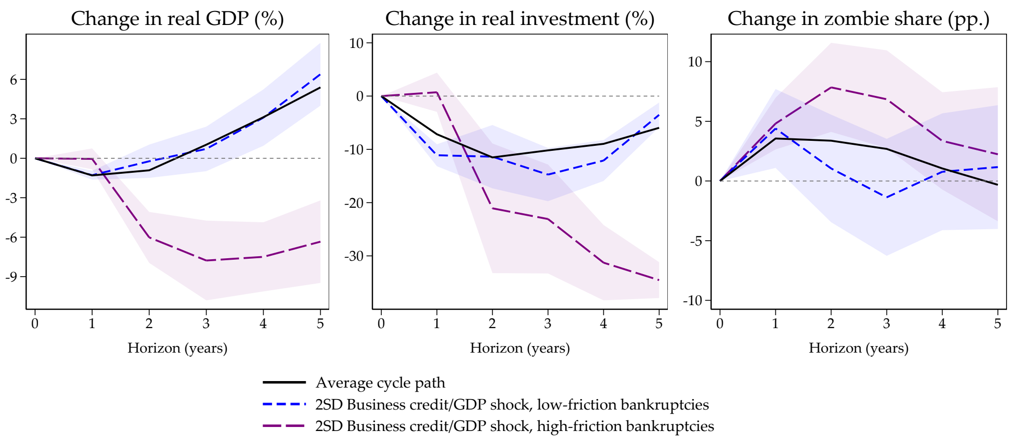


Figure 1.G.6. Controlling for possible confounders of bankruptcy frictions

Notes: The figure shows predictions for real GDP, real Investment and the aggregate zombie share (from Banerjee and Hofmann, 2018) under high and low legal frictions, adding controls in levels and as interaction with business credit booms. Conditional country fixed effects and on the same set of controls as detailed in the main text, except a very small sample ($N = 21$) do not allow predictions in the right panel of (b) to include country fixed effects and macroeconomic controls. 90% CIs shaded based on standard errors clustered on countries.

Table 1.H.1. Summary statistics for full sample of annual data

	N	Mean	SD	SD resid.	Min	P10	P90	Max
Business credit change	1286	0.04	0.16	0.15	-0.63	-0.15	0.22	0.62
Household credit change	1218	0.04	0.08	0.07	-0.35	-0.03	0.13	0.44
Business credit	1373	0.86	0.37	0.19	0.12	0.44	1.40	2.14
Household credit	1313	0.35	0.26	0.11	0.00	0.03	0.72	1.21

Notes: Credit is measured relative to GDP, changes refer to changes in the credit-to-GDP ratio over five years. *SD resid* denotes residual standard deviation after controlling for country fixed effects and country-specific linear time trends.

Appendix 1.H Business credit data

For parts of the post-WW2 sample, we can draw on financial accounts data of the OECD and Eurostat databases and individual publications such as Bonci and Coletta (2012) for Italy, Roe (1971) and Office for National Statistics (2016) for U.K. data, Deutsche Bundesbank (1983) and Deutsche Bundesbank (1994) for German data. All postwar U.S. data are from the Fed's Flow of Funds.

In addition, we rely on comprehensive measures of business credit provided by the "Total credit database" assembled by the Bank of International Settlements (BIS). These include secured and unsecured debt obligations of all maturities and from all types of lenders in addition to conventional bank lending contracts. For methodological details see Dembiermont, Drehmann, and Muksakunratana (2013).

For earlier years, we proxy credit growth using data on bank lending to the nonfinancial business sector. In addition, we extend the business lending series of Jordà, Schularick, and Taylor (2017) to obtain data for the 19th and the first half of the 20th. We fill post-WW2 gaps with data kindly provided by Müller (2018).

For the pre-WW2 period, we calculate bank credit to the nonfinancial business sector based on the assets of specialized commercial banks, providing loans to business and other corporate financing. For example in the case of Germany, we sum credit extended to non-banks by joint-stock industrial banks as well as commercial credit unions. Where the banking sector is more diversified, we exploit that the bulk of pre-WW2 household loans were mortgages and obtain business credit as the residual to total private credit. Here, we can rely on Jordà, Schularick, and Taylor (2017) for necessary data on residential mortgages and total credit. We list all sources in detail below.

Table 1.H.1 presents summary statistics of business credit and of household credit for comparison.

Sources

Australia

1948–1954 Lending to nonfinancial corporate business from Karsten Müller (2018) "Credit Markets around the World, 1910–2014", from SSRN (accessible online at https://ssrn.com/abstract=3259636).

1955–1976 Residual of total bank loans to nonfinancial private sector and total bank loans to households (both from JST MacroHistory Database).

1977–1988 Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

1989–2013 Total non-equity liabilities of the private nonfinancial business sector from OECD financial accounts data.

2014–2020 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

Belgium

1950–1979 Residual of total loans to nonfinancial private sector and total loans to households (both from JST MacroHistory Database).

1980–1993 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (acessible online at https://www.bis.org/statistics/totcredit.htm).

1994–2013 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2014–2020 Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

Canada

1880–1941 Lending of chartered banks recorded in Urquhart, M. C., and Buckley, K. A. H., Historical Statistics of Canada, “Banking and Finance," Series H87-179 and Canada Statistical Yearbooks (various).

1942–1960 Lending to nonfinancial corporate business from Karsten Müller (2018) “Credit Markets around the World, 1910–2014", from SSRN (accessible online at https://ssrn.com/abstract=3259636).

1961–1969 Total non-equity liabilities of the private nonfinancial business sector from Statistics Canada, Series J568-875, Table J596-607 (accessible online at https://www150.statcan.gc.ca/n1/pub/11-516-x/sectionj/4147440-eng.htm#6).

1970–2013 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2014–2020 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

Denmark

1875–1950 Business loans of banks proxied by lending and domestic bills of exchange from commercial banks from Hans Christian Johannsen (1985) “Dansk Historisk Statistik 1814–1980", Table 6.6.

1951–1993 From Kim Abildgren (2007) “Financial Liberalization and Credit Dynamics in Denmark in the Post–World War II Period", Danmarks Nationalbank, Working Papers 47/2007, Appendix B, Table B.1 and B.2, Series “Commercial lending".

1994–2013 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2014–2018 Rurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2019-2020 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

Finland

1948–1969 Calculated from Statistics Finland (various), Statistical Yearbook (various issues). Table “Loans by the credit institutions by groups of borrowers on 31 December", Series “Total w/o municipalities and parishes”. Base is 1970 value.

1970–1994 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

1995–2013 Financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2014–2019 eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

France

1902–1933 Residual of total bank credit from JST database (from Saint Marc, Patat, and Lutfalla) less real estate lending from Crédit Foncier.

1958–1976 From Annual Reports of the Conseil National du Crédit, published between 1959 and 1976: Crédit aux entreprises industrielles et comercielles, total series. Available at www.gallica.bnf.fr.

1977–1994 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

1995–2012 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2013–2018 Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2019-2020 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

Germany

1885–1920 From Bundesbank (1976): loans and discounts of joint-stock banks (Aktienkreditbanken) and commercial credit unions (Genossenschaftsbanken) to non-banks proxying lending to business.

1924–1944 From Bundesbank (1976): loans and discounts of Großbanken and Kreditgenossenschaften.

1949–1990	From Bundesbank (1983) "Revidierte Ergebnisse der gesamtwirtschaftlichen Finanzierungs- und Geldvermögensrechnung für die Jahre 1950–1959", and Deutsche Bundesbank (1994) "Ergebnisse der gesamtwirtschaftlichen Finanzierungsrechnung für Westdeutschland 1960–1992. Total private nonfinancial business sector liabilities less equity.
1991–2012	OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.
2013–2018	Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.
2019-2020	Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

Ireland

1932–2002	From Rebecca Stuart (2017) "70 years of personal disposable income and consumption in Ireland", Journal of the Statistical and Social Inquiry Society of Ireland, Vol.46, pp.47–70 and sourced cited therein: Bank lending to business.
2003–2018	From Central Bank of Ireland, online Bank Balance Sheets Data, Table A.5 "Loans to the Irish Private Sector", credit to the private nonfinancial business sector.

Italy

1948–1949	Lending to nonfinancial corporate business from Karsten Müller (2018) "Credit Markets around the World, 1910–2014", from SSRN (accessible online at https://ssrn.com/abstract=3259636).
1950–1994	Financial accounts data on total non-equity liabilities from Bonci and Coletta (2012) "Italy's Financial Accounts since 1950", SSRN: http://ssrn.com/abstract=2120474.
1995–2012	OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.
2013–2018	Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.
2019-2020	Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

Japan

1948–1963	From Nihon Ginkō Tōkeikyoku and Nihon Ginkō Chōsakyoku (various) as well as Honpō Keizai Tōkei and Nihon Ginkō Toōkeikyoku, Tokyo. 1948–59: Table "All banks: Loans classified by industry", Series "Total without lending to private households, local governments, and financial institutions". 1960–61: Table "Outstanding loans and discounts of all banks by industry", Series "Total (without lending to private persons, local governments, and finance)". 1962–63: Table "All banks (banking accounts): Loans classified by industry", Series "Total without loans to households, local government, financials, and companies

overseas" + Table "All banks (trust accounts): Loans classified by industry", Series "Total without loans to households, local government, financials, and companies overseas".

1964–1979 Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

1980–2012 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2013–2020 Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

Netherlands

1946–1989 Bank lending to business sector proxied by loans of "Handelsbanken" from De Nederlandsche Bank (2000).

1990–1994 Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

1995–2018 Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2019-2020 Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

Norway

1872–1939 Bank lending to nonfinancial business sector proxied by commercial bank lending from Historical Monetary Statistics for Norway.

1940–1974 Lending to nonfinancial corporate business from Karsten Müller (2018) "Credit Markets around the World, 1910–2014", from SSRN (accessible online at https://ssrn.com/abstract=3259636).

1975–1994 Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

1995–2013 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2014–2019 Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

Portugal

1947–1978 Lending to nonfinancial corporate business from Karsten Müller (2018) "Credit Markets around the World, 1910–2014", from SSRN (accessible online at https://ssrn.com/abstract=3259636).

1979–1994 Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

1995–2013 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2014–2019 Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

Spain

1904–1935 Bank lending to business from Estadísticas Históricas de España, by Carreras and Tafunell (1989); table 9.12: Entitades de crédito.

1946–1979 Residual of total bank loans to nonfinancial private sector and total loans to households (both from JST MacroHistory Database).

1980–2012 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2013–2019 Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

Sweden

1872–1940 Residual of total bank loans to nonfinancial private sector and total loans to households (both from JST MacroHistory Database); total bank loans less loans of housing credit institutions.

1975–1979 Bank loans to business calculated from Statistics Sweden (various), Financial Market Statistics. Series: "Housing credit institutions – lending, SEK millions", Series "Non-financial corporations" + Series: "Banks – total landing and lending to non-MFI, SEK million", Series "Non-financial corporations – Total", Series "Financial corporate sector, not MFI – Total".

1980–1994 Bank loans to business and capital market debt from "Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

1995–2013 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2014–2019 Eurostat financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

Switzerland

1870–1976 Bank loans to business from JST MacroHistory Database, building on Swiss National Bank. "Historical Time Series." 2009. Section 5: "Banks in Switzerland".

1977–1998 Bank loans to business from Swiss National Bank, "Historical Time Series 5." 2009. "Banks in Switzerland.", Table 21 "Sectoral breakdown of domestic assets", Series "Non-Financial Corporations, Private legal entities .

1999–2011 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2012–2020 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

United Kingdom

1880–1950 Residual of total bank loans to nonfinancial private sector and total loans to households from JST MacroHistory Database.

1951–1956 Bank of England (2017); Table LPQBC57 (accessible online at http://www.bankofengland.co.uk/).

1957–1965 Total non-equity liabilities of industrial and commercial companies from Roe (1971) “The financial interdependence of the UK economy 1957–66”, London: Chapman and Hall.

1966–1978 Total non-equity liabilities of the private nonfinancial business sector from Pettigrew (1980) “National and sector balance sheets for the United Kingdom", Economic Trends, November, pp. 82–100.

1979–1986 Total non-equity liabilities of industrial and commercial companies from Sbano (2008) "New historical data for assets and liabilities in the UK", Economic & Labour Market Review, Vol. 2(4), pp. 40–46.

1987–2013 OECD financial accounts data on total non-equity liabilities of the private nonfinancial business sector.

2014–2020 Bank loans to business and capital market debt from “Credit to the non-financial sector" database of the Bank of International Settlements (accessible online at https://www.bis.org/statistics/totcredit.htm).

United States of America

1916–1938 Total corporate debt less interbank debt from James, John A. and Richard Sylla (2006), “Debt and Flow of Funds” in Historical Statistics of the United States,” edited by Susan B. Carter, Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright.

1945–2020 Total loans, bonds and miscellaneous liabilities of nonfinancial corporate businesses and total loans and miscellaneous liabilities of nonfinancial noncorporate businesses from Board of Governors of the Federal Reserve System (2021) “Financial Accounts of the United States.”

Appendix References

Abiad, Abdul, Enrica Detragiache, and Thierry Tressel. 2010. "A new database of financial reforms." *IMF Staff Papers* 57: 281–302.

Adrian, Tobias, Nina Boyarchenko, and Domenico Giannone. 2019. "Vulnerable Growth." *American Economic Review* 109 (4): 1263–89.

Banerjee, Ryan N., and Boris Hofmann. 2018. "The rise of zombie firms: Causes and consequences." *BIS Quarterly Review* March: 67–78.

Bonci, Riccardo, and Massimo Coletta. 2012. "Italy's Financial Accounts since 1950." Working Paper, Bank of Italy.

Bry, Gerhard, and Charlotte Boschan. 1971. *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs.* New York: NBER.

Covas, Francisco, and Wounter Den Haan. 2011. "The Cyclical Behavior of Debt and Equity Finance." *American Economic Review* 101 (2): 877–99.

Dembiermont, Christian, Mathias Drehmann, and Siriporn Muksakunratana. 2013. "How much does the private sector really borrow - a new database for total credit to the private non-financial sector." *BIS Quarterly Review* March: 65–81.

Deutsche Bundesbank. 1983. "Revidierte Ergebnisse der gesamtwirtschaftlichen Finanzierungs- und Geldvermögensrechnung für die Jahre 1950–1959." Frankfurt: Deutsche Bundesbank, Hauptabteilung Volkswirtschaft.

Deutsche Bundesbank. 1994. "Ergebnisse der gesamtwirtschaftlichen Finanzierungsrechnung für Westdeutschland 1960–1992." Frankfurt: Deutsche Bundesbank, Hauptabteilung Volkswirtschaft.

Djankov, Simeon, Oliver Hart, Caralee McLiesh, and Andrei Shleifer. 2008. "Debt enforcement around the world." *Journal of Political Economy* 116 (6): 1105–49.

Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer. 2007. "Private Credit in 129 Countries." *Journal of Financial Economics* 12 (2): 77–99.

Driscoll, John C., and Aart C. Kraay. 1998. "Consistent covariance matrix estimation with spatially dependent data." *Review of Economics and Statistics* 80: 549–60.

Hoechle, Daniel. 2007. "Robust standard errors for panel regressions with cross-sectional dependence." *Stata Journal* 7 (13): 281–312.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2013. "When Credit Bites Back." *Journal of Money, Credit and Banking* 45 (2): 3–28.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2017. "Macrofinancial History and the New Business Cycle Facts." In *NBER Macroeconomics Annual 2016,* edited by Martin Eichenbaum and Jonathan A. Parker. Chicago: University of Chicago Press.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2020. "Disasters everywhere: The costs of business cycles reconsidered." Working Paper, Federal Reserve Bank of San Francisco.

Linnemann, Ludger, and Roland Winkler. 2016. "Estimating nonlinear effects of fiscal policy using quantile regression methods." *Oxford Economic Papers* 68 (4): 1120–45.

Mian, Atif, and Amir Sufi. 2010. "Household leverage and the recession of 2007–09." *IMF Economic Review* 58 (1): 74–117.

Müller, Karsten. 2018. "Credit Markets around the World, 1910–2014." Working Paper, NUS Business School.

Office for National Statistics. 2016. "Pre-ESA95 financial accounts and balance sheets." Data retrieved from https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts.

Roe, Alan. 1971. *The financial interdependence of the UK economy 1957–66.* Londong: Chapman & Hall.

Stolbov, Mikhail, and Maria Shchepeleva. 2020. “Macrofinancial linkages in Europe: Evidence from quantile local projections.” *International Journal of Finance & Economics* 26: 5557–69.

Chapter 2

Market Creditor Protection, Debt Structure and Investment

Credit is the dominant flow of business funding. In the classical approach, firms concentrate their debt in the hands of a few creditors and establish lending *relationships* (Diamond, 1984). However, such relationships can be undesirable for the firm (Rajan, 1992; Bolton and Scharfstein, 1996; Boot, 2000; Schwert, 2020).[1] Alternatively, firms may issue standardized debt securities in public capital markets, where many investors buy and sell small positions to enjoy portfolio diversification and liquidity on an individual basis. Such *market-based* lending fragments the creditor base.

Creditor dispersion is costly for firms because it impairs debt restructuring. On the one hand, dispersed creditors suffer a collective action problem that creates a temptation to hold out of agreements and free-ride on others' concessions (Gertner and Scharfstein, 1991). This can frustrate private debt restructuring and require costly court interventions. On the other hand, insiders—i.e., the debtor and relationship lenders—may out-maneuver poorly-coordinated market creditors and restructure debt opportunistically (Brudney, 1992; Baird, 2023). The possibility of opportunistic restructurings will undermine insiders' incentives to contain investment risk ex ante.

In this chapter, I highlight that legal protection of market creditors trades-off both frictions. Strong protection can limit the scope for opportunistic restructuring of market debt. But at the same time, it empowers holdouts and makes it harder to implement efficient restructuring solutions against their dissent (Roe, 1987). That is, stronger market creditor rights may reduce the ex-ante cost of moral hazard, but at the expense of higher distress cost ex post. Which of the two

1. Lending relationships can impair management incentives ex-ante—and thus firm value—due to hold-up power in good states and soft-budget-constraint problems in distress (Rajan, 1992; Bolton and Scharfstein, 1996). By contrast, arm's-length debt not only eschews the soft-budget-constraint problem but can mitigate it for senior relationship debt by serving as a buffer (Boot, 2000; Park, 2000; Rauh and Sufi, 2010). Moreover, relationship creditors' monitoring costs can be excessive i) in the sense of swamping the expected value of liquidity services in distress (Bolton and Freixas, 2000; Bolton et al., 2016) or ii) when creditors cannot benefit from upside potential (Besanko and Kanatas, 1993).

effects dominates is an empirical question, and answers may depend on the context. For the US, I find that a recent strengthening of bond market creditor protection predominantly increased distress costs: Distressed firms were forced more frequently into costly court procedures, and healthy firms responded by cutting bond issuance and real investment.

I start with a model to illustrate the two opposing economic channels. It is grounded in the assumption that market creditors cannot contract on firm governance.[2] This creates moral hazard: To the extent that the debtor and its relationship creditors can expect to rid the firm of market debt in financially dire circumstances, they will spend less resources on management and monitoring in order to avoid those. To zoom in on this very conflict, the model groups firm owners, relationship creditors and the managers they appoint and interfere with under the label of firm *"insiders"*.[3] Anticipating insider moral hazard, market creditors will guard themselves by demanding higher yields ex-ante. This effectively shifts moral hazard costs back onto insiders and discourages bond issuance in the first place. Insofar as insider finance and market debt are imperfect substitutes—modeled as wedge between insider and market discount rates—financing costs rise and undermine real investment. Protecting market creditors from coercive debt exchange offers limits the ability to shed market debt in distress and thus reduces the cost of moral hazard embodied in yields. However, such protection pushes firms into costly bankruptcy whenever severe distress would actually require strong coercion.[4] A calibration of the model indicates that the net effect can be sizable, but may go either way.

I test the economic ramifications of market creditor protection using a landmark US court ruling that strengthened bondholder protection in 2014 (Court of the Southern District of New York, 2014). The court broadened the interpretation of existing law to protect dispersed bondholders from coercive bond exchange offers: It ruled against *exit consents*—a class of bond exchange transactions commonly used to discourage holdouts—arguing that they can be abused to force poorly-coordinated bondholders into accepting unfavorable terms. Because it re-interpreted federal law, the ruling set an important precedent for every subsequent bond exchange. It was motivated by legislative history rather than economic considerations and surprised practitioners as well as legal scholars.[5] The ruling came to be known under the name of

2. Market creditors barely monitor management. Neither do they monitor the way in which relationship creditors exercise control over debtor management (Chava and Roberts, 2008; Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2012; Roberts, 2015; Arnold and Westermann, 2023). That is, even if market creditors were to include provisions in their lending contracts on how management ought to act or in inter-creditor agreements on how relationship lenders ought to exercise control, they could not effectively enforce them.

3. Monitoring relationship creditors influence debtor management (Chava and Roberts, 2008; Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2012; Roberts, 2015; Arnold and Westermann, 2023). That is, firm governance is co-determined by owners and relationship creditors. To capture frictions between owners and relationship creditors (cf., Bergman and Callen, 1991; Aghion and Bolton, 1992; Rajan, 1992; Hart, 1995), the model subjects insiders' group-level behavior to an elevated discount rate: Equity and relationship credit carry extra opportunity cost—rooted in agency frictions—which incentivize bond issuance in the first place.

4. In the model, the deadweight cost of bankruptcy is an implicit cost of market-based borrowing and born by both insiders and market creditors. Thus, yields reflect it only partially.

5. In fact, litigation related to the multi-billion USD bankruptcy of *Caesars* casino conglomerate drew upon the Marblegate verdict soon after.

the plaintiff hedge fund: *Marblegate*. To estimate the effect of this regime shift at the national level, I rely on differential firm-level exposure.

As a first step, I confirm warnings that Marblegate would exacerbate the holdout problem in private bond exchanges and force more distressed firms into a formal bankruptcy procedure. Filing rates surged, driven by firms with an above-median level of bond debt relative to book assets—henceforth referred to as *bond-intensive*. Other firms barely change their filing behavior.[6] The effect is quantitatively large: among the quartile of bond-intensive firms with the highest levels of financial distress, bankruptcy filing rates essentially doubled. For out-of-court bond restructurings, I document that Marblegate resulted in higher bond recoveries in the exchanges that still did occur and document evidence consistent with a larger prevalence of holdouts. Because bankruptcy procedures inflict additional direct and indirect costs (Hotchkiss et al., 2008; Lubben, 2012; Epaulard and Zapha, 2022), this evidence is consistent with the aforementioned ex-post distress cost channel.

How much did Marblegate reduce the ex-ante cost of moral hazard? If it dominated the increase in ex-post distress cost, healthy firms should have *expanded* bond issuance and investment. To test, I exploit heterogeneous exposure at the firm level. Those with low default risk or little reliance on bond finance will have been agnostic about Marblegate. By contrast, risky, bond-intensive businesses should have reacted more strongly. Estimating difference-in-differences (DiD) regressions on the sample of risky firms, I find a 25 percent cut in investment rates in the bond-intensive subsample relative to less bond-reliant peers. The cut occurs right after the verdict and persists over the next two years. I find no commensurate accumulation of cash or liquid assets, and thus refute a strong precautionary motive behind the cut. Instead, it mirrors a reduction of net debt issuance. Zooming in on bond issuance activity, I find that the quarterly probability to place a substantive bond issue halved from about 6 percent to only 3 percent. These bonds were partially substituted by additional loans. Higher loan issuance also refutes the notion that Marblegate merely operated through a debt overhang channel. Running the same specifications for the placebo sample of safe firms—who should care much less about institutional features of distress resolution such as Marblegate—I find no reaction in investment nor bond issuance nor loan issuance. Conclusions remain unchanged when I estimate the full triple-DiD specification splitting firms along both bond intensity and risk.

Bond intensity as well as risk are chosen or at least influenced by management. To avoid endogenous selection in response to the ruling, DiD regressions are estimated with both features measured in the quarter right before Marblegate. Nevertheless, effects could still be driven by confounding features that co-determine i) bond-intensity and risk together with ii) the time profile of investment and debt issuance for reasons unrelated to Marblegate. To mitigate concerns of such type, I deploy an alternative identification approach exploiting firm-quarter-specific events that are unrelated to bond intensities or default risk ratings. Specifically, I estimate firm's ability to substitute into bond finance upon relationship lender balance sheet shocks, and compare this substitutability before and after Marblegate. Consistent with previous literature, I show that

6. Using the universe of US insurer bond holdings data, I confirm a given firm can expect to face wider bondholder dispersion when it increases the volume of outstanding bonds.

such shocks increase borrower's propensity to increase bond issuance. Importantly however, I find that this propensity almost collapses for shocks hitting after Marblegate, supporting the notion that it increased firms' effective cost of bond finance.

Overall, my results suggests that stronger bondholder rights predominantly elevated the ex-post distress cost of bond finance. Considering that the verdict was a mere re-interpretation of existing law, as opposed to a full-blown legal reform, the economic magnitude of effects on investment and bond issuance appear especially considerable. However, theory predicts that these effects are context-dependent and could vary across countries and time.

Other related literature. This chapter builds a new bridge between the literature on creditor rights and the literature on corporate debt structure.

A large literature has analyzed how the protection of creditor rights against the interest of borrowers drives the supply of credit, the value of collateral and firms' incentive to lever up, take business risk and innovate (Djankov, McLiesh, and Shleifer, 2007; Davydenko and Franks, 2008; Acharya and Subramanian, 2009; Haselmann, Pistor, and Vig, 2009; Acharya, Amihud, and Litov, 2011; Becker and Strömberg, 2012; Gennaioli and Rossi, 2013; Vig, 2013; Favara et al., 2017; Closset and Urban, 2019). An equally intense conflict rages *between creditors* (Welch, 1997; Bris, Welch, and Zhu, 2006; Berglöf, Roland, and Thadden, 2010; Baird, 2023). My analysis acknowledges the importance of creditor-creditor conflict, not only for ex-post but also ex-ante outcomes, emphasizing the collective action problem that better organized parties can exploit to their own benefit.

Recent cross-country studies suggests that stronger creditor rights encourage debt structure concentration across countries (Goyal, Naaraayanan, and Srinivasan, 2019; John et al., 2021), but lacks conclusive evidence on channels as well as real effects. First, I document that well-protected market creditors can encumber distress resolution, highlighting a specific mechanism consistent with the cross-country findings. That is, the common assumption of financially inflexible market debt used in corporate finance and the macro-finance literature (e.g., Bolton and Scharfstein, 1996; Bolton and Freixas, 2000; Boot, 2000; Hackbarth, Hennessey, and Leland, 2007; Berglöf, Roland, and Thadden, 2010; Crouzet, 2018) is actually subject to legal design. Second, I document real effects beyond a mere re-composition of financial structure which likely operate through a change in effective corporate discount rates (cf. Gormsen and Huber, 2023).

While relationship creditors tend to be senior to market creditors for various reasons (Welch, 1997; Gennaioli and Rossi, 2013), I look beyond the long-standing debate over merits and caveats of absolute priority, i.e., strictly honoring the claims' seniority ranking (see Schwartz, 1994; Baird, 2017). Instead, I emphasize market creditors' double-sided ex post conflict, who often face an insider coalition of both senior creditors as well as junior equity. Moreover, the rift between relationship and market creditors might well run *through* a creditor class, i.e., creating a conflict between creditors with equal priority.

A growing literature highlights how relationships can arise in corporate bond markets (Di Maggio, Kermani, and Song, 2017; Zhu, 2021; Nagler and Ottonello, 2023). Conversely, co-ordination frictions may arise among multiple banks (Brunner and Krahnen, 2008; Bellon, Harpedanne, and Pinardon-Touati, 2022).[7] Both strands of literature illustrate that there is a conceptual difference between *market* creditor and *arm's-length* creditor while relationship lending is neither tied to a specific financial organizations nor security class. Instead, the dichotomy of relationship and arm's-length lending may be more realistically conceptualized as a spectrum of hybrid approaches. My results are consistent with the view that market-based lending on average features "weaker" relationships than other forms of debt finance.

The efficiency of bankruptcy law exercises considerable influence over the size of credit markets in general, and bond markets in particular (Djankov et al., 2008; Becker and Josephson, 2016).[8] Instead, my analysis focuses on *out-of-court* restructurings opposed to court-supervised bankruptcy procedures. Like Fan (2024), I use the "Marblegate" court ruling on out-of-court exchange offers for empirical identification. While she examines behavior of distressed firms, my analysis centers firms outside distress and they response through ex-ante debt composition. By emphasizing that inefficient private restructuring will increase bankruptcy filings, I complement Donaldson et al. (2022), who highlight that more efficient bankruptcy can crowd-in private restructuring.

Large firms are prone to face creditor dispersion. Hence, well-calibrated protection of dispersed creditors is especially important for those. A growing body of evidence links the prevalence of large firms to economic development, pointing to the potential—and challenge—of realizing returns so scale (Bento and Restuccia, 2017; Chen, 2022; Kwon, Ma, and Zimmermann, 2022). My results point to the protection of dispersed creditors as one institutional ingredient to well-functioning large firms.

Structure. The chapter proceeds with a description of the institutional background and a theory in Section 2.1. Section 2.2 presents empirical results; describing the court ruling, data sources and discussing empirical identification strategy and findings. Section 2.3 concludes.

2.1 Market debt restructuring

In Section 2.1.1, I focus on the corporate bond market, which intermediates the lion's share of capital market-based business credit in the US. The theory presented in Section 2.1.2 applies to any form of market lending.

2.1.1 Institutional background

Almost half of all US corporate debt restructurings occur outside the courts (Gilson, John, and Lang, 1990; Asquith, Gertner, and Scharfstein, 1994; Moody's, 2020). Out-of-court restructurings are preferable because they avoid additional costs of a bankruptcy process. Legal and consulting fees are larger in formal court procedures and total between 1% and 10% of firm asset

7. However, loan syndicates tend to concentrate control rights in the hands of few relationship lenders who monitor and renegotiate on behalf of the entire syndicate (Berlin, Nini, and Yu, 2020).

8. The economic implications of costly distress resolution can be sizable also for the macroeconomic cycle (see, for example, Becker and Ivashina, 2022; Jordà et al., 2022; Ma and Kornejew, 2022).

value (Hotchkiss et al., 2008; Lubben, 2012). In addition, bankruptcy can inflict sizable indirect costs: A filing flags poor financial health to a wide array of stakeholders that do not usually monitor the firm's accounts. Suppliers, customers and (prospective) employees will then reconsider relationship-specific investments and disrupt operations by withholding trade credit, switch products or look for employers with superior job stability (Sautner and Vladimirov, 2017; Antill and Hunter, 2021; Elias, 2023).[9] In addition, preparations for disclosure in bankruptcy procedures and distributional conflicts between investors can distract management and undermine day-to-day operations. Existing empirical evidence indicates that these indirect costs can devour 20% of the firm's going-concern value (Hotchkiss et al., 2008; Epaulard and Zapha, 2022).

However, creditor dispersion subjects out-of-court restructuring to holdout risk (Gertner and Scharfstein, 1991; Asquith, Gertner, and Scharfstein, 1994): A small creditor can free-ride on others' concessions for re-establishing borrower solvency—while enjoying full recovery himself. Thus, an entire bloc of many small creditors can be trapped in a prisoner's dilemma in which everyone refuses to write down debt, prohibiting debt restructuring altogether. Coordination afforded by a court-supervised procedure can overcome such grid-lock and rescue a firm's going concern value. In the traditional view, this justifies the additional costs of bankruptcy (Jackson and Scott, 1989; Gilson, John, and Lang, 1990; Asquith, Gertner, and Scharfstein, 1994).

The holdout problem is particularly pronounced in the US by the *Trust Indenture Act* (TIA), a cornerstone of US securities law passed alongside other New Deal legislation in 1939. Section 316(b) prohibits amendments of "core payment terms" of corporate bond contracts—principal, coupon structure and maturity date—by a majority vote. Effectively, it grants each individual bondholder the right to refuse material restructuring of her debt—even if a majority of other investors holding bonds from the same issue would agree to change its indenture accordingly. The law was motivated by irregularities in corporate bond restructurings during the Great Depression that fell under the scrutiny of the newly formed US Securities and Exchange Commission (SEC) (Roe, 1987; Brudney, 1992). Its corresponding multi-volume report on the "Work, Activities, Personnel and Functions of Protective Reorganization Committees" states:

> "The inside group—namely, the management, the bankers, or the two together, as the case may be—is in control of the company on the eve of reorganization. It therefore starts with certain definite advantages over any other group. Accepted reorganization practices provide numerous means and devices which enable this group to maintain and further these advantages." (Securities and Exchange Commission, 1937, Part I, p. 243)

For decades to come, dispersed bond market debt could be restructured in the US only with the power and supervision of a bankruptcy court.[10] But this started to change in the 1980s, as professional distressed debt investors played an increasingly prominent role in the

9. For example, (Bucola and Bornstein, 2023) highlight that suppliers' trade credit is one of the most important form of short-term financing in the economy.

10. In fact, this was one of the original objectives pursued by the act's architects (see Baird, 2023).

riskiest segments of the (secondary) bond and loan markets (Altman, 2014). These investors—typically hedge funds or investment banks—specialized in forecasting economic potential and capital structure dynamics of distressed firms and strategically accumulated debt securities in secondary markets. Thereby, they acquired special bargaining positions and the chance to strike profitable restructuring deals. The professionalization of distress resolution gradually overturned the traditional view that bond debt could only be restructured in-court: Stronger concentration of debt and repeated interactions between distressed-debt investors overcame coordination frictions that prevented out-of-court restructuring before (Buccola, 2019; Hotchkiss, Smith, and Strömberg, 2021). Moreover, legal innovations of coercive bond exchange offers—so-called *exit-consents*—facilitated the restructuring bond debt that remained in dispersed ownership (Bratton and Levitin, 2018).

Exit-consents discourage holdouts despite the TIA's strong individual bondholder rights. They link a bond exchange to a vote over protective indenture covenants: Bondholders can *exit*—and receive cash or new securities in exchange—if they *consent* to stripping the legacy bonds off certain protections.[11] One variant is to target a parent guarantee when bonds are owed by a subsidiary with little assets. Another is to subordinate the old bonds to the newly exchanged securities (this version is analysed in detail by Gertner and Scharfstein, 1991). These votes are permissible under the TIA because they do not directly concern principal, coupon or maturity. Exit-consents leave holdouts with nominally unimpaired claims, but also fewer chances to actually collect on them. Thereby, they discourage opportunistic holdout strategies—but also compel bondholders to accept whatever is marginally better than the holdout recovery.[12] Thus, legal restrictions on exit-consents have a first-order impact on out-of-court recoveries for dispersed bondholders in general.

2.1.2 The economic role of market creditor rights

I develop a model clarifying how market creditor rights can affect a firm's financing, governance and investment policy. It illustrates the following points:

(1) Out-of-court market creditor protection can improve corporate governance but also raise the cost of financial distress by pushing firms into bankruptcy.
(2) The sign of the net effect on market borrowing and real investment is ambiguous.
(3) The net effect on market borrowing and real investment is sizable under plausible parameter calibrations.

Main mechanism. Firms can offer market creditors to exchange their securities at any time. Due to coordination failure, dispersed market creditors may fail to refuse a (coercive) debt exchange offer as long as it leaves them no worse off than bankruptcy would—for which they

11. Exchanges are often conditional on a minimum participation rate to ensure that collected votes satisfy the indentures majority requirements to legally remove the targeted covenant.

12. Out-of-court renegotiations take place "under the shadow of the bankruptcy code", i.e., are framed by the outside option of resolving distress in court. Thus, parties effectively bargain over how to share the value saved by sparing the cost of bankruptcy.

can file individually, and thus unaffected by coordination frictions.[13] This carries two implications. Firstly, debt exchanges will only occur when market debt would actually be impaired in bankruptcy.[14] Secondly, exchange offers can extract rents from market creditors as large as the dead-weight costs of bankruptcy.[15,16,17] These rents increase the pie available to relationship creditors and equity owners. To zoom in on this very conflict, I group firm owners, relationship creditors and the managers they appoint and interfere with under the single label of firm *"insiders"*—i.e., the group comprising all agents possessing important control rights over the firm in some states of the world.[18,19]

Market debt exchange rents make financial distress less dreadful for firm insiders. This creates *moral hazard* because market creditors do not monitor, and hence cannot effectively contract over, the governance of firm insiders. Instead, market creditors will guard themselves through higher rates ex-ante, making also investment success—where debt obligations can be

13. Coercive bond exchanges can force *higher* hair-cuts onto holdouts if some majority of bondholders participates (Gertner and Scharfstein, 1991). If coordination frictions prevent a majority from jointly refusing the offer, each and every bondholder will find it weakly dominant to participate as long as the value of participation above the value of holding out *individually*. Then, in equilibrium, debtors may set the pay-off for participating bondholders just right above the holdout value—in principle entirely independent of the actual going concern of the firm. Whenever bondholder can file for bankruptcy individually, the holdout value may not be smaller than the bondholder's bankruptcy pay-off. Insiders can credibly commit to refuse any bilateral negotiation with individual minority bondholders to avoid being black-mailed with a bankruptcy filing by any individual bondholder.

14. Abstracting from exchanges that update bond terms as market conditions improve.

15. In the US, any claimant can essentially file for bankruptcy individually such that any out-of-court resolution occurs "under the shadow of bankruptcy". Effectively, each party must receive at least its bankruptcy payoff and the only value to be bargained over is the dead-weight cost of bankruptcy saved in a private out-of-court restructuring. If market creditor coordination frictions are severe and very coercive bond exchanges are permissible, such exchanges can extract the entire extra value of avoiding a formal bankruptcy procedure.

16. Firms *cannot commit* to forgo rents in bond restructuring because of contract incompleteness. Arm's-length creditors face prohibitive coordination (and information) frictions to tailor contracts to evolving circumstances. Inevitably, contractual loopholes and blind spots emerge, allowing debtors and relationship creditors to undermine and hollow-out any such protective provisions written into financial contracts ex-ante.

17. A qualitatively similar mechanic emerges when assuming that bondholder have inferior information about the going concern value, i.e., the pie to be split during debt renegotiations. Appendix 2.B presents a model clarifying how rent extraction may purely be based on information asymmetries. (Morris and Shin, 2004) highlight that better information does not generally reduce the risk of coordination failure, however.

18. A large literature has analysed a wide array of important agency and information frictions within the group of insiders, shown how they matter for corporate governance along various dimensions. The mechanisms I study here does not rely on any single specific friction, but only on the fact that frictions of insider finance encourages the use of arm's-length (i.e., outside) financing. Hence, I will capture the entirety of frictions within the group of insiders through an elevation of the discount rate that governs their group-level behaviour: A insider discount rate is synonyms with higher opportunity cost of insider funds and thus induces the incentive to issue bonds in the first place. The key advantage of this approach is to be agnostic about and abstract from the exact interaction between insiders. However, potential interaction between specific insider frictions and market creditor rights calls for further research.

19. Since the vast majority of fresh corporate financing is sources via credit markets—equity issuance covers less than 10% of financing needs according to data of Erel et al. (2012)—the distinction between insider and market finance may be thought of more directly as the distinction between relationship and market-based lending.

honoured in full—less attractive. Both forces dis-incentivise firm insiders to implement costly management and monitoring measures that would increase the likelihood of business success.

The law defines the permissible set of exchange offers. Extensive out-of-court protection—tolerating nothing but a narrow set of transactions involving minor market debt impairment—will curtail insider rent extraction. This improves their incentives to keep the firm's profitability high (cf., Bolton and Scharfstein, 1996), i.e., constituting the commitment device needed to reign in on moral hazard in a way private incomplete contracts with dispersed market creditors cannot deliver. At the same time, heavily distressed firms may be forced into bankruptcy as legal constraints on exchange offers prevent necessary bond hair-cuts to be to effectuated out-of-court. That is, at the margin, optimal out-of-court bondholder protection balances ex-ante commitment gains with ex-post distress costs associated to market finance.

Model horizon. In a finite (two or three) period model, the firm's continuation value cannot be endogenized. This is an important caveat because the going concern value i) affects firm policy and distress resolution and ii) changes with market creditor rights to the extent they affect firm behaviour. Hence, *quantitative* assessment of how market rights influence firm outcomes will be more reliable if based on an infinite-horizon model that fully endogenises—and hence captures the channel running through—the firm's going concern value.

2.1.2.1 Model assumptions

In every period t, insiders choose the scale of operations $K_t \geq 0$ through investment or divestment,[20]

$$k(K_{t-1}, K_t) \; = \; K_t - (1-\delta)K_{t-1} \tag{2.1}$$

incur fire sale discounts that depend on market depth $\theta > 0$ in case of divestment[21]

$$\frac{\theta - k_t \mathbb{1}(k_t \,\geq\, 0)}{\theta - k_t} \;=\; \begin{cases} \frac{\theta}{\theta - k_t} \in [0,1) & \text{if} \quad k_t \,<\, 0 \\ 1 & \text{else} \end{cases} \tag{2.2}$$

and generate operating profits in the next period $t+1$ subject to decreasing economies of scale $\alpha \in (0,1)$,[22]

$$a_{t+1} K_t^{\alpha}. \tag{2.3}$$

Operative profitability $a_{t+1} \in \mathbb{R}$ is unknown at time t. All agents rationally expect $\overline{a} > 0$ with probability $p(a_t, M_t)$ and a less fortunate outcome $\underline{a} < \overline{a}$ with the complementary probability $1 - p(\cdot)$.[23] Probability $p(\cdot)$ depends on firm insiders' management and monitoring expenses

20. K_t is to be interpreted as the *book* value of assets.

21. Incomplete depreciation generates realistic steady-state investment rates. Asset sale discounts capture asset specificity.

22. Operating profits are sales and other income less operating expenses, including wage bill and material costs but excluding capital maintenance expenses. Stronger curvature implies higher long-term profitability, and hence models degree and dynamics of competition (Hennessey and Whited, 2005).

23. Operating profitability might be negative, i.e., $\underline{a} < 0$ is permissible.

$M_t \geq 0$, effectiveness of which may differ across states a_t. I assume that i) success probability strictly increases with management and monitoring expenses while ii) certain success is infinitely costly:

$$M_t^1 > M_t^2 \iff p(a_t, M_t^1) > p(a_t, M_t^2), \tag{2.4}$$

$$M_t \to \infty \iff p(a_t, M_t) \to 1. \tag{2.5}$$

Specifically, I stipulate the following functional form for the probability of success $p(\cdot)$, conforming with conditions (2.4) and (2.5):

$$p(a_t, M_t) = \pi + (1-\pi)\frac{M_t}{\gamma(a_t) + M_t} \qquad \text{with} \quad \gamma(a_t) = \begin{cases} \underline{\gamma} & a_t = \underline{a} \\ \overline{\gamma} & a_t = \overline{a} \end{cases} \tag{2.6}$$

where $\pi \in [0,1)$ determines the overall (ir-) relevance of management and monitoring while $\underline{\gamma} > 0$ and $\overline{\gamma} < 0$ govern its marginal effectiveness in each state.

To fund capital expenses, insiders can issue market bonds at each point in time t for unit price $P(\cdot)$, promising market creditors to pay $B_t > 0$ at $t+1$. *Actual* repayment $\tilde{B}(\cdot)$ depends on whether the realised state warrants debt restructuring.[24] Thus, the price that market bonds fetch at issuance depends on expectations about next periods actual repayment. While scale of operations K_t and market debt issuance B_t are easy to verify and contract upon, market creditors cannot effectively monitor insider governance quality M_t. Instead, they anticipate insiders' optimal policy based on the observed state and the contracted choice, i.e., $M^*(K_{t-1}, B_{t-1}, a_t, K_t, B_t)$.[25] Market bonds will thus be priced according to $P(\cdot) = P(E[\tilde{B}(K_t, B_t, a_{t+1})], M^*(\cdot))$.[26] Market creditors are risk-neutral, in perfect competition and willing to lend without limit as long as they can expect to cover their opportunity cost of funds ρ_b.

Insiders cover any remaining financing needs themselves, e.g., through credit lines, term loans or equity. In return, they extract free cash-flow in future periods, e.g., dividends and loan repayment.[27] Importantly, insiders discount future value at the exogenous rate $\rho_i > \rho_b$. This captures opportunity costs elevated above the market discount rate through obstacles specific to insider funding: agency and information frictions associated to relationship lending (e.g., Rajan, 1992; Bolton and Scharfstein, 1996; Schwert, 2020) and equity issuance (e.g., Myers and Majluf, 1984), but also limited owner wealth and bank balance sheet constraints. This is a stark simplification. But it appears to be an elegant way to summarize complex incentives without

24. Restructuring outcomes depend on—and thus will be explained after—the firm's value function.

25. Market creditors effectively know the equilibrium effort choice, but they cannot commit insiders to choose a possibly value-enhancing higher effort level if that would give insiders the incentive to deviate after issuance.

26. Further details are presented later alongside assumptions on restructuring and bankruptcy.

27. Insiders may re-negotiate of their contractual relationships at any time, e.g., allowing banks to accommodate distressed firms or squeeze profitable ones.

wedding the model to a specific mechanism.[28] Ultimately, insiders seek to balance cost of insider finance against the cost of restructuring distressed bond debt (see Bolton and Scharfstein, 1996; Crouzet, 2018).

Risk-neutral insiders maximize their expected discounted payouts by selecting scale of operation, bond issuance, and corporate governance (K_t, B_t, M_t) conditional on past investments, legacy bond debt as well as current profitability (K_{t-1}, B_{t-1}, a_t) with initial conditions $K_{-1} = B_{-1} = 0$. Insiders will file for bankruptcy and receive $V_C(\cdot)$ in court if operating the firm carries a lower (expected) value.[29] Taken together, the insiders' value function $V(\cdot)$ satisfies the following Bellman equation:

$$\begin{aligned} V(K_{t-1}, B_{t-1}, a_t) \;=\; \max \Bigg\{ & V_C(K_{t-1}, a_t), \\ & \max_{K_t, B_t, M_t} \Bigg(a_t K_{t-1}^{\alpha} - k(K_{t-1}, K_t) \frac{\theta - k\mathbb{1}(k \geq 0)}{\theta - k} - M_t \\ & \quad - \tilde{B}(K_{t-1}, B_{t-1}, a_t) + P(a_t, K_t, B_t, M_t^*) B_t \\ & \quad + \frac{1}{\rho_i} \Big[p(a_t, M_t) V(K_t, B_t, \overline{a}) \\ & \qquad + \big(1 - p(a_t, M_t)\big) V(K_t, B_t, \underline{a}) \Big] \Bigg) \Bigg\} \end{aligned} \tag{2.7}$$

In bankruptcy, the (going concern) value of the firm is $V(K_{t-1}, 0, a_t)$. This value is always non-negative and nests the option to liquidate ($K_t = 0 \; \forall t$). I assume that the bankruptcy process devours fraction $\beta \in (0,1)$ of the going concern value as dead-weight loss and splits the remaining value according to absolute priority: Insider claims are junior to market debt except secured claims totalling some fraction $\omega \in (0,1)$ of book assets K_{t-1}.[30] That is, insiders receive[31]

28. In the background, I assume insiders to optimally compose equity and relationship lending in a way that balances issuance cost and information frictions in equity finance with elevated intermediation and monitoring cost, hold-up and soft-budget-constraint problems associated with relationship credit. Ultimately, these costs force the firm to forgo investments that would have a positive net present value in absence of these frictions, i.e., when financed with arm's-length bonds. They are thus a simple modeling device to implicate insider agency frictions without imposing a selected mechanism while keeping the model tractable.

29. Further details are presented alongside other restructuring and bankruptcy assumptions below.

30. I interpret ωK_{t-1} as banks' first-lien and revolving debt claims, which receive priority over bond market claims in bankruptcy—in order to minimise agency frictions *among* insiders (contain management moral hazard and create incentives to monitor in the first place Diamond, 1993; Park, 2000) and limit bankruptcy litigation costs (Welch, 1997). These mechanisms are beyond this model so ω is exogenous. If endogenised, insiders would *always* set $\omega = 0$: It redistributes ex-post from market creditors to insiders and because insiders have higher discount rates than market creditors, the market debt price today increases by more than the expected continuation value from the perspective of insiders. Moreover, by reducing market creditor recovery in bankruptcy, higher ω expands the set of states in which out-of-court restructurings are restrained by the legislator, risking additional bankruptcy dead-weight losses, see the description of how bankruptcy and out-of-court restructuring are modelled.

As a consequence, I have to assume that insiders' incentive to tame internal agency friction by placing some of their claims senior (ω) is by and large invariant to changes in *out-of-court* market creditor rights. Relaxing this assumption, however, is seems worthy of future research.

31. Strictly speaking, there is another outer max operator, comparing the min with the bankruptcy pay-out in case market debt could be honoured in full, i.e., $V(K_{t-1}, 0, a_t)(1-\beta) - B_{t-1}$. This is superfluous in the model however,

$$V_C(K_{t-1}, a_t) = \min\{\omega K_{t-1}, V(K_{t-1}, 0, a_t)(1-\beta)\} \tag{2.8}$$

Market creditors receive the remainder $V(K_{t-1}, 0, a_t)(1-\beta) - V_C(K_{t-1}, a_t)(\leq B_{t-1})$, defining their reservation value for accepting any out-of-court debt exchange offer in the absence of regulation. Crucially, I assume that the market debt recovery rate from an exchange offer must not fall short of $\Lambda \in [0,1]$, capturing **market creditor protection**. Given these bounds, insiders will engage in out-of-court restructuring only if profitable, and thus effectively need to repay[32]

$$\tilde{B}(K_{t-1}, B_{t-1}, a_t) = \min\left\{B_{t-1}, \max\left\{V(K_{t-1}, 0, a_t)(1-\beta) - V_C(K_{t-1}, a_t), \Lambda B_{t-1}\right\}\right\}. \tag{2.9}$$

Risk neutral market creditors price bonds at their expected returns discounted by their opportunity cost of funds ρ_b, spelled out in Appendix 2.A.1 Equation 2.A.1.

2.1.2.2 Model implication

Solution of the model boils down to solving the Bellman equation (2.7), corresponding policy functions of which prescribe optimal investment, financing and management policy of the firm.

The link between success probability p and management and monitoring intensity M_t specified in Equation allows me to derive a closed-form solution for effort conditional on bond issuance and investment directly from the first-order condition of the maximization in (2.7):

$$\frac{\partial p}{\partial M_t} = \frac{\rho_i}{V(K_t, B_t, S_t, \overline{a}) - V(K_t, B_t, \underline{a})} \quad \text{for} \quad M > 0 \tag{2.10}$$

$$\Rightarrow M^*(a_t, K_t, B_t) = \max\left\{0, \sqrt{\frac{\gamma(a_t)}{\rho_i}(1-\pi)\Big(V(K_t, B_t, \overline{a}) - V(K_t, B_t, \underline{a})\Big)} - \gamma(a_t)\right\} \tag{2.11}$$

In addition to saving considerable computational resources during numerical solution, expression (2.11) facilitates insights into how bondholder protection can reign in on moral hazard and increase bond issuance.

In the remainder of this Section, I first describe the model mechanisms underpinning the trade-off for market creditor protection between ex-post cost of default and ex-ante discipline. I then present the numerical solution and calibration procedures. Finally, I explore counterfactual predictions for alternative market creditor rights regimes using comparative statics. Additional details to each of these steps can be found in Appendix 2.A.

as insiders will never file for bankruptcy in these cases in the fist place—honouring market debt in full out-of-court spares the bankruptcy dead-weight loss.

32. The option to file for bankruptcy protects market debt against exchange offers in good states, in which the going concern value less bankruptcy cost is larger than what is owed to bondholders. In bad states, the legal constraint helps to prevent market creditors being always pressed against their bankruptcy reservation value.

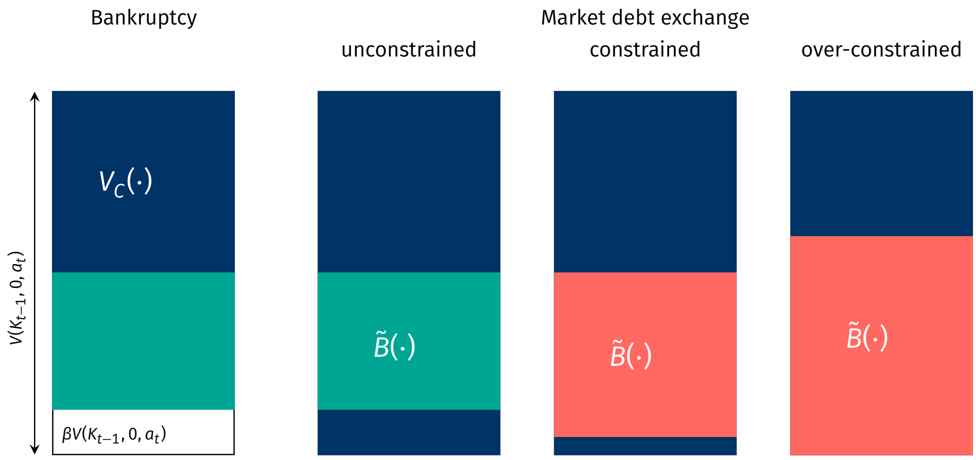


Figure 2.1. The effect of market creditor protection on out-of-court restructuring

Notes: Schematic illustrations of how different levels of market creditor rights affect the distribution of value in market debt exchanges and may push insiders to file for bankruptcy, increasing the cost of default.

Market creditor rights and ex-post cost of default. To understand how out-of-court market creditor protection affects ex-post cost of default, consider equation (2.9) together with the Bellman equation, both of which summarize the decision to file for bankruptcy:

$$V(K_{t-1}, B_{t-1}, a_t) \; = \; \max \left\{ V_C(\cdot), V(K_{t-1}, 0, a_t) - \tilde{B}(\cdot) \right\} \tag{2.12}$$

When firm value is large, insiders are effectively unable to cut market debt and thus $\tilde{B}(\cdot) = B_{t-1}$. When firm value is sufficiently small, however, three qualitatively distinct cases may arise. They are illustrated in Figure 2.1. In the first, legal constraints are too lax to affect out-of-court market debt exchanges such that market creditors will receive exactly their bankruptcy reservation value. Notably, insiders are able to extract extra value equal to the dead-weight loss of bankruptcy. In the second case, laws constrain out-of-court bond exchanges, but the additional value which market creditors receives is less than the bankruptcy dead-weight. Hence, insiders still benefit from restructuring bond debt out-of-court relative to a bankruptcy filing. Finally, if market creditors protection is too strong for the prevailing circumstances of a distressed firm, out-of-court bond exchanges would have to grant bondholders a recovery which leaves insiders with less value than what they can expect to obtain in court. That is, market creditor rights inflict additional cost of default by prompting insiders to file for bankruptcy.

Firms become over-constrained in their out-of-court exchange offer when legacy contractual market debt debt B_{t-1} exceeds threshold $\Lambda^{-1}(V(K_{t-1}, 0, a_t) - V_C(\cdot))$. That is, strengthening market creditor protection tightens limits on market debt beyond which default costs increase due to bankruptcy dead-weight losses. For additional algebraic details, see Appendix 2.A.1.

Market creditor rights and ex-ante discipline. To understand how out-of-court market creditor rights can reign in on moral hazard and promote market bond issuance, consider first the response of insider value to additional market debt absent bankruptcy risk:[33,34]

$$\frac{\partial V}{\partial B_t} = \underbrace{\left(\frac{1}{\rho_i} - \frac{1}{\rho_b}\right)}_{<0} \underbrace{\left[p(a_t, M_t)\frac{\partial V(\cdot, \overline{a})}{\partial B_t} + \left(1 - p(a_t, M_t)\right)\frac{\partial V(\cdot, \underline{a})}{\partial B_t}\right]}_{<0} + \underbrace{\frac{\partial P(\cdot)B_t}{\partial M^*}}_{>0} \underbrace{\frac{\partial M^*}{\partial B_t}}_{\leq 0} \tag{2.13}$$

Under bankruptcy risk, the first summand becomes *negative* for non-negligible bankruptcy dead-weight because market creditors will receive less in expectation than insiders pay out. Taken together, insiders will issue market debt until the risk of bankruptcy looms—except when moral hazard drives down the price of market debt too much before that point.[35]

What determines the magnitude of moral hazard effects $\frac{\partial M^*}{\partial B_t}$? Considering equation (2.9), market debt repayment will react one-for-one to bond issuance in financially healthy states where market debt is honoured in full. By contrast, it will increase by only $\Lambda \in [0, 1]$ if regulation binds and will not react at all if debt exchanges occur in unconstrained fashion. Hence, the differential effect of market debt on future values will be zero if market debt is sufficiently small so that it can be honoured in full in *both* states.[36] For all intermediate levels, the differential effect of bond debt on future states will be negative and equal $-\mathscr{A}$ under unconstrained debt exchanges and $-\mathscr{A}(1-\Lambda)$ for constrained or over-constrained debt exchanges. For a precise definition of $\mathscr{A}$ see details in Appendix 2.A.1. That is, as market creditor rights bind and tighten, moral hazard shrinks towards zero, increasing market debt issuance.

Note that the value of market debt issuance changes with Λ only due to moral hazard. This will lead to a non-monotonic reaction to expanding market creditor rights: Once moral hazard is shrunk beyond the state-specific threshold, firms will lever up with bond debt until the next unit would provoke bankruptcy dead-weight costs. Ultimately, the jump is due to the discrete nature of the profitability state space carrying positive point masses. A continuum of profitability states, by contrast, would imply a continuum of thresholds such that effects on market debt issuance cumulate continuously with growing Λ.

Market debt and firm investment. In the model, insider agency frictions captured by ρ_i effectively reduce investment compared to a hypothetical firm fully funded with market-based debt. Market debt can circumvent these frictions by substituting the applicable discount rate to the proportion in which *marginal* continuation value is pledged to market creditors. Effectively, market finance allows firm insiders to sideline their agency frictions and move the corporate

33. If bankruptcy dead-weight costs are sufficiently large, the firm will always manage avoid bankruptcy in equilibrium due to the binary profitability state space.

34. Derivation of Equation (2.13) builds on the first order condition for bond issuance together with some intermediate steps, all of which are detailed in Appendix 2.A.1.

35. Remember that market creditors will anticipate any moral hazard and demand yield compensation today, by lowering the price at which they are willing to buy newly issued market debt.

36. Theoretically, market debt may be so large as to trigger debt resolution in *both* states, in which case the differential effect of market debt on future values will be zero as well. For $\alpha \in (0, 1)$, this would lead to bond-to-asset ratios of above 1. These equilibria are infeasible if insider governance is sufficiently sensitive, i.e., moral hazard is non-negligible, see Equation (2.A.6) in Appendix 2.A.1.

discount rate closer to the market discount rate. A detailed analysis can be found in Appendix 2.A.1.

Numerical solution. I solve the model using value function iteration, plugging the closed-form solution for M^* of Equation (2.11) into bondholders willingness to pay given by Equation (2.A.1) found in Appendix 2.A. My initial guess for the value function iteration is $V(K_{t-1}, B_{t-1}, a_t) = 0 \, \forall (B_{t-1}, K_{t-1}, a_t)$. Hence, the equilibrium will correspond to that of a model where the firm faces a distant terminal period, after which the firm's value is zero. More details can be found in Appendix 2.A.2.

Calibration. The calibration targets key moments of risky *compustat* firms (S&P entity rating BBB- or worse) over the decade 2010Q1 to 2019Q4. Details are described in Appendix 2.A.3 alongside Table 2.A.1 showing calibrated parameter values.[37]

Figure 2.2 compares selected empirical moments to those of simulated model data. Panel 2.2a presents averages for the market debt share and operating profitability (model counterpart: $a_t K_{t-1}^{\alpha}/K_{t-1}$) as well as moments characterising its dispersion. The calibrated model matches baseline balance sheet metrics almost perfectly: The average bond intensity is 27.95% (27.55% in the data) and average profitability is 2.81% (2.73% in the data). Equally important, it realistically captures extreme profitability events: Under low (high) profitability, operating profits relative to assets averages to −18.8% (3.4%) in the model. In the data, I can split the distribution of profit rates such that averages of both partitions, −18.9% and 3.0%, come very close.[38] The 95%-confidence interval for the empirical probability to transition from the higher into the lower profitability partition is [0.49%, 0.66%]. In the model, this probability endogenously depends on governance quality and averages at 0.63%.

Panel 2.2b compares Kaplan-Meier survival estimates of expected probabilities for spells of low profitability to exceed a given duration. In the data, low profitability is defined as before, i.e., the partition of the profitability distribution whose mean matches the corresponding model moment. The simulated data spells track the distribution of empirical spell durations reasonably closely. Probabilities for spells to persist beyond the first five quarters are slightly higher in the model but are compensated by higher exit probabilities thereafter. Taken together, the expected duration of low profitability spells stands at about five quarters in the model and does not deviate significantly in the data.

37. Naturally, magnitude and pattern of model predictions are sensitive to calibration choices. Rigorous structural estimation—even if it was less computationally burdensome than it would be in this case—cannot reliably clear quantitative ambiguity as it still may be corrupted by features entirely artefact to model choices taken for the sake of tractability. For this reason, I turn to reduced-form estimation exploiting an unexpected change in jurisprudence which substantially strengthened the protection of bondholder rights.

38. Overall, profitability states are slightly more spread out in the model. This is necessary to match other moments, especially to prevent overshooting in the high-low transition probability and the bond share.

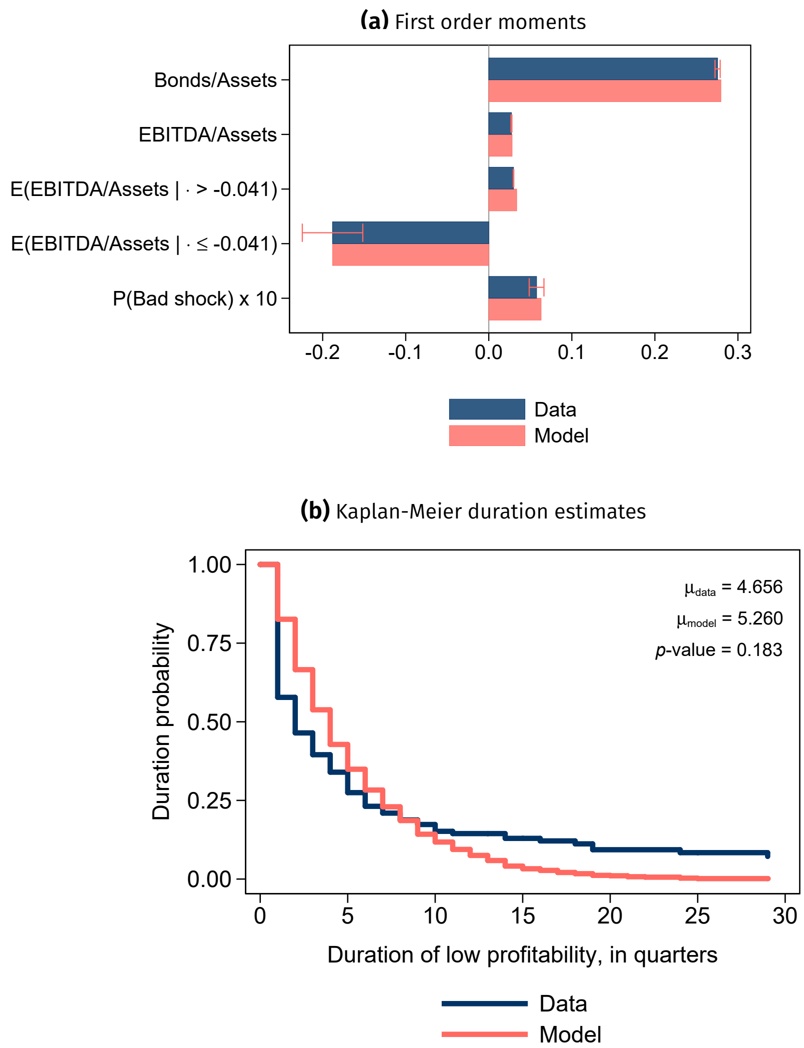


Figure 2.2. Moments from model simulations and empirical counterparts

Notes: Comparing moments from 5000 model firms simulated for ten years (40 model periods) to empirical counterparts from quarterly compustat data on risky nonfinancial firms (S&P rating BBB or worse) for the decade starting 2010Q1. Top panel: Averages of four continuous variables and one binary variable. Whiskers mark 95% confidence intervals for empirical moments. A *bad shock* refers to a shift from the fortunate into the unfortunate profitability regime, i.e., $a_t = \underline{a} | a_{t-1} = \overline{a}$ in the model and $\text{EBITDA}_t / \text{Assets}_t \leq x \mid \text{EBITDA}_{t-1} / \text{Assets}_{t-1} > x$ in the data. Bottom panel: Kaplan-Meier survival estimates for the duration of low profitability spells. Average spell durations for data and model displayed in the top right corner alongside the p-value of a test on their equality.

Comparative statics across regimes of different market creditor rights. How do firm outcomes change across different degrees of bondholder protection? I keep all parameters at their calibrated baseline values and vary Λ. The resulting comparative statics are shown in Figure 2.3: For each value of Λ, it plots the firm's average bond debt and capital stock from 5000 firms simulated for 40 model quarters. As bond haircuts get compressed in out-of-court bond exchanges, neither bond issuance nor investment reacts initially. However, once bondholder rights push the effective (moral hazard) cost of bond finance below the excess cost of insider finance, bond issuance shifts into a new equilibrium (levering up to the point where the next unit would trigger bankruptcy upon and unfortunate profitability shock), making additional investments profitable. Where exactly the shift occurs depends on parameters including ρ_i, $\gamma(a_t)$ and π, all of which plausibly vary empirically across individual firms within the population of firms. Hence, the aggregate response is likely to look more hump-shaped, depending on the distribution of those parameter constellations.

Once bondholder protection overcomes insider moral hazard, further strengthening only adds constraints to ex-post bond exchanges, increasing the expected cost of distress for any given bond leverage. In response, firms shrink their bond issuance, gradually this time, and curtail investment. Total firm value tracks the pattern of capital very closely and is displayed in Figure 2.A.1 in Appendix 2.A.4

The net effect on total assets (and hence investment) is ambiguous. Reforming market creditor rights regimes may change capital stocks by -4.4% to +13% relative to the baseline ($\Lambda = 0.57$). Given that the aggregate of assets held by high-yield-rated public firms stands at about 150% of GDP, aggregate wealth gains may be considerable. Similarly, effects observed for bond issuance could imply growth in the aggregate corporate bond market between -15% and +45%, considering that outstanding high-yield issues account for about a third of overall market by volume. However, the aggregate can be influenced by amplifying or dampening general equilibrium feedback as well as the distribution of firm-specific sensitivity points. Dispersion thereof will attenuate the economy-wide effects relative to largest firm-specific impact.

To summarise, the economic impact of market creditor rights is possibly large but its direction is a-priori ambiguous. Knowing on which side of the curve a given institutional setup resides indicates the desirable nature of reform.

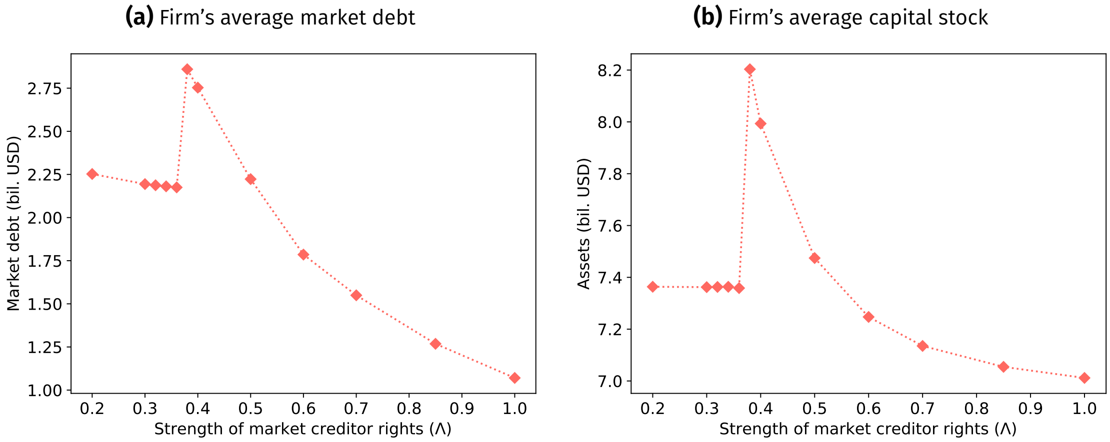


Figure 2.3. Potential effects of market creditor rights on finance and investment

Notes: Comparative statics across Λ; average across a firm's life-cycle obtained from 5000 model firms simulated for ten years (40 model periods). Units scaled such that average capital in the baseline ($\Lambda = 0.57$) matches compustat's average asset value in US Dollars for risky nonfinancial firms.

2.2 Evidence on the economic role of market creditor rights

In this section, I describe the US court verdict which expanded market creditor rights in 2014, outline data sources, discuss my identification strategy and present the evidence on the verdict's economic ramifications. I group the latter into whether they concern outcomes ex post or ex ante of distress.

2.2.1 The Marblegate ruling

In *Marblegate Asset Management v. Education Management Corp*, the bondholder *Marblegate Asset Management* sued against an exit-consent transaction proposed by a coalition of the distressed debtor *Education Management Corp* and its secured term-loan creditors. The debtor business—founded in 1962 and growing into one of the largest for-profit providers of US college and graduate education with more than 20,000 employees—consisted of a holding company liable for 1.3 billion USD of secured term loans and a subsidiary liable for 500 million USD of unsecured bonds. Marblegate Asset Management was a minority bond investor, holding par value of 14.3 million USD.

When Education Management slid into financial distress in 2014, it commenced negotiations with secured term loan creditors. Negotiations resulted in a restructuring support agreement (RSA) which, among other things, offered bondholders to exchange their claims for new bonds with an effective recovery of roughly 33%. To discourage bondholders from holding out, the RSA stipulated the following exit-consent transaction: In case of any hold-outs, secured term lenders would release the parent holding of loan guarantees, triggering an indenture-conform cancellation of the bonds' parent guarantee via an extant intercreditor agreement. Then, secured term lenders would foreclose on the company's assets—including assets of the subsidiary liable for bond debt—and immediately sell to a newly formed subsidiary. Consenting bondholders would receive new claims against the newly formed subsidiary. Dissenting bondholders, by contrast, would be left with a nominally unimpaired, yet effectively worthless claim against an empty corporate shell.

Marblegate Asset Management held out and sued against the coalition in October 2014 at the Court of the Southern District of New York.[39] It essentially claimed that the bond exchange offer was overly coercive. After hearings and other proceedings in November, the court shared an opinion with both parties on December 15, which went into effect on December 30, 2014. Broadening the interpretation of the Trust Indenture Act Section 316(b), the court largely sided with bondholders:[40]

> *The record before this Court, however, leaves little question that the Intercompany Sale [moving foreclosed assets out of reach for dissenting bondholders] is precisely the type of debt reorganization that the Trust Indenture Act is designed to preclude. [...] The Court cannot accept an interpretation that is neither mandated by the statute's text nor remotely in conformity with the statutory purpose and legislative history. [...]*
>
> *This Court is not so naïve as to think that establishing Plaintiffs' ultimate right to full payment will not pose problems for the Proposed Restructuring. [...] Yet, whatever the ultimate cost to [the debtor], its creditors, its employees, and its students, the Trust Indenture Act simply does not allow the company to precipitate a debt reorganization outside the bankruptcy process to effectively eliminate the rights of nonconsenting bondholders.*

The verdict wielded implications far beyond the original case and prompted extensive press coverage, law firm client briefs and academic debate (Chapman and Cuttler LLP, 2015; New York Times, 2015a; Reuters, 2015; Wall Street Journal, 2015; Roe, 2016). Perhaps most importantly, the verdict was unanticipated: Members of the US National Bankruptcy Conference noted that

> *[Marblegate] can be viewed as making out of court restructurings involving bonds covered by the [Trust Indenture Act] by a less than unanimous bondholder vote more difficult than previously thought. (National Bankruptcy Conference, 2015, emphasis added)*

revealing how the verdict upended the prevailing understanding and expectations about how existing law is applied.

The plaintiff, *Marblegate Asset Management*, was a hedge fund accumulating distressed debt to seek the risk-return of active restructuring engagement. However, the court's ultimate concern lay with bondholders of the garden-variety: institutional wealth managers like insurers or

39. The Southern District of New York is the most important bankruptcy court in the US alongside Delaware and the Southern District of Texas.

40. While the court made its objections clear at this point and ordered the Education Management Corp parent to continue to guarantee the bond debt, the final verdict condemning the transaction to run afoul of the Trust Indenture Act was officially issued on June 23, 2015.

pension funds as well as retail investors, who invest in bond markets for portfolio diversification purposes, that is, precisely to avoid debtor-specific monitoring and concentrated financial exposure. Lacking both the relationship as well as coordinative capacity to effectively participate in restructuring negotiations, they often see no better option than to sell to professional distressed debt investors once distress depresses the value of their securities. Hence, the ruling was driven by the desire to "give courts broad power to police workouts" (Bratton and Levitin, 2018) and ensure that arm's-length bondholders receive a more equitable share of the gains from avoiding the cost of bankruptcy.[41] As such, the verdict was not motivated by concurrent economic considerations. For example, there no single mentioning of economic terms like "corporate investment" (or variations thereof), "economic activity", "employment", "recession", "growth".

While the court acknowledged the risk posed to out-of-court restructurings, it emphasised its interpretation of the original intention of the law. However, market observers did worry about elevated default costs as firms would be pushed into bankruptcy instead of restructuring debt swift and smoothly out of court:

> *Ultimately, the largest take-away is that minority bondholders may now have increased leverage when negotiating with issuers and other creditors, and troubled companies and their creditors will therefore likely have to reconsider what they can accomplish in an out-of-court restructuring on a non-consensual basis, without resorting to the filing of a bankruptcy petition. (Chapman and Cuttler LLP, 2015)*

The defendants filed the verdict for review in the Second Circuit Court of Appeals.[42] In a contentious two-vs-one decision, the higher court largely overturned the original Marblegate ruling on January 17, 2017. For this reason, my main analysis focuses on the original ruling of Dec 30, 2014 and the two-year sample until the end of 2016. A perceived positive probability of overturning renders estimates conservative.

The Second Circuit ruling itself is of narrower statistical value for three reasons. First, the overturning was partial in the sense that the Court of Appeals left uncertainty as to whether exit-consent transactions could target parent guarantees in the same way as they used to do (Millar, 2017; Bratton and Levitin, 2018). Second, after the original verdict sparked attention, anticipation effects accompanying the appeal process and adjustment measures taken in the meantime muddy economic impacts of the 2017 verdict. Finally, the split decision will have made market participants might have become wary about similar policy shifts or according use of judge discretion in the future. However, Appendix 2.D.2 repeats the key event studies for the Court of Appeals ruling and documents a consistent reversal of effects.

41. The larger the cost of bankruptcy, the more does the balance of power affect the distribution of value out-of-court. In fact, in the case of EDMC, the cost of bankruptcy would have been disastrous because a formal bankruptcy filing would have jeopardized an important source of revenue from the Department of Justice, so-called Title IV funding. This made the out-of-court conflict over value especially intense, cumulating in litigation.

42. At the end of 2015, US congress lobbying attempted to overturn the courts decision through legislation but failed last minute (New York Times, 2015b).

2.2.2 Data

I explore firm-level balance sheets, cash flow statements, income statements, bankruptcy filings, data on bond issuance, returns, ownership and default recovery rates and information on loan issuance and lending relationships to build separate data sets. Throughout the analysis, I exclude financial firms (NAICS code 52) and public administration (NAICS code 9) and use the following notation: f indexes firms, q marks the quarter of the observation.

Quarterly firm financial statements are sourced from Standard & Poor's *compustat* merged with more detailed information on the debt structure in *CapitalIQ*. I match dates and auxiliary data for all bankruptcy filings in the sample between 2013Q1 and 2018Q4 covered by New Generation Research's *bankruptcydata.com*.[43] In addition, I aggregate bond issuance from Mergent's FISD at the issuer-quarter level and match them to GVKEY-quarters via correct historical CUSIP-6 identifiers.[44]

To measure the actual dispersion of bondholdership, I can draw on the data from the National Association of Insurance Commissioners (NAIC) detailing the (corporate) bond portfolio for each an every insurance company in the US. The S&P *CapitalIQ* CUSIP-9 link allows me to consolidate the information at the firm level, gauge the size distribution of each firm's bond holdings and relate it to firm-level variables based on *CapitalIQ* or *compustat*.

Data on bond restructurings and associated recovery rates are sourced from Moody's Default and Restructuring Database.

For auxiliary analyses documented in Appendix 2.C, I use Refinitiv's *DealScan* database and associated linking tables updated from Chava and Roberts (2008) to identify lending relationships and measure lenders' financial health with Standard & Poor's SNL data via a name matching algorithm. Moreover, I obtain monthly bond returns from the TRACE database in the version compiled by WRDS to which I merge information about monthly bond ratings, bond maturity and covenants as well as issuer characteristics from Mergent's FISD.

2.2.3 Exposure to Marblegate and empirical identification

The Marblegate verdict affected debt restructuring by increasing bondholder protection,which affected different groups of firms differentially. First, regulation of distress resolution should concern firms only if they face default risk. Second, even risky firms should have been insensitive if bond markets were irrelevant to their financing. Taken together, firms' exposure to Marblegate should grow in the firm's

- default risk, and
- bond debt relative to asset value

both of which can be measured from ratings and balance sheet data.

The differential reaction of high-exposure firms compared to low-exposure peers can shed light onto the impact of Marblegate and hence the economic effects of stronger market creditor

43. I merge information using CIK identifiers of SEC filings linked to GVKEY identifiers by WRDS.
44. I use linking information provided via *CapitalIQ* to track changes in CUSIP-GVKEY affiliation over time.

rights.[45] Associated difference-in-differences estimates can be interpreted based on the following three considerations.

First, broader economic shocks may confound Marblegate's effects on investment of borrowing activity. Fortunately, the macroeconomic environment was stable and rather favorable at the time as evidenced in Appendix 2.C.1.[46]

Second, a firm's default risk and bond intensity correlates with other firm characteristics, including unobservable ones. Measuring default risk and bond intensity right *before* Marblegate renders such correlation innocuous for the identification of Marblegate's effects—unless: i) Marblegate coincides with another relevant shock or ii) confounding firm characteristics alter the firm's *sensitivity* to market creditor rights. The first concern is mitigated by the tranquil macroeconomic environment at the time—but can never be fully ruled out. Similarly, there is no obvious confounder fitting the second concern, but absolute elimination is likewise impossible. To simultaneously address these issues, I report results from an alternative empirical approach in Section 2.2.5.5 whose identifying assumptions do neither rely on the exact date of the Marblegate ruling nor on measures of bond intensity or risk. Specifically, I investigate firms' propensity to switch to bond market finance upon an adverse shock to the balance sheet of their relationship lender (Becker and Ivashina, 2014, and others). Comparing such firm-quarter-specific shocks occurring at some point before Marblegate to similarly sized shocks occurring sometime thereafter tests for any change in the marginal appeal of bond finance that could be attributed to the ruling.

Third, when bonds are in concentrated ownership, coercive debt exchange offers are irrelevant for effectuating out-of-court debt debt restructuring: large bondholders can engage and preserve their interests in negotiations with the debtor and other creditors, see Section 2.1.1. Hence, bond intensity is a valid measure of exposure only if it correlates well with bondholder dispersion. I test this below.

There is no exhaustive US micro data on bond ownership—except for the insurance industry. Insurers are the single most important class among US corporate bond investors (Koijen and Yogo, 2023) and security-level portfolio data from the US National Association of Insurance Commissioners allows me to calculate firm-level bondholder dispersion *within insurer holdings*. Yet, insurers still account only for about a third of all outstanding US corporate bonds, and even less within the segment of risky high-yield bonds. Thus, constructing a meaningful measure from the NAIC data requires the assumption that the distribution of individual positions among insurers is roughly representative—or at least independent—of the distribution among other classes of owners: mutual funds, hedge funds, banks and the household sector. This assumptions appears plausible enough to assess rough correlations.

45. The theory presented in Section 2.1.2 suggests that effects will go in different directions for different firms, depending on whether ex-ante disciplining or ex-post complications dominate. Analyzing potential effect heterogeneity across firms appears to be a promising route for future investigations.

46. In mid 2014, oil prices dropped and triggered financial distress among US oil and gas producers, refineries and pipeline operators. I confirm that my results are not driven by distress in these sectors by excluding them in robustness checks shown in Appendix 2.D.1. Any reductions in input costs for other sectors would go against the negative repercussions I am documenting for Marblegate.

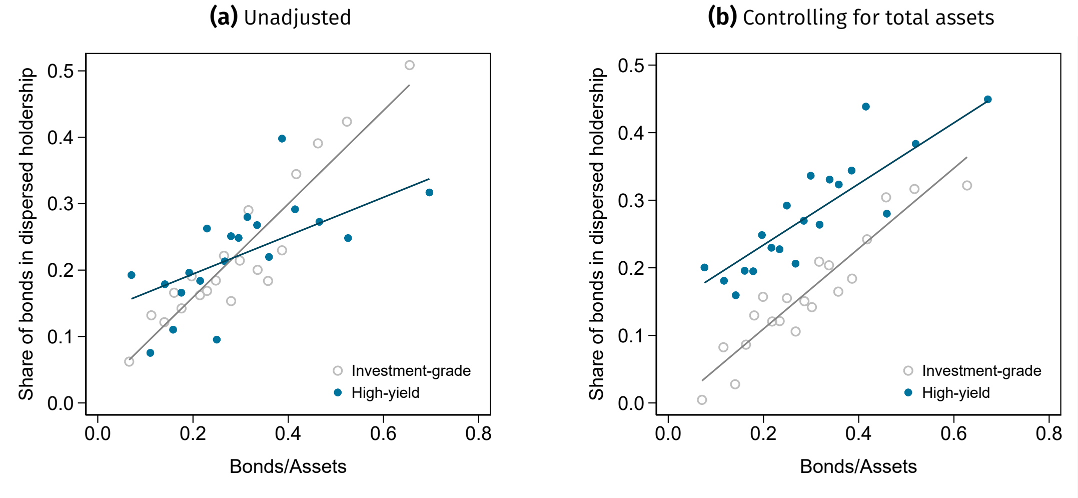


Figure 2.4. Bond intensity and bond ownership dispersion

Notes: Binned scatter plots of firm-level data for 2014 Q4; right panel controls non-linearly for firm size measured by its decile in the cross-sectional distribution of asset values. Bond dispersion (y-axis) is defined as the share of a firm's bond debt spread over positions individually holding less than 0.1%. It is proxied using NAIC data on individual insurer bond portfolios, assuming that the holding size distribution of insurers is representative for other sectors (mutual funds, banks, households, and foreign investors).

Figure 2.4 shows binned scatter plots relating a firm's bond intensity to its bond dispersion as measured by the share of the firm's bond debt spread over positions individually holding less than 0.1% of the firm's total outstanding bonds. The data concerns 2014 year-end values and is split by S&P's long-term issuer rating of default risk. The right panel controls non-linearly for firm size measured by its decile in the cross-sectional distribution of asset values. Irrespective of the perspective—and especially even after controlling for firm size—there is a strong positive association between bond intensity and bond dispersion.[47]

Beyond aforementioned shortcomings, contemporaneous bond dispersion is an imperfect measure of exposure to Marblegate because bonds are easily traded in secondary markets: bond dispersion today will be an unreliable measure of bond dispersion when debt restructuring becomes necessary. Instead, the volume of outstanding bond debt indicates the expected dispersion at restructuring.[48] Relative to total assets, it will measure expected reorganisation risks posed by hold-outs.

47. Interestingly, dispersion tends to be even larger for high-yield bond issuers after accounting for the fact that they tend to be smaller than investment-grade firms.

48. Even when normalised by firm size, the left panel of Figure 2.4 confirms a strong correlation with bond dispersion.

2.2.4 Effects of Marblegate on distress resolution

The ultimate intention behind the Marblegate ruling was to raise bondholders' recovery in distressed bond exchanges. But commentators warned at the time that it also would exacerbate the hold-out problem in private bond exchanges and force more distressed firms into a formal bankruptcy procedure.[49] In this subsection, I provide evidence for both higher out-of-court recovery as well as increased bankruptcy filing rates.

Figure 2.5 illustrates outcomes of 130 out-of-court distressed bond exchanges between 1990 and 2020 in the US, details on which are covered by Moody's Default and Restructuring Database. The left panel plots the recoveries of bonds against the total recovery for all debt claims, which can be interpreted as a measure of overall distress severity. Non-parametric local regression estimates plotted in dashes suggest a positive and essentially linear relationship between bond recoveries and total recoveries. Importantly, under Marblegate bond recovery rates increase *conditional on total recovery*. The effect strengthens as the distributional conflict between claimholders intensifies. This is consistent with the prediction Marblegate protected bondholders against coercive bond exchanges. In fact, Figure 2.C.3 in Appendix 2.C suggests that much of the higher average bond recoveries are driven by *lower participation* in exchange offers, e.g., hold-outs.

To test statistical significance within that set of 130 observations, I estimate

$$\text{bondrecovery}_i = \beta_0 + \sigma_{\text{sector}(i)} + \tau t_i + \beta_1 M_i + \beta_2 \text{totalrecovery}_i + \beta_3 (M_i \times \text{totalrecovery}_i) + e_i \tag{2.14}$$

where $\sigma_{\text{sector}(i)}$ filters industry-specific differences at the NAICS 1-digit level and τt_i captures any linear time trend in bond recovery rates from out-of-court exchange offers. The right panel of Figure 2.5 plots $\hat{\beta}_1 M_i + \hat{\beta}_2 \text{totalrecovery}_i + \hat{\beta}_3 (M_i \times \text{totalrecovery}_i)$ across different levels of total recovery alongside its 95% confidence intervals. Conditional on industry fixed effects and time trend, estimates indicate a statistically significant tilt induced by Marblegate in the relation between bond recovery and overall recovery to the benefit of bondholders was also statistically significant.

Figure 2.6 presents evidence suggesting that emboldened hold-outs indeed pushed additional firms into bankruptcy to restructure bond debt. It shows average Chapter 11 filing rates across groups of firms differing by financial distress and bond intensity, comparing the two-year period preceding with the two years after the Marblegate verdict. Conditioning on firm-quarter-specific financial distress—measured via classical Altman (1968) Z-scores—is important to filter any broad fluctuations in economic conditions. Two observations stand out. Firstly, the Z-score offers a reliable measure of distress in my sample, clustering the majority of bankruptcy filings in its lowest sample quartile. Secondly, and more importantly, the post-Marblegate period experiences an increase in the tendency to file for bankruptcy conditional on distress. This increase in concentrated among bond-intensive firms. This is consistent with the prediction that

49. Bankruptcy procedures add direct and indirect costs which may devour as much as a fifth of the firm's going concern value (Epaulard and Zapha, 2022).

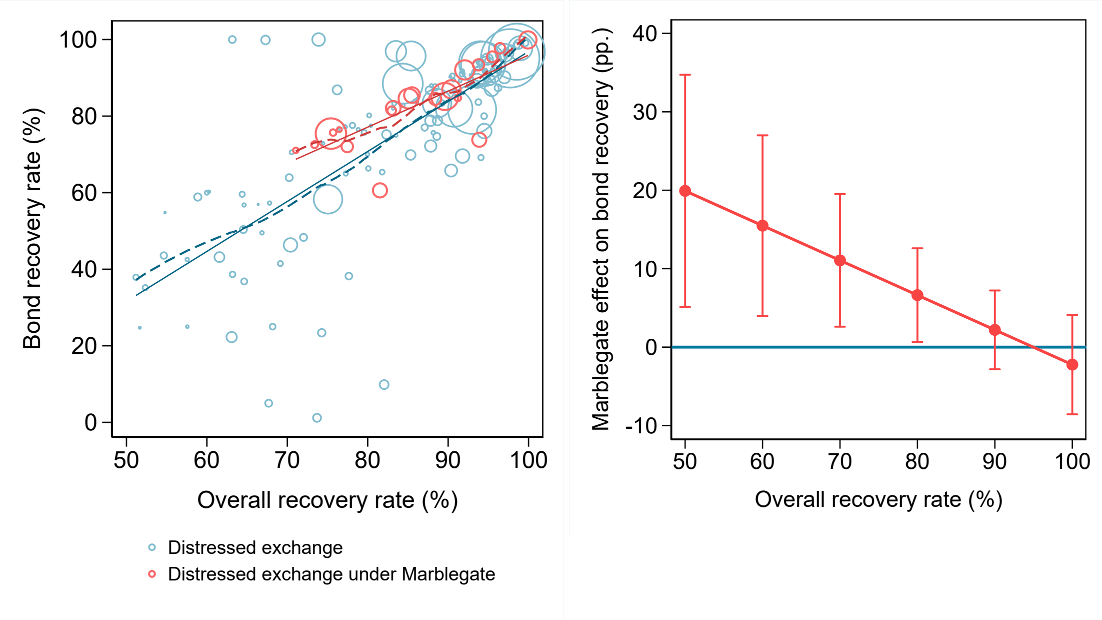


Figure 2.5. Marblegate bolstered bond recoveries out-of-court

Notes: Recovery rate information for 130 out-of-court distressed bond exchanges between 1990 and 2020 in the US from Moody's Default and Restructuring Database. Circle areas represent the total volume of debt outstanding before default. Estimates shown on the right conditional on linear time trend and industry fixed effects (NAICS single-digit).

stronger protection of uncoordinated bondholders may create hold-outs that over-burdened out-of-court restructuring.

Are these differences statistically significant and robust? To test, I estimate a regression for quarterly bankruptcy filings of firms with Z-scores below the median. The effect of Marblegate on bankruptcy filing patterns will be detected by the interaction of two binary indicators: one for the Marblegate period, $M_q = \mathbb{1}(q \in \{2015Q1, ...2016Q4\})$ as well as one for bond-intensive firms $B_{f,q} = \mathbb{1}(\text{bonds}_{f,q}/\text{assets}_{f,q} > 0.25)$:[50]

$$\text{filing}_{f,q} \;=\; \beta_1 M_q + \beta_2 B_{f,q} + \beta_3 (M_q \times B_{f,q}) + \boldsymbol{x}_{f,q}\boldsymbol{\gamma} + e_{f,q} \tag{2.15}$$

where $\text{filing}_{f,q}$ is a binary variable indicating whether firm f filed for bankruptcy in quarter q. The interaction coefficient, β_3, captures the additional effect of Marblegate on the exposed population of firms. In the largest model, firm-level controls $\boldsymbol{x}_{f,q}$ include firm and quarter fixed effects, the full set of indicators for quintiles of the quarterly distribution of total assets as well as the two-digit NAICS industry classification, both sets interacted with the Marblegate indicator. Controlling for the interaction of Marblegate and size is potentially important because large firms are more likely to be bond-intensive and may require formerly court procedures simply

50. The median bond intensity for risky, non-financial firms is 24.3% in 2014 year-end compustat data. The average stands at 27.2%.

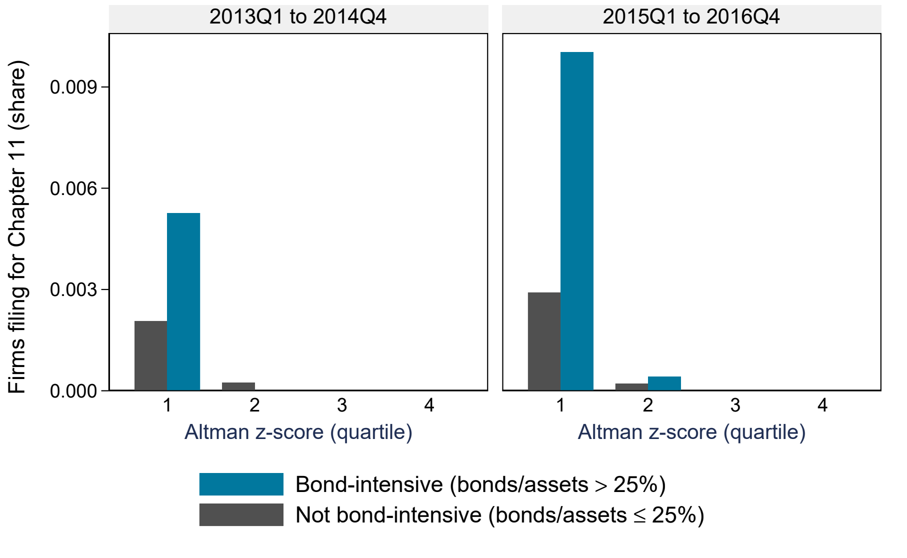


Figure 2.6. Marblegate pushed bond-intensive firms into court

Notes: Shares of non-financial compustat firms filing for bankruptcy between 2013Q1 and 2016Q4 across quartiles of the distribution of distress Z-scores Altman (1968). Marblegate marks the period 2015Q1 to 2016Q4.

due to their size, and hence $B_{f,q}$ might simply capture a size effect. Similarly, controlling for period-specific industry effects rules out that bond-intensity simply picks up on industry-specific shocks.[51]

Table 2.1 presents estimates of β_3, alongside β_1 and β_2 and across a cascade of different control vectors. The estimated $\hat{\beta}_3$ remains stable and highly significant across the board, and is economically sizable: Marblegate increased the propensity to file for Chapter 11 bankruptcy by around 0.5 percentage points for bond-intensive firms—more than doubling their sample base rate.

It is worth noting that all these effects become more pronounced when I restrict attention to pre-packaged bankruptcy filings, i.e., bankruptcy petitions filed *after* major claim holders agreed on a restructuring plan. These pre-packs are the closest in-court substitute to an out-of-court restructuring. Private restructuring support agreements (RSAs) often stipulate a bankruptcy petition with a restructuring plan akin to the out-of-court deal in case of debt exchange failure.[52]

51. For example, firms in the extraction, distribution or refining of oil and gas experience economic difficulties after a sustained drop in oil prices throughout 2014.

52. Pre-packaged bankruptcy filings are often argued to be faster and cheaper. This is consistent with the theory outlined in Section 2.1.2: Stronger market creditor rights push those firms into bankruptcies for which dead-weight losses are small. For other cases, stronger market creditor rights re-distribute value out-of-court instead, e.g., see Figure 2.5.

Table 2.1. Chapter 11 filings of bond-intensive firms, before and after Marblegate

	(1) Raw	(2) Firm FE	(3) Time FE	(4) Period× Industry	(5) Period× Size
Marblegate × Bond-intensive	0.0026*	0.0052***	0.0052***	0.0044***	0.0051***
	(0.0014)	(0.0016)	(0.0016)	(0.0017)	(0.0018)
Bond-intensive	0.0019**	0.0016	0.0015	0.0015	0.0013
	(0.0008)	(0.0020)	(0.0020)	(0.0021)	(0.0021)
Marblegate	0.0003	0.0013**			
	(0.0006)	(0.0006)			
Firm FE		Yes	Yes	Yes	Yes
Quarter FE			Yes	Yes	Yes
Marblegate × Industry FE				Yes	Yes
Marblegate × Size FE					Yes
R^2	0.001	0.002	0.003	0.006	0.008
Filings	68	68	68	68	67
N	26666	26666	26666	25305	25158

Notes: Sample of non-financial compustat firms in distress (Z-score below the median) between 2013Q1 and 2016Q4. Marblegate marks the period 2015Q1 to 2016Q4. Firms are considered to be "bond-intensive" if liable for bond debt exceeding 25% of total asset value. Size measured by quintiles of quarter-specific distribution of total assets. Industry fixed effects based on 2-digit NAICS codes. With quarter fixed effects, M_q becomes collinear and is thus omitted from specifications (3)-(5). Standard errors in parentheses clustered at the firm level. *** p <0.01, ** p <0.05, * p <0.10.

2.2.5 Effects of Marblegate on finance and investment

By affecting size and distribution of firm value ex post, institutions for distress resolution carry profound implications for economic choices ex ante (e.g., Djankov et al., 2008; Becker and Josephson, 2016; Lian and Ma, 2021). The theory in Section 2.1.2 describes how market creditor rights may bolster or curb bond financing and investment of healthy firms, depending on the relative strength of two effects: The erosion of resolution efficiency ex post, and the control of moral hazard ex ante. I presented evidence on adverse ex-post effects of Marblegate in the previous section. But ex-ante outcomes also depend on potential insider commitment. This section presents evidence on the impact of Marblegate on ex-ante financing and investment choices of US firms. Ultimately, the direction of effects carry information about whether market creditor rights prevailing in the US are too strong or too weak. Estimates of the reaction in stock and bond prices are presented in the Appendix Sections 2.C.5 and 2.C.6.

2.2.5.1 Investment

Did Marblegate affect firm investment, in which direction, and how much? To test, I estimate the difference-in-differences of risky firms' investment rates across firms with different bond intensity, i.e., how bond-intensive firms differ in their investment activity over time (the first difference) relative to other firms (the second difference). Investment rate refers to capital expenditures relative to last quarter's assets. [53] I measure bond-intensity a quarter before the verdict to side-step potential Marblegate-induced selection, indicating bond-intensive firms by $B_{f,2014Q3} = \mathbb{1}(\text{bonds}_{f,2014Q3}/\text{assets}_{f,2014Q3} > 0.25)$.[54] The threshold of 25% is close to the variable's median (mean) of 24.3% (27.2%) in 2014Q3. To verify Marblegate coincided with a clear shift—as opposed to merely bisecting a pre-existing trend—I estimate quarter-specific coefficients $\beta(q)$:

$$\frac{\text{capex}_{f,q}}{\text{assets}_{f,q-1}} = \phi_f + \tau_q + \beta(q)B_{f,2014Q3} + e_{f,q} \tag{2.16}$$

where fixed effects ϕ_f and τ_q filter firm and quarter-specific variation.[55] I estimate (2.16) on the sample with a S&P long-term entity high-yield rating as well as in the placebo sample of investment-grade firms for comparison.

Figure 2.7 visualizes estimates of $\beta(q)$ relative to 2014Q4, together with 95% confidence intervals,. The left panel shows estimates for the sample of risky firms—with a S&P long-term entity high-yield rating—as well as in the placebo sample of investment-grade firms for comparison on the right. To avoid selection effects, I also use ratings from 2014Q3, the quarter before Marblegate.

Among risky firms, I find bond-intensive businesses to sharply cut investment rates by more than -40 basis points relative to low-bond peers. The effect occurs right after Marblegate in the first quarter of 2015 and persists for the next two years with some mild reversal. These effects are statistically significant but also quantitatively considerable given that average quarterly investment rates range around 1.5 percent. Before 2014Q4, differences between the two groups of firms are insignificant and show no trend. By contrast, safe firms are virtually unaffected, consistent with the hypothesis that firms with little risk of distress should not react to a change in institutions governing distress resolution.[56, 57]

These effects are robust to additional controls and in alternative samples. The DiD setup of Equation (2.17) adds a variable vector of controls $\boldsymbol{x}_{f,q}$ and captures the average Marblegate effect for bond-intensive firms by β:[58]

53. To prevent outliers from driving OLS estimates, I winsorise investment rates by 1% at both tails.

54. However, effects are actually robust towards alternative measurement timing assumptions. For example, see Figure 2.D.1 in Appendix 2.D.1 using quarter-specific, that is, contemporaneous bond intensities.

55. I control for firm dynamics and other potential confounders in a next step.

56. Consistent with Marblegate affecting bond-intensive firms, the drop shown in the left panel of Figure 2.7 indeed reflects bond-intensive firms *cutting* investment instead of low-bond firms *increasing* investment. Appendix Figure 2.C.4 plots average quarterly investment rates for each group of firms in each sub-samples. While investment rates for bond-intensive risky firms almost always ranged above those of low-bond firms before Marblegate, the relation reversed for the post-Marblegate period, driven by movements of bond-intensive firms.

57. After the Second Circuit overturned the original Marblegate ruling on January 17, 2017, investment effects reverse, see Figure 2.D.3 in Appendix 2.D.2. As discussed earlier, the January 2017 ruling is less clear-cut from a statistical viewpoint, which may explain why effects are more gradual.

58. Note that firm and quarter fixed effects ϕ_f and τ_q render level effects for $B_{f,2014Q3}$ and M_q superfluous.

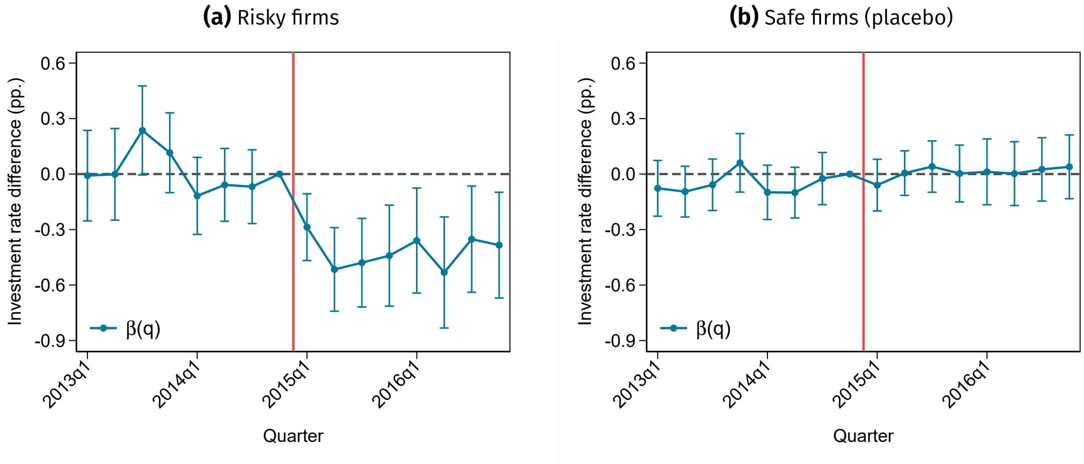


Figure 2.7. Marblegate's effect on firm investment rates

Notes: Estimates of average investment rates—net of firm-fixed effects—by quarter and bond intensity from Equation (2.16) within compustat non-financial firms. The left panel shows results for risky firms with a S&P high-yield rating right before Marblegate in 2014Q3. The right panel shows results for safe firms with a S&P investment-grade rating in 2014Q3. Whiskers mark 95% CI for $\beta(q)$ based on standard errors clustered at the firm level.

$$\frac{\text{capex}_{f,q}}{\text{assets}_{f,q-1}} = \phi_f + \tau_q + \beta\,(M_q \times B_{f,2014Q3}) + \boldsymbol{x}_{f,q}\boldsymbol{\gamma} + e_{f,q} \tag{2.17}$$

Table 2.2 presents results across a range of specifications varying controls and sample. Firm controls include four lags of asset growth, lagged Tobin's Q and the firm's lagged liquidity ratio to filter differences due to growth dynamics, prospects and financial position. The effect remains statistically significant, ranging from -30 to -43 basis points, corresponding to an average relative reduction of firm-level investment rate of about -15% to -29%. Notably, the effect in the placebo sample of investment-grade firms is quantitatively small, positive and statistically indistinguishable from zero. Column (5) dispenses with ratings data and instead measures firm default risk using Z-scores to include unrated firms, documenting a very similar effect. Column (6) zooms in on firms with a BB rating, i.e., firms with credit risk, but for which default is very unlikely to happen within the next few years.[59] Even within this subsample, effects remain quantitatively sizable indicating that I measure ex-ante effects as opposed to the ex-post impact of actual restructurings. Appendix Table 2.D.1 shows estimates to be robust for alternative samples, controls, measurement choices and essentially unchanged when I estimate a triple-DiD using both bond intensity and risk.

Discussing alternative interpretations. In the model of Section 2.1.2, moral hazard associated with market leverage lured insiders to care less about distress. Alternatively, it is conceivable that insiders would use bond finance to gamble and (over-) invest into very risky projects.

59. Standard and Poors (2024) reports that less than 1.5 percent of BB-rated firms default within a two year horizon.

Table 2.2. Marblegate's average effect on investment rates across specifications

	(1) W/o Firm Controls	(2) Baseline	(3) IG	(4) Quarter × Industry	(5) Low Z-Score	(6) BB Rating
Marblegate × Bond-intensive	-0.0043***	-0.0047***	0.0010	-0.0022**	-0.0030***	-0.0030***
	(0.0010)	(0.0009)	(0.0006)	(0.0009)	(0.0006)	(0.0011)
Firm controls		Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter × Industry FE				Yes		
Investment rates, mean	0.0153	0.0155	0.0119	0.0155	0.0119	0.0132
R^2	0.71	0.71	0.79	0.75	0.55	0.70
N	9489	8475	6559	8468	22058	4561

Notes: Estimates of Equation (2.17) using compustat sample of non-financial firms. Sample restricted to firms with a S&P rating of BB or worse; except column (3), (5) and (6), which focus on investment grade-rated firms; all firms with a below-median Z-score; and the subsample of firms with a BB rating respectively. Ratings and Z-scores refer to pre Marblegate values observed in 2014Q3. Dependent variable is capital expenditures rel. to last quarter's assets. The binary variable *Marblegate* indicates quarters 2015Q1-2016Q4. Firms are considered to be "bond-intensive" if their bond debt relative to assets exceeds 25% a quarter before Marblegate. Firm controls include four lags of asset growth, lagged Tobin's Q and the firm's lagged liquidity ratio. Industry fixed effects based on 2-digit NAICS codes. Standard error in parentheses clustered at the firm level. *** p <0.01, ** p <0.05, * p <0.10.

Would the interpretation of estimated investment effects be different if moral hazard was of the gambling type? Bond-financed over-investment into risky negative-NPV projects would allow insiders to benefit from greater upside while squeezing market creditors more in bad states. But again, market creditors would guard ex ante by demanding higher yields, forcing insiders to internalize the cost of moral hazard and thus ultimately deter market finance—and investment, albeit of lower quality. Market creditor protection in turn limits insiders' ability to squeeze market creditors in bad states, discouraging gambling and thereby sets into motion the same virtuous spiral of market lending and investment. Hence, also under these assumptions, negative investment effects indicate that the (negative) default cost effect of market creditor rights overcompensates its (positive) commitment effect.

May results be driven by a precautionary motive instead of an increase in corporate discount rates? Arguably, firms might become reluctant to convert safe liquid assets into illiquid investment lotteries if Marblegate increases default costs. In the presence of financial constraints, such a precautionary motive could explain the cut in capital expenditure even without any changes to financing costs. In this case, investment cuts would mirror cash accumulation rather than reductions in net debt issuance, which I test in the next subsection.

2.2.5.2 Other cash flows

Evidence in the previous section suggests that Marblegate reduced capital expenditure cash outflows among exposed firms. Did it also affect financial investments? And how did firms balance the reduction in outflows: Did they increase cash buffers or did they cut financing inflows?

Examining the last question carries particular significance because it helps to evaluate whether investment cuts are driven by a precautionary motive rather than a shift in corporate discount rates. As Marblegate increased the cost of default, firms might become reluctant to convert safe liquid assets into illiquid investment lotteries. In the presence of financial constraints, such a precautionary motive could explain the cut in capital expenditure without any effect on corporate discount rates.

I estimate regressions for different cash flow variables using the same specification as for investment rates

$$\frac{\mathrm{CF}_{f,q}}{\mathrm{assets}_{f,q-1}} = \phi_f + \tau_q + \beta(M_q \times B_{f,2014Q3}) + \boldsymbol{x}_{f,q}\boldsymbol{\gamma} + e_{f,q} \tag{2.18}$$

where $\mathrm{CF}_{f,q}$ denotes either capital expenditures, net long-term financial investments, net total cash accumulation or net debt issuance. Firms controls are identical to the previous specification, including four lags of asset growth, lagged Tobin's Q and the firm's lagged liquidity ratio.

Table 2.3 presents the estimates. Column (1) reproduces the main capex result for reference. Column (2) reports negative effects for net financial investments smaller than for capital expenditure but of similar order of magnitude. Importantly, columns (3) and (4) document that there is virtually no effect on total cash accumulating and that all adjustments appear to be balanced by a reduction in net debt issuance. Taken together, these results corroborate the interpretation, that Marblegate increased effective corporate discount rates by distorting debt structure choices, with negative consequences for firm investment.

2.2.5.3 Zooming in on debt issuance

Previous evidence suggests that healthy firms exposed to Marblegate cut investment and net debt issuance. This aligns with the interpretation that the ruling increased financing costs by complicating bond restructurings. Accordingly, cuts to debt issuance should concentrate in bond issuance. Loan issuance should stay unaffected or even increase to the extent that firms substituted sources of debt finance. To test this, I investigate bond and loan issuance analogously to the way I estimate investment effect.

Bond issuance. I replace the dependent variable in the DiD Equation (2.17) by an indicator for bond issuance:

$$\mathbb{1}(\mathrm{Issuance}_{f,q}) = \phi_f + \tau_q + \beta(M_q \times B_{f,2014Q3}) + \boldsymbol{x}_{f,q}\boldsymbol{\gamma} + e_{f,q} \tag{2.19}$$

Notation and measurement of right-hand side variables replicates the previous set-up, i.e., controls $\boldsymbol{x}_{f,q}$ include four lags of asset growth, lagged Tobin's Q, the firm's lagged liquidity ratio and

Table 2.3. Marblegate's effect across the cash flow statement

	(1) Capex (base)	(2) Financial investment	(3) Cash	(4) Liquid assets	(5) Net debt issuance
Marblegate × Bond-intensive	-0.0047***	-0.0009*	-0.0007	-0.0017	-0.0065**
	(0.0009)	(0.0005)	(0.0022)	(0.0024)	(0.0025)
Firm controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Dependent variable, mean	0.0155	0.0008	0.0014	0.0012	0.0102
R^2	0.71	0.29	0.18	0.20	0.12
N	8475	7980	8474	6797	8232

Notes: Estimates of Equation (2.18) using compustat non-financial firms with a S&P rating of BB+ or worse. The sample period covers quarters 2013Q1 to 2016Q4. The binary variable Marblegate indicates quarters 2015Q1-2016Q4. Firms are considered to be "bond-intensive" if their bond debt relative to assets exceeded 25% a quarter before Marblegate. Firm controls include four lags of asset growth, lagged Tobin's Q and the firm's lagged liquidity ratio. Standard error in parentheses clustered at the firm level. *** p <0.01, ** p <0.05, * p <0.10.

quarter-industry-specific fixed effects. Several bond issues are small, i.e., barely complicating distress resolution, so I focus on quarters where volumes exceed 5% of book assets.[60]

Table 2.4 presents the results across a range of specifications varying controls and sample. The different columns replicate set-ups tested for investment rates and add Column (6) with estimates for the intensive margin of bond issuance. Estimates of β are significantly negative, indicating that bond-reliant firms reduced the quarterly probability of new issuances for significantly by about -3 percentage points after to the ruling—except among the placebo sample of investment-grade companies, where effects are not statistically different from zero. Given average issuance rates of about 6% among bond-intensive firms, these estimates imply a 50% reduction of bond financing activity for affecting companies. I also find a mild reduction at the intensive margin. Appendix Table 2.D.2 documents robustness of results in alternative samples, for additional controls, other measurement choices and within a triple-DiD using both bond intensity and risk.

Loan issuance. I find evidence that firms attempt to substitute from bonds into loans. Appendix Section 2.C.7 repeats the analysis of this section for loan issuance measured from CapitalIQ and documents quarterly loan issuance probabilities to increase by about 2 percentage points. Substitution is imperfect, however, as total net debt issuance falls, see Table 2.3. Importantly, the increase in loans underscores that Marblegate operated through higher financing costs as opposed to mere debt overhang.

60. Results are robust to using all bond issues, see Appendix Table 2.D.2.

Table 2.4. Marblegate's effect on bond issuance

	(1) W/o firm controls	(2) Baseline	(3) IG	(4) Quarter × Industry	(5) Low z-score	(6) Issuance size
Marblegate × Bond-intensive	-0.029***	-0.034***	-0.015	-0.034***	-0.018***	-0.004*
	(0.008)	(0.008)	(0.010)	(0.009)	(0.004)	(0.002)
Firm controls		Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	
Quarter FE	Yes	Yes	Yes	Yes	Yes	
Quarter × Industry FE				Yes		
Level effects						Yes
$\hat{P}$(issuance), bond-intensive	0.058	0.059	0.065	0.059	0.024	0.047
$\hat{P}$(issuance), not bond-int.	0.022	0.022	0.049	0.022	0.006	0.048
R^2	0.11	0.12	0.09	0.14	0.12	0.05
N	9546	8484	6562	8477	22111	425

Notes: Estimates of Equation (2.19) using compustat sample of non-financial firms covering quarters 2013Q1 to 2016Q4. Dependent variable is a binary indicator for a bond issuance >5% of assets, except column (6) showing results for log bond issuance relative to assets. Sample restricted to firms with a S&P rating of BB+ or worse; except column (3) and (5), which focus on investment grade-rated firms and all firms with a below-median Z-score, respectively. Column (6) restricts to firm-quarters with bond issuance. The binary variable *Marblegate* indicates quarters 2015Q1-2016Q4. Firms are considered to be "bond-intensive" if their bond debt relative to assets exceeded 25% a quarter before Marblegate. Firm controls include four lags of asset growth, lagged Tobin's Q and the firm's lagged liquidity ratio. Industry refers to 2-digit NAICS sectors. Standard error in parentheses clustered at the firm level. *** p <0.01, ** p <0.05, * p <0.10.

2.2.5.4 Back-of-the-envelope calculation

The estimated change in capital expenditures after Marblegate is considerable, ranging between -10% and -30% among bond-intensive and risky firms relative to other risky firms with little or no bond debt. I suggest that firms reacted to higher cost of default, based on evidence of higher bankruptcy risk. But can the estimated increase in bankruptcy risk plausibly trigger investment effects of this magnitude? I assess the quantitative plausibility using a back-of-the-envelope calculation, which I summarize it below. All details can be found in Appendix 2.D.

Bankruptcy risk and financing cost. I first gauge how elevated bankruptcy risk would translate into financing costs. I use a simple accounting framework to link the cost component of bonds to their bankruptcy risk. Based on corresponding estimates from Table 2.1 Column (2) and available estimates of the cost of bankruptcy, I calculate that Marblegate increased the quarterly marginal cost of bond finance by +1.7 to +8.7 basis points, depending on exact assumptions about the cost of bankruptcy.

Multiplying the increase in the cost of bond debt with the share of bond in fresh finance based on estimates from Table 2.4, I calculate that Marblegate should have increased *quarterly* corporate discount rates of risky and bond-intensive firms by around +0.4 to +2 basis points.

Financing cost and investment. I use a simple q model to link changes in the corporate discount rate to firm investment. To obtain a tractable formulation whose components can be measured from the data, I build on Gormsen and Huber (2023): I add the standard assumptions of Hayashi (1982), to approximate the marginal value of capital, q_t, with its average value measured by Tobin's Q. Then, I relate Q to the duration of net earnings via the Gordon growth model (Gormsen and Lazarus, 2023).

The literature on q models offers a range of estimates for the adjustment cost parameter (Gilchrist and Himmelberg, 1995; Hall, 2004; Cooper and Haltiwanger, 2006; Philippon, 2009; Groth and Khan, 2010; Eberly, Rebelo, and Vincent, 2012; Lin et al., 2018). I compute investment effects under three different values that enclose estimates from the aforementioned literature.

Taken together, I obtain a grid of possible investment effects, depending on assumptions about bankruptcy cost β and the adjustment cost ϕ. To ease interpretation, I divide effects by the average investment rate of 0.016 and multiply by 100 to obtain percent values. Resulting elasticities are presented in Table 2.5: They span a large range of -2.5% to -75%, reflecting inconclusive evidence about two important parameters. This means that under plausible economic assumptions, my estimates of bankruptcy risk from Section 2.2.5 can rationalize investment cuts in the range of -10% to -30% which I document in Section 2.2.4.

Table 2.5. Investment effects implied by bankruptcy risk estimates

	$\beta = 0.02$	$\beta = 0.05$	$\beta = 0.10$
$\phi = 2$	-14.9%	-37.3%	-74.5%
$\phi = 4$	-7.5%	-18.6%	-37.3%
$\phi = 12$	-2.5%	-6.2%	-12.4%

Notes: Relative changes in investment rates for bond-intensive and risky firms as implied by estimates of higher bankruptcy risk after the Marblegate ruling. Numbers are based on a back-of-the-envelope calculation and are shown across different plausible assumptions for bankruptcy costs β (as a fraction of asset value) and the parameter ϕ from a standard quadratic capital adjustment costs function.

2.2.5.5 Marblegate and loan-bond substitutability

Becker and Ivashina (2014) documented firms turning to the bond market as a "spare tire" (Greenspan, 1999) to mitigate adverse credit supply shocks from distressed banking systems. To the extent that Marblegate changed ex-post distress or ex-ante moral hazard cost of bond finance, the ruling should have changed firms ability to smoothing out adverse bank loans shocks.

To test this, I estimate the effect of shocks to relationship lender balance sheets on firms bond issuance, and compare reactions before and after the Marblegate ruling. I identify banking relationships of compustat firms with *DealScan* lead arrangers and proxy lenders' balance sheet shocks using SNL data: Variation in the level of non-performing loans relative to total loans that cannot be predicted by lagged non-performing loans relative to total loans, lagged market-to-book and lagged loan-loss reserves relative to total loans. Specifically, I estimate a panel regression of bond issuance on relationship lender non-performing loan ratios and its interaction with a Marblegate dummy controlling for lender characteristics, firm characteristics and fixed effects:

$$\mathbb{1}(\text{issuance}_{f,q+1}, \text{issuance}_{f,q+2}) = \phi_f + \tau_q + \beta_1 \lambda_{f,q} + \beta_2 (M_q \times \lambda_{f,q}) + \boldsymbol{x}_{f,q}\boldsymbol{\gamma} + e_{f,q} \qquad (2.20)$$

where $\mathbb{1}(\text{issuance}_{f,q+1}, \text{issuance}_{f,q+2})$ assumes a value of 1 when the firm issues bonds of at least 5% of book asset value during the next two quarters. $\lambda_{f,q}$ measures the share of non-performing loans at the firm's relationship lender. Vector $\boldsymbol{x}_{f,q}$ controls for lender and firm characteristics. On the lender's side, it captures lags of the lenders' non-performing loan share, market-to-book ratio, loan-loss reserves ratio and log total assets. In the firm's side, it includes contemporaneous and lagged Tobin's Q, liquidity ratio, leverage, bond leverage and asset growth. Similar to before, ϕ_f, τ_q, M_q denote firm fixed effects, quarter fixed effects and a dummy marking the Marblegate period. I restrict attention to firms with non-zero bond debt to exclude those without bond market access to start with. Note that this specification tests predictions about Marblegate without relying on neither i) the precise date of the verdict nor ii) possibly endogenous measures of bond intensity or default risk.

Estimation results are presented in Table 2.6. Column (1) confirms that firms increased the probability of future bond issuance after relationship lender balance sheet health deteriorated unexpectedly:[61] In response to a +1 percentage point increase in the lender's non-performing loan ratio, the firm's probability of bond issuance increases by +1.7 percentage points. However, this no longer holds true under the Marblegate regime, when the sensitivity of bond issuance essentially collapses. Reassuringly, this pattern is entirely driven by risky firms, see Column (2). Similar to what Becker and Ivashina (2014) document, safe firms are unresponsive to lender distress, both prior to and after Marblegate as shown in Column (3).

Column (4) reports estimates from an regression analogous to Column (2) but replacing the dependent variable by capital expenditures over the next two quarters, normalized by contemporaneous assets. Results are consistent with the interpretation that poorer substitutability of bank loans upon lender distress also worsen effects on real investment. Before Marblegate, lender distress shock were not associated with investment cuts. After Marblegate, however, an unpredicted +1 percentage point increase in the relationship lender's non-performing loans ratio decreased investment of the next two quarters by -0.18 percentage points relative to assets. This is quantitatively meaningful given a base rate of about 3% but estimates are statistically imprecise.

61. This finding also indicates that changes in the relationship lender's non-performing loan ratio are not driven by distress at—and hence are exogenous to—the firm itself.

Table 2.6. Marblegate and the impact of relationship lender distress on bond issuance

	(1) Full sample	(2) Risky firms	(3) Safe firms	(4) Capex, risky firms
Marblegate × Lender distress	-2.70**	-5.50***	-0.64	-0.25
	(1.20)	(1.72)	(1.44)	(0.34)
Lender distress	1.65*	4.73***	-1.02	0.07
	(0.96)	(1.32)	(1.09)	(0.20)
Firm controls	Yes	Yes	Yes	Yes
Lender controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Average dependent	0.10	0.09	0.10	0.03
R^2	0.22	0.23	0.23	0.65
N	4592	2369	2564	2083

Notes: Estimates of Equation (2.20) for rated compustat non-financial firms with non-zero bond debt over the period 2013Q1 to 2016Q4. Column (2) restricts the sample to firms with a S&P rating of BB+ or worse. Column (3) restricts the sample to firms with a S&P rating of BBB- or better. Column (4) replaces the dependent by capital expenditures over the next two quarters, normalized by next quarter's assets. The binary variable Marblegate indicates quarters 2015Q1-2016Q4. Lender distress is measured by the ratio of non-performing loans. Lender controls include lags of non-performing loans relative to total loans, market-to-book ratios and loan-loss reserves relative to total loans as well as the log of lender total assets. Firm-level controls include the contemporaneous value and one lag of the firm's asset growth, Tobin's Q, liquidity ratio, leverage, bond leverage as well as asset growth. Standard error in parentheses clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

2.3 Conclusion

The inability to restructure market debt is a central assumption in a long tradition of scholarship in corporate finance and macro-finance (e.g., Bolton and Scharfstein, 1996; Bolton and Freixas, 2000; Boot, 2000; Hackbarth, Hennessey, and Leland, 2007; Berglöf, Roland, and Thadden, 2010; Crouzet, 2018). I highlight the role of legal design: Poorly-coordinated market creditors will impede negotiations *to the extent that they command relevant legal rights*. In fact, much empirical support for market debt's financial inflexibility came from the US, where corporate bond markets have been governed by particularly strict bondholder protection since the Trust Indenture Act of 1939.[62]

I argue that market creditor rights affect the cost of market finance by trading-off moral hazard and restructuring frictions. The trade-off roots in the dispersion of market creditors: Their collective action problem warrants special protection against opportunistic restructurings, but

62. There have been various proposals to reform the mode of bond debt restructuring in the US (National Bankruptcy Conference, 2015; Roe, 2016; Bratton and Levitin, 2018).

makes such protection costly by empowering hold-outs strategies. In theory, these two countervailing forces can be economically considerable under plausible parameter calibrations.

I test the economic ramifications of market creditors using a sudden expansion of bondholder protection in the US at the end of 2014. I provide evidence consistent with worse hold-out problems and higher rates of bankruptcy filings, i.e., higher cost of debt restructuring. More importantly, I show that healthy firms cut bond issuance and real investment. These results suggest that additional costs of restructuring swamped any potential benefits from moral hazard containment.

Effects are economically sizable, despite the marginal nature of the institutional change. This highlights the risk that over-protecting market creditors may choke public credit markets and jeopardize their potential to augment traditional bank intermediation. However, theory suggests that effects are context-specific. Fully understanding the macroeconomic role of market creditor rights—e.g., for bond market development and its *spare-tire* function during banking crises—calls for additional research of cross-country data.

References

Acharya, Viral V., Yakov Amihud, and Lubomir Litov. 2011. "Creditor rights and corporate risk-taking." *Journal of Financial Economics* 102 (1): 150–66.

Acharya, Viral V., and Krishnamurthy V. Subramanian. 2009. "Bankruptcy codes and innovation." *Review of Financial Studies* 22: 4949–88.

Aghion, Philippe, and Patrick Bolton. 1992. "An incomplete contracts approach to financial contracting." *Review of Economic Studies* 59 (3): 473–94.

Altman, Edward. 1968. "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy." *Journal of Finance* 23 (4): 589–609.

Altman, Edward. 2014. "The role of distressed debt markets, hedge funds and recent trends in bankruptcy on the outcomes of Chapter 11 reorganizations." *American Bankruptcy Institute Law Review* 22: 75–123.

Antill, Samuel, and Megan Hunter. 2021. "Consumer choice and corporate bankruptcy." Harvard Business School, mimeo.

Arnold, Marc, and Ramona Westermann. 2023. "Debt renegotiations outside distress." *Review of Finance* 27 (4): 1183–228.

Asquith, Paul, Robert Gertner, and David Scharfstein. 1994. "Anatomy of financial distress: An examination of junk-bond issuers." *Quarterly Journal of Economics* 109 (3): 625–58.

Baird, Douglas. 2017. "Priority matters: Absolute priority, relative priority, and the costs of bankruptcy." *University of Pennsylvania Law Review* 165: 785–829.

Baird, Douglas. 2023. "Three faces of creditor-on-creditor aggression." *American Bankruptcy Law Journal* 97: 213–53. American Bankruptcy Law Journal.

Becker, Bo, and Victoria Ivashina. 2014. "The cyclicality of credit supply: Firm-level evidence." *Journal of Monetary Economics* 62: 76–93.

Becker, Bo, and Victoria Ivashina. 2022. "Weak corporate insolvency rules: The missing driver of zombie lending." *AEA Papers and Proceedings* 112: 516–20.

Becker, Bo, and Jens Josephson. 2016. "Insolvency resolution and the missing high-yield bond markets." *Review of Financial Studies* 29 (10): 2814–49.

Becker, Bo, and Per Strömberg. 2012. "Fiduciary duties and equity-debtholder conflicts." *Review of Financial Studies* 25 (6): 1931–69.

Bellon, Aymeric, Louis-Marie Harpedanne, and Noémie Pinardon-Touati. 2022. "Mediating financial intermediation." Mimeo.

Bento, Pedro, and Diego Restuccia. 2017. "Misallocation, establishment size, and productivity." *American Economic Journal: Macroeconomics* 9 (3): 267–303.

Berglöf, Erik, Gérard Roland, and Ernst-Ludwig von Thadden. 2010. "The design of corporate debt structure and bankruptcy." *Review of Financial Studies* 23 (7): 2648–79.

Bergman, Yaacov, and Jeffrey Callen. 1991. "Opportunistic underinvestment in debt renegotiation and capital structure." *Journal of Financial Economics* 29: 137–71.

Berlin, Mitchell, Greg Nini, and Edison Yu. 2020. "Concentration of control rights in leveraged loan syndicates." *Journal of Financial Economics* 137 (1): 249–71.

Besanko, David, and George Kanatas. 1993. "Credit market equilibrium with bank monitoring and moral hazard." *Review of Financial Studies* 6 (1): 213–32.

Bolton, Patrick, and Xavier Freixas. 2000. "Equity, bonds, and bank debt: Capital structure and financial market equilibrium under asymmetric information." *Journal of Political Economy* 108 (2): 324–51.

Bolton, Patrick, Xavier Freixas, Leonardo Gambacorta, and Paolo Emilio Mistrulli. 2016. "Relationship and transaction lending in a crisis." *Review of Financial Studies* 29 (10): 2643–76.

Bolton, Patrick, and David Scharfstein. 1996. “Optimal debt structure and the number of creditors.” *Journal of Political Economy* 104 (1): 1–25.

Boot, Arnoud. 2000. “Relationship banking: What do we know?” *Journal of Financial Intermediation* 9: 7–25.

Bratton, William, and Adam Levitin. 2018. “The new bond workouts.” University of Pennsylvania, mimeo.

Bris, Arturo, Ivo Welch, and Nign Zhu. 2006. “The costs of bankruptcy: Chapter 7 liquidation versus chapter 11 reorganisation.” *Journal of Finance* 61 (3): 1253–303.

Brudney, Victor. 1992. “Corporate bondholders and debtor opportunism: in bad times and good.” *Harvard Law Review* 105 (8): 1821–78.

Brunner, Antje, and Jan Pieter Krahnen. 2008. “Multiple lenders and corporate distress: Evidence on debt restructuring.” *Review of Economic Studies* 75 (2): 415–42.

Buccola, Vincent. 2019. “Bankruptcy’s cathedral: Property rules, liability rules and distress.” *Northwestern University Law Review* 114 (3): 705–50.

Bucola, Luigi, and Gideon Bornstein. 2023. “The macroeconomics of trade credit.” Stanford University, mimeo.

Chapman and Cuttler LLP. 2015. *Marblegate II and the “Tyranny of the Minority” – Another Weapon is Added toBondholders’ Arsenal to Disrupt Exchange Offers and Restructurings.* Client Alert pulished July 8, 2015.

Chava, Sudheer, and Michael Roberts. 2008. “How does financing impact investment? The role of debt covenants.” *Journal of Finance* 63 (5): 2085–121.

Chen, Zhang. 2022. “Economic growth and the rise of large firms.” Princeton University, mimeo.

Closset, Frédéric, and Daniel Urban. 2019. “The balance of power between creditors and the firm: Evidence from German insolvency law.” *Journal of Corporate Finance* 58: 454–77.

Cooper, Russell, and John Haltiwanger. 2006. “On the nature of capital adjustment costs.” *Review of Economic Studies* 73 (3): 611–33.

Court of the Southern District of New York. 2014. *Marblegate Asset Management v. Education Management Corp.* Opinion and order No 14. Civ. 8584 (KPF), from Dec 30.

Crouzet, Nicolas. 2018. “Aggregate implications of corporate debt choices.” *Review of Economic Studies* 85: 1635–82.

Davydenko, Sergei, and Julian Franks. 2008. “Do bankruptcy codes matter? A study of defaults in France and Germany and the UK.” *Journal of Finance* 63 (2): 565–608.

Di Maggio, Marco, Amir Kermani, and Zhaogang Song. 2017. “The value of trading relations in turbulent times.” *Journal of Financial Economics* 124 (2): 266–84.

Diamond, Douglas. 1984. “Financial intermediation and delegated monitoring.” *Review of Economic Studies* 51 (3): 393–414. Accessed March 9, 2023.

Diamond, Douglas. 1993. “Seniority and maturity of debt contracts.” *Journal of Financial Economics* 33 (3): 341–68.

Djankov, Simeon, Oliver Hart, Caralee McLiesh, and Andrei Shleifer. 2008. “Debt enforcement around the world.” *Journal of Political Economy* 116 (6): 1105–49.

Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer. 2007. “Private credit in 129 countries.” *Journal of Financial Economics* 84 (2): 299–329.

Donaldson, Jason, Edward Morrison, Giorgia Piacentino, and Xiaobo Yu. 2022. “Restructuring vs. bankruptcy.” Columbia Law and Economics Working Papers, mimeo.

Eberly, Janice, Sergio Rebelo, and Nicolas Vincent. 2012. “What explains the lagged-investment effect?” *Journal of Monetary Economics* 59 (4): 370–80.

Elias, Jared. 2023. “Employee bankruptcy trauma.” Harvard Law School, mimeo.

Epaulard, Anne, and Chloé Zapha. 2022. “Bankruptcy costs and the design of preventive restructuring procedures.” *Journal of Economic Behavior & Organization* 196: 229–50.

Erel, Isil, Brandon Julio, Woojin Kim, and Michael S. Weisbach. 2012. “Macroeconomic conditions and capital raising.” *Review of Financial Studies* 25 (2): 341–76. Accessed September 1, 2023.

Fan, Xin. 2024. "Publicly traded debt restructuring methods, corporate investment, and debt contracting." *Management Science* forthcoming.

Favara, Giovanni, Erwan Morellec, Enrique Schroth, and Philip Valta. 2017. "Debt enforcement, investment, and risk taking across countries." *Journal of Financial Economics* 123 (1): 22–41.

Gennaioli, Nicola, and Stefano Rossi. 2013. "Contractual resolutions of financial distress." *Review of Financial Studies* 26 (3): 602–34.

Gertner, Robert, and David Scharfstein. 1991. "A theory of workouts and the effects of reorganization law." *Journal of Finance* 46 (4): 1189–222.

Gilchrist, Simon, and Charles Himmelberg. 1995. "Evidence on the role of cash flow for investment." *Journal of Monetary Economics* 36 (3): 541–72.

Gilson, Stuart, Kose John, and Larry Lang. 1990. "Troubled debt restructurings: An empirical study of private reorganizationof firms in default." *Journal of Financial Economics* 27: 315–53.

Gormsen, Niels, and Kilian Huber. 2023. "Corporate discount rates." University of Chicago Booth School of Business, mimeo.

Gormsen, Niels Joachim, and Eben Lazarus. 2023. "Duration-driven returns." *Journal of Finance* 78 (3): 1393–447.

Goyal, Vidhan K., S. Lakshmi Naaraayanan, and Anand Srinivasan. 2019. "Banking relationships and creditor rights." *Quarterly Journal of Finance* 09 (04): 1950016.

Greenspan, Alan. 1999. *Do efficient financial markets mitigate financial crises?* Speech given in Sea Island, Gerorgia.

Groth, Charlotta, and Hashmat Khan. 2010. "Investment adjustment costs: An empirical assessment." *Journal of Money, Credit and Banking* 42 (8): 1469–94.

Hackbarth, Dirk, Christopher Hennessey, and Hayne Leland. 2007. "Can the trade-off thery explain debt structure?" *Review of Financial Studies* 20 (5): 1389–428.

Hall, Robert E. 2004. "Measuring factor adjustment costs." *Quarterly Journal of Economics* 119 (3): 899–927.

Hart, Oliver. 1995. *Firms, contracts and financial structure.* Oxford University Press.

Haselmann, Rainer, Katharina Pistor, and Vikrant Vig. 2009. "How law affects lending." *Review of Financial Studies* 23 (2): 549–80.

Hayashi, Fumio. 1982. "Tobin's marginal q and average q: A neoclassical interpretation." *Econometrica* 50 (1): 213–24.

Hennessey, Christopher A., and Toni M. Whited. 2005. "Debt dynamics." *Journal of Finance* 60 (3): 1129–65.

Hotchkiss, Edith, Kose John, Robert Mooradian, and Karin Thorburn. 2008. "Bankruptcy and the resolution of financial distress." In *Handbook of Empirical Corporate Finance,* edited by B. Espen Eckbo, 235–87. Handbooks in Finance. San Diego: Elsevier.

Hotchkiss, Edith, David Smith, and Per Strömberg. 2021. "Private equity and the resolution of financial distress." *Review of Corporate Finance Studies* 10 (4): 694–747.

Jackson, Thomas, and Robert Scott. 1989. "On the nature of bankruptcy: An essay on bankruptcy sharing and the creditors' bargain." *Virginia Law Review* 75 (2): 155–204.

John, Kose, Mahsa Kaviani, Lawrence Kryzanowski, and Hosein Maleki. 2021. "Do country-level creditor protections affect firm-level debt structure concentration?" *Review of Finance* 25 (6): 1677–725.

Jordà, Òscar, Martin Kornejew, Moritz Schularick, and Alan Taylor. 2022. "Zombies at large? Corporate debt overhang and the macroeconomy." *Review of Financial Studies* 35 (10): 4561–86.

Koijen, Ralph, and Motohiro Yogo. 2023. "Understanding the ownership structure of corporate bonds." *American Economic Review: Insights* 5: 73–92. 1.

Kwon, Spencer, Yueran Ma, and Kaspar Zimmermann. 2022. "100 years of rising corporate concentration." Mimeo.

Lian, Chen, and Yueran Ma. 2021. "Anatomy of corporate borrowing constraints." *Quarterly Journal of Economics* 136 (1): 229–91.

Lin, Xiaoji, Chong Wang, Neng Wang, and Jinqiang Yang. 2018. "Investment, Tobin's q, and interest rates." *Journal of Financial Economics* 130 (3): 620–40.

Lubben, Stephen. 2012. "What we 'know' about Chapter 11 cost is wrong." *Fordham Journal of Corporate & Financial Law* 17 (1): 141–87.

Ma, Yueran, and Martin Kornejew. 2022. "Business bankruptcy and its economic effects." INET, mimeo.

Millar, James. 2017. *Marblegate v. EDMC: What does the Second Circuit's opinion say (and not say) about releasing a guarantee.* Faegre Drinker Client Brief.

Moody's. 2020. "Recoveries in a pandemic-driven default cycle." Sector In-Depth Report, May 2020.

Morris, Stephen, and Hyun Song Shin. 2004. "Coordination risk and the price of debt." *European Economic Review* 48 (1): 133–53.

Myers, Steward C., and Nicholas S. Majluf. 1984. "Corporate finance and investment decisions when firms have information that investors do not have." *Journal of Financial Economics* 13: 187–221.

Nagler, Florian, and Giorgio Ottonello. 2023. "A corporate finance view of market debt illiquidity." Mimeo.

National Bankruptcy Conference. 2015. *Proposed Amendments to Bankruptcy Code to FacilitateRestructuring of Bond and Credit Agreement Debt.* Open letter and report to Representatives Marino and Johnson and Senators Grassley and Leahy.

New York Times. 2015a. *Obscure Law Is Getting Its Sexy On.* Published Jan 24, 2015.

New York Times. 2015b. *Wall Street's debt restructruing fight heads to Washington.* Published Dec 7, 2015.

Nini, Greg, David Smith, and Amir Sufi. 2012. "Creditor control rights, corporate governance, and firm value." *Review of Financial Studies* 25 (6): 1713–61.

Park, Cheol. 2000. "Monitoring and structure of debt contracts." *Journal of Finance* 55 (5): 2157–95.

Philippon, Thomas. 2009. "The bond market's q." *Quarterly Journal of Economics* 124 (3): 1011–56.

Rajan, Raghuram. 1992. "Insiders and outsider: The choice between informed and arm's-length debt." *Journal of Finace* 47 (4): 1367–400.

Rauh, Joshua, and Amir Sufi. 2010. "Capital structure and debt structure." *Review of Financial Studies* 23 (12): 4242–80.

Reuters. 2015. *Education Management bond plan cannot short dissidents–U.S. judge.* Published June 23, 2015.

Roberts, Michael. 2015. "The role of dynamic renegotiation and asymmetric information in financial contracting." *Journal of Financial Economics* 116 (1): 61–81.

Roberts, Michael, and Amir Sufi. 2009. "Control rights and capital structure: An empirical investigation." *Journal of Finance* 64 (4): 1657–95.

Roe, Mark. 1987. "The voting prohibition in bond workouts." *Yale Law Journal* 97 (2): 232–79.

Roe, Mark. 2016. "The Trust Indenture Act in Congress and the courts in 2016: Bringing the SEC to the table." *Harvard Law Review Forum* 129 (7): 360–77.

Sautner, Zacharias, and Vladimir Vladimirov. 2017. "Indirect costs of financial distress and bankruptcy law: Evidence from trade credit and sales." *Review of Finance* 22 (5): 1667–704.

Schwartz, Alan. 1994. "The absolute priority rule and the firm's investment policy." *Washington University Law Review* 72 (3): 1213–29.

Schwert, Michael. 2020. "Does borrowing from banks cost more than borrowing from the market?" *Journal of Finance* 75 (2): 905–47.

Securities and Exchange Commission. 1937. *Report on the study and investigation of the work, activities, personnel and functions of protective and reorganization committees.* Washington, D.C.: United States Government Printing Office.

Standard and Poors. 2024. *Default, transition, and recovery: 2023 annual global corporate default and rating transition study.* Accessed April 28, 2024. https://www.spglobal.com/ratings/en/research/

articles/240328-default-transition-and-recovery-2023-annual-global-corporate-default-and-rating-transition-study-13047827.

Vig, Vikrant. 2013. "Access to collateral and corporate debt structure: Evidence from a natural experiment." *Journal of Finance* 68 (3): 881–929.

Wall Street Journal. 2015. *The Examiners: End the Trust Indenture Act's Bondholder Voting Ban.* Commentary by Mark Roe, published on Sep 29, 2015.

Welch, Ivo. 1997. "Why is bank debt senior? A theory based on asymmetry and claim priority based on influence costs." *Review of Financial Studies* 10 (4): 1203–36.

Zhu, Qifei. 2021. "Capital supply and corporate bond issuances: Evidence from mutual fund flows." *Journal of Financial Economics* 141 (2): 551–72.

Appendix 2.A Model details

The competitive bond market will absorb newly issued bonds at a price that equals expected, discounted repayments:

$$\begin{aligned}P(a_t,K_t,B_t,M_t^*) \;=\; \frac{1}{\rho_b}\Big(p(a_t,M_t^*)\Big(&\mathbb{1}(V(K_t,B_t,\overline{a}) \;>\; V_C(K_{t-1},\overline{a}))\frac{\tilde{B}(K_t,B_t,\overline{a})}{B_t} \\ &+\mathbb{1}(V(\cdot) \;=\; V_C(\cdot))\frac{V(K_{t-1},0,\overline{a})(1-\beta)-V_C(K_{t-1},\overline{a})}{B_t}\Big) \\ +\big(1-p(a_t,M_t^*)\big)\Big(&\mathbb{1}(V(K_t,B_t,\underline{a}) \;>\; V_C(K_{t-1},\underline{a}))\frac{\tilde{B}(K_t,B_t,\underline{a})}{B_t} \\ &+\mathbb{1}(V(\cdot) \;=\; V_C(\cdot))\frac{V(K_{t-1},0,\underline{a})(1-\beta)-V_C(K_{t-1},\underline{a})}{B_t}\Big)\Big)\end{aligned} \tag{2.A.1}$$

2.A.1 Details on model implications

Market creditor rights and ex-post cost of default. To understand effect of out-of-court market creditor protection on ex-post cost of default, consider equation (2.9) together with the simplified version of the Bellman equation:

$$V(K_{t-1},B_{t-1},a_t) \;=\; \max\big\{V_C(\cdot),V(K_{t-1},0,a_t)-\tilde{B}(\cdot)\big\} \tag{2.A.2}$$

If $\tilde{B}(\cdot)=B_{t-1}$, there is no need for debt restructuring, and nobody has the incentives to file for bankruptcy. Otherwise, there are three qualitatively distinct cases. In the first, legal constraints are too lax to affect out-of-court bond exchanges such that bondholder will receive exactly their bankruptcy reservation value:

$$\text{Unconstrained bond exchange:}\quad \tilde{B}(\cdot) \;=\; V(K_{t-1},0,a_t)(1-\beta)-V_C(K_{t-1},a_t) \tag{2.A.3}$$

Plugging this into equation (2.A.2), clarifies that insiders will not want to file for bankruptcy in this case (while bondholders are indifferent). In particular, insiders are able to extract extra value equal to the dead-weight loss of bankruptcy.

In the second case, laws constrain out-of-court bond exchanges, but the additional value which bondholders receives is less than the bankruptcy dead-weight. Hence, insiders still benefit from restructuring bond debt out-of-court relative to a bankruptcy filing:

$$\text{Constrained bond exchange:}\quad \tilde{B}(\cdot) \;=\; \Lambda B_{t-1} \;\leq\; V(K_{t-1},0,a_t)-V_C(\cdot) \tag{2.A.4}$$

Finally, if bondholder protection is too strong for the prevailing circumstances of a distressed firm, out-of-court bond exchanges would have to grant bondholders a recovery which leaves insiders with less value than what they can expect to obtain in court. That is, market creditor rights inflict additional cost of default by prompting insiders to file for a bankruptcy procedure, as made explicit when plugging in the relation below into Equation (2.A.2):

$$\text{Over-constrained bond exchange:}\quad \tilde{B}(\cdot) \;=\; \Lambda B_{t-1} \;>\; V(K_{t-1},0,a_t)-V_C(\cdot) \tag{2.A.5}$$

Market creditor rights and ex-ante discipline. To understand how out-of-court market creditor rights can reign in on moral hazard and promote market bond issuance, start by considering the response of insider value to additional market debt:

$$\frac{\partial V}{\partial B_t} = \frac{\partial P(\cdot)B_t}{\partial B_t} + \frac{\partial P(\cdot)B_t}{\partial M^*}\frac{\partial M^*}{\partial B_t} + \frac{1}{\rho_i}\left[p(a_t,M_t)\frac{\partial V(\cdot,\overline{a})}{\partial B_t}\big(1-p(a_t,M_t)\big)\frac{\partial V(\cdot,\underline{a})}{\partial B_t}\right] \tag{2.A.6}$$

Putting changes in governance aside for the moment, the bond pricing equation (2.A.1) implies that additional value market creditors expect to receive tomorrow equals the value insiders expect to loose—as long as there will be no bankruptcy. However, note the difference in discounting:[63]

$$\text{if } V(\cdot,a_t) \geq V_C(\cdot,a_t)\ \forall a_t \in \{\underline{a},\overline{a}\}:$$

$$\frac{\partial P(\cdot)B_t}{\partial B_t} = -\frac{1}{\rho_b}\left[p(a_t,M_t)\frac{\partial V(\cdot,\overline{a})}{\partial B_t} + \big(1-p(a_t,M_t)\big)\frac{\partial V(\cdot,\underline{a})}{\partial B_t}\right] \tag{2.A.7}$$

As soon as the next unit of market debt pushes insiders' future value of operation (in state of low profitability) marginally below their bankruptcy reservation value V_C, market creditors anticipate potential dead-weight losses from bankruptcy, provoking to a non-continuous drop-down in market debt prices, i.e., an infinite slope. Absent bankruptcy risk, plugging (2.A.7) into (2.A.6) yields

$$\frac{\partial V}{\partial B_t} = \underbrace{\left(\frac{1}{\rho_i}-\frac{1}{\rho_b}\right)}_{<0}\underbrace{\left[p(a_t,M_t)\frac{\partial V(\cdot,\overline{a})}{\partial B_t} + \big(1-p(a_t,M_t)\big)\frac{\partial V(\cdot,\underline{a})}{\partial B_t}\right]}_{<0} + \underbrace{\frac{\partial P(\cdot)B_t}{\partial M^*}}_{>0}\underbrace{\frac{\partial M^*}{\partial B_t}}_{\leq 0}$$

Under bankruptcy risk, the first summand becomes *negative* for non-negligible bankruptcy dead-weight because market creditors will receive less in expectation than insiders pay out. Taken together, insiders will issue market debt until the risk of bankruptcy looms—except moral hazard, $\frac{\partial M^*}{\partial B_t} < 0$, drives down the price of market debt too much before that point.[64]

What determines the magnitude of moral hazard effects? Consider how the optimal insider effort, M^*, changes with market bond issuance (at some interior point, i.e., $M^* > 0$):

$$\frac{\partial M^*}{\partial B_t} = \underbrace{\sqrt{\frac{\gamma(a_t)(1-\pi)}{\rho_i 4\big(V(K_t,B_t,\overline{a}) - V(K_t,B_t,\underline{a})\big)}}}_{\equiv\mathscr{A}}\left(\frac{\partial V(K_t,B_t,\overline{a})}{\partial B_t} - \frac{\partial V(K_t,B_t,\underline{a})}{\partial B_t}\right) \tag{2.A.8}$$

63. This logic compels insiders to issue market ebt in the first place, because insiders face higher opportunity cost of funds and their future value shrinks in today's bond issuance today.

64. Remember that market creditors will anticipate any moral hazard and demand yield compensation today, by lowering the price at which they are willing to buy newly issued market debt.

If the firm operates, i.e., $K_t = 0$, the radicand will be finite and strictly positive such that the strength of moral hazard is determined by the differential effect of bond debt on either future state. Specifically,

$$\frac{\partial V(\cdot, a_t)}{\partial B_t} = \begin{cases} -\frac{\partial \tilde{B}(\cdot, a_{t+1})}{B_t} & \text{if } V(\cdot) > V_C(\cdot) \\ 0 & \text{else} \end{cases}$$

Considering equation (2.9), market debt repayment will react one-for-one to bond issuance in financially healthy states where market debt is honoured in full. By contrast, it will increase by only $\Lambda \in [0, 1]$ if regulation binds and will not react at all if debt exchanges occur in unconstrained fashion. Moreover, note that bankruptcy occurs in the good state only if would also take place in the bad, while dead-weight cost will always deter the firm from issuing so much bond as to trigger bankruptcy in all states.

Hence, the differential effect of market debt on future values will be zero if market debt is sufficiently small so that it can be honoured in full in *both* states.[65] For all intermediate levels, the differential effect of bond debt on future states will be negative and equal $-\mathscr{A}$ under unconstrained debt exchanges and $-\mathscr{A}(1 - \Lambda)$ for constrained or over-constrained debt exchanges. That is, as market creditor rights bind and tighten, moral hazard shrinks towards zero, increasing market debt issuance.

Note that the value of market debt issuance changes with Λ only due to moral hazard. This will lead to a non-monotone reaction to expanding market creditor rights: Once moral hazard is shrunk beyond the state-specific threshold, firms will lever up with bond debt until the next unit would provoke bankruptcy dead-weight costs. Ultimately, the jump is due to the discrete nature of the profitability state space carrying positive point masses. A continuum of profitability states, by contrast, would imply some continuum of thresholds such that effects on market debt issuance cumulate continuously with growing Λ.

Market debt and investment. To understand how exactly bond finance can spur additional investment, consider how insider value changes with additional investment while assuming for now that insiders will not want to file for bankruptcy in t nor in either state of $t + 1$:

$$\frac{\partial V}{\partial K_t} = -1 + \frac{1}{\rho_i}\left[p(a_t, M_t)\frac{\partial V(\cdot, \overline{a})}{\partial K_t} + \left(1 - p(a_t, M_t)\right)\frac{\partial V(\cdot, \underline{a})}{\partial K_t}\right] + \frac{\partial P(\cdot)B_t}{\partial K_t} + \frac{\partial P(\cdot)B_t}{\partial M^*}\frac{\partial M^*}{\partial K_t}$$

Using an argument similar to that underlying Equation (2.A.7), bondholders can expect to receive what insiders expect to give up—or less, in case of bankruptcy. That is, there is equivalence in the first order conditions up to the discount factor—with a discontinuity around

65. Theoretically, market debt may be so large as to trigger debt resolution in *both* states, in which case the differential effect of market debt on future values will be zero as well. For $\alpha \in (0, 1)$, this would lead to bond-to-asset ratios of above 1. These equilibria are infeasible if insider governance is sufficiently sufficiently sensitive, i.e., moral hazard is non-negligible, see Equation (2.A.6).

bankruptcy, where the derivative becomes ∞. Hence, analogous to before, but implicitly allowing for bankruptcy as indicated by the inequality:

$$\frac{\partial V}{\partial K_t} \geq \overbrace{-1 + \frac{1}{\rho_i}\left[p(a_t, M_t)(\alpha \overline{a} K_t^{\alpha-1} + 1 - \delta) + \big(1 - p(a_t, M_t)\big)(\alpha \underline{a} K_t^{\alpha-1} + 1 - \delta)\right]}^{\text{Baseline marginal value}}$$
$$+ \underbrace{\left(\frac{1}{\rho_b} - \frac{1}{\rho_i}\right)\left[p(a_t, M_t)\frac{\partial \tilde{B}(\cdot, \overline{a})}{\partial K_t} + \big(1 - p(a_t, M_t)\big)\frac{\partial \tilde{B}(\cdot, \underline{a})}{\partial K_t}\right] + \frac{\partial P(\cdot)}{\partial M^*}\frac{\partial M^*}{\partial K_t}B_t}_{\text{Additional marginal value from bonds}}$$

That is, bond issuance makes investment more valuable because it effectively applies a higher discount factor to the portion of the continuation value which is pledged to outside market creditors—or even averts bankruptcy. In addition, investment functions as commitment device attenuating moral hazard associated to outstanding market debt.[66]

In the model, marginal value of investment related to the discount rate differential may disappear in some states, e.g., when there is no restructuring in the high-profitability and constrained restructuring in the low-profitability state. However, this is an artifact of a discrete profitability state space. Under continuous profitability state—i.e., a probability-weighted integral inside the square brackets of the lower term—there would always be some state with unconstrained bond exchanges. Hence, future bondholder values, and thus current bond prices, would always be sensitive to investment policy.

How market creditor rights ultimately increase investment. For sufficiently small levels of Λ, bond restructuring (in the poor profitability state) will be unconstrained. The exact level is determined by the balance between the value of substituting insider finance on the one hand and the moral hazard effects scaled by the sensitivity of bond prices to success probability in turn scaled by the sensitivity of success probability to governance on the other. There will be some equilibrium bond exchange hair-cut x such that from $\Lambda = x$ onward, exchanges become constrained and abruptly shrink the negative effect of moral hazard from $-\mathscr{A}(1-0)$ to $-\mathscr{A}(1-\Lambda)$.

66. Note that

$$\frac{\partial \tilde{B}(K_t, B_t, a_{t+1})}{\partial K_t} = \begin{cases} 0 & \text{if no haircut, i.e., } B(K_t, B_t, a_{t+1}) = B_t \\ (1-\beta)(\alpha a_{t+1} K_t^{\alpha-1}) - \omega & \text{if unconstrained, i.e., } B_t > B(K_t, B_t, a_{t+1}) > \Lambda B_t \\ 0 & \text{if constrained, i.e., } B_t > B(K_t, B_t, a_{t+1}) = \Lambda B_t \end{cases}$$

as well as

$$\begin{aligned} \frac{\partial M^*}{\partial B_t} &= \mathscr{A}\left(\frac{\partial V(K_t, B_t, \overline{a})}{\partial K_t} - \frac{\partial V(K_t, B_t, \underline{a})}{\partial K_t}\right) \\ &= \mathscr{A}\left(\alpha K_t^{\alpha-1}(\overline{a} - \underline{a}) + \frac{\partial \tilde{B}(\cdot, \underline{a})}{\partial K_t} - \frac{\partial \tilde{B}(\cdot, \overline{a})}{\partial K_t}\right) \\ &> 0 \end{aligned}$$

The marginal benefit of issuing bonds jumps up, remaining positive until bond debt becomes so large as to threaten bankruptcy (in the poor profitability state) next period. Yet, exchange offers start becoming attractive in the other state, (re-)activating the bond-related marginal value of investment and thus prompting capital to grow as long as bondholder recovery is sensitive to investment.[67] The motion comes to a halt once the volume of market leverage hits the bankruptcy boundary.

The non-monotone increase in bond issuance and investment roots in the discrete nature of the profitability state space. By contrast, a continuum profitability states implies some continuum of thresholds $\{x_j\}$. When Λ passes the next threshold, effects on bond issuance and investment cumulate continuously.

2.A.2 Numerical implementation

I solve the model using value function iteration, plugging the closed-form solution for M^* of Equation (2.11) into bondholders willingness to pay given by Equation (2.A.1).[68]

67. If bankruptcy dead-weight loss is sufficiently small or profitability states sufficiently far apart, the process may not trigger that intermediate stage and thus leave the capital stock unchanged. However, this is an artefact of only modelling two profitability states: Generally, growing bond debt triggers unconstrained restructuring—activating the additional value for ex-ante investment—in the future state neighbouring the constrained state in terms of profitability. As the set of profitability states grows to infinity, the minimal bankruptcy dead-weight loss thus shrinks to zero.

68. Value function iteration alone would be insufficient without a closed-form solution of M_t^*. That is, for other functional forms of $c(M_t)$ and $p(M_t)$ that do not permit such a solution, value function iteration would be conditional on a (state-dependent) guess for M_t^* and have to be wrapped into an outer numerical root finding procedure for the equilibrium effort policy. Legacy code for this solution approach is stored in module `./compute/theory/model_armslength_dynamic/modules/_archive/twoStage/`

1.) Stipulate investor beliefs about the effort policy $M_t^*(B_{t-1}, K_{t-1}, a_t)$. (Possibly use the fact that in a simple version of the model policies will be state-*independent*, i.e., constant across states.)

2A.) Find the corresponding (firm insider) policy mapping based on value function iteration.

- 2.1) Guess a value function.
- 2.2) Given investor beliefs and value function guess, compute the right-hand side of the Bellman equation (2.7) for all states (K_{t-1}, B_{t-1}, a_t) to obtain new value function.
- ↻ Iterate until the maximal absolute discrepancy between guessed and resultant value function falls below a (small) threshold.
- 2.3) Obtain policy mapping for final value function and stipulated investor beliefs.

2B.) Find the corresponding (firm insider) policy mapping based on numerical root finding (this guards against non-convergence in the iteration, but is computationally much more expensive of course).

- 2.1) Guess a value function.
- 2.2) Given investor beliefs and value function guess, compute the right-hand side of the Bellman equation (2.7) for all states (K_{t-1}, B_{t-1}, a_t).
- 2.3) Calculate the absolute discrepancy in the Bellman equation across all states, take maximum.
- ↻ Repeat with procedure (Broyden) numerically minimising the maximal absolute value function discrepancy.
- 2.4) Obtain policy mapping for final value function and stipulated investor beliefs.

1) Guess a value function (stipulate the terminal value function $V(\cdot) = 0$).
2) Compute the right-hand side of the Bellman equation (2.7), including M^*, for all states $(K_{t-1}, B_{t-1}, S_{t-1}, a_t)$ to obtain a new value function.

↻ Iterate until the maximal absolute discrepancy between guessed and resultant value function falls below a (small) threshold.

3) Obtain policy mapping for final value function.

2.A.3 Calibration

Table 2.A.1 shows the calibration of the 13 parameters. Where applicable, I target related moments from risky *compustat* firms (S&P entity rating BBB- or worse), using a full decade of data, 2010Q1-2019Q4, to capture a robust number of extreme profitability observations.

ρ_b is set to 1%, slightly above the three-month US Treasury bill rate around the Marblegate ruling.

β is set to 0.05, consistent with empirical evidence on total direct and indirect costs of bankruptcy, estimated to range between 1% and 20% of the firm's going concern value (Hotchkiss et al., 2008; Lubben, 2012; Epaulard and Zapha, 2022).

δ is set to the empirical average quarterly depreciation rates of 0.013.

θ is set to 0.01, consistent with an asset liquidation value of about 40% in an "orderly liquidation process" spanning three quarters (Kermani and Ma, 2022).

ω is set to 0.289, the average volume of secured loans relative to assets at the eve of a bankruptcy filing in compustat data.

The following parameters are calibrated jointly to match the moments shown in the main text Figure 2.2, i.e., average bonds-to-assets ratio, average profitability as well as its dispersion across states, the probability to transition from the high into the low profitability state and the duration distribution of low-profitability spells. Each parameter affects certain model features more than others.

ρ_i is set to ρ_b + 10 basis points, primarily targeting the average bond share

α is set to 0.85, primarily targeting average profitability[69]

$\overline{a}, \underline{a}$ are set to 0.02 and -0.10, primarily targeting the dispersion of profitability (while generating the need for debt restructuring, without which the model would be uninteresting)

---

3) Compute maximal absolute discrepancy between actual effort policy and corresponding investor beliefs.

↻ Repeat with procedure to minimising the maximal absolute discrepancy in policies (either Broyden or, under state-independent policies, loop through all points on the M grid.).

69. Existing structural estimates have found the curvature of operating profits to be 0.55 (Hennessey and Whited, 2005). However, these models featured constantly changing profitability which renders the capital stock generally suboptimal, reducing profit rates. By contrast in my model, firms eventually hit the optimal capital stock and stick with it for a potentially long time. These models were also estimates on annual data.

$\pi, \underline{\gamma}$ are set to 0.195 and ∞ primarily targeting the duration distribution of spells of low profitability

$\overline{\gamma}$ is set to 1×10^{-6}, primarily targeting the probability to transition from high to low profitability

Λ is set to 0.57, primarily targeting the average bond share

Table 2.A.1. Parameter calibration values

ρ_b	Market discount rate	1.0100000
ρ_i	Insider discount rate	1.0110000
α	Profit curvature	0.8500000
δ	Depreciation rate	0.0130000
θ	Ease of liquidation	0.0100000
π	Base success probability	0.1950000
$\overline{a}$	High profitability	0.0200000
$\underline{a}$	Low profitability	-0.1000000
$\underline{\gamma}$	Governance costs, unfortunate state	9.9990000
$\overline{\gamma}$	Governance costs, fortunate state	0.0000010
Λ	Out-of-court market creditor rights	0.5700000
ω	Share of senior insider claims	0.2890000
β	Bankruptcy dead-weight loss	0.0500000

Notes: All model parameters alongside short description and the value set during calibration to match data moments.

2.A.4 Additional results and predictions

Analogous to Figure 2.3 in the main text, Figure 2.A.1 presents the comparative statics with respect to market creditor protection Λ for additional model variables: Total firm value $V(K_{t-1}, 0, a_t)$ (i.e., its going concern value), bond intensity B_t/K_t, governance costs M_t and the bond issuance price $P(\cdot)$.

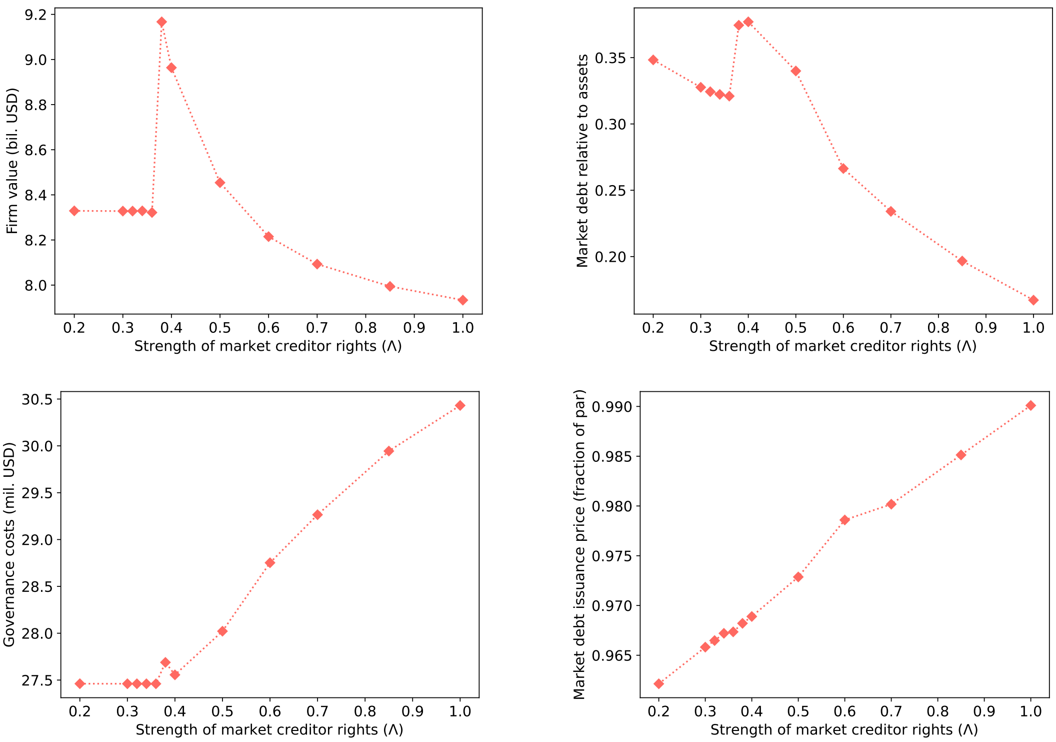


Figure 2.A.1. Bond market creditor rights and firm outcomes

Notes: Comparative statics across Λ; average across a firm's life-cycle obtained from 5000 model firms simulated for ten years (40 model periods). Units scaled such that average capital in the baseline ($\Lambda = 0.57$) matches compustat's average asset value in US Dollars for risky non-financial firms.

Appendix 2.B Model of bond restructuring with asymmetric information

In this section, I illustrate theoretically i) how an coalition of debtor and relationship creditors can extract information rents from restructuring arm's-length debt, ii) why these information rents can undermine investment success and iii) clarify under which assumptions law should protect arm's-length creditors out-of-court and by how much. The model builds on the following key notions:

(1) Arm's-length creditors hold significantly *less information* about business prospects than the debtor and its relationship creditors, which I will refer to as "insiders". This can result in a transfer of value from arm's-length creditors to insiders when debt needs to be restructured.

(2) Information rents make the state of financial distress less dreadful for insiders, undermining incentives to exert managerial effort (debtor) and engage in costly monitoring (relationship creditors). At the same time, arm's-length creditors demand compensation through higher rates ex-ante, making investment success—where arm's-length debt obligations are honoured in full—less attractive. Both forces *dis-incentivise insiders* to implement costly (but efficient) measures maximising the investment's net present value (NPV).

(3) Insiders *cannot commit* ex ante to forego information rents ex post. Contracts are incomplete and arm's-length creditors face prohibitive frictions in adjusting contracts ex-post. Emerging contractual loopholes allow insiders to undermine and hollow-out protective provisions possibly stipulated ex ante.

Investment choice. Consider a single-project firm that requires a fixed amount α of arm's-length credit to pursue an investment opportunity.Other financing is provided by insiders: firm owners and relationship creditors. To focus the analysis, I abstracts from agency frictions between insiders. That is, I assume that they share value accruing to the group as a whole in a way that aligns individual incentives with the objective of maximising total group value.[70]

Insiders maximise their expected value $E[V_i(\cdot)]$ choosing management and monitoring strategies $\boldsymbol{m}$ and gross return to arm's-length credit R_a. To supply α, creditors must cover their opportunity cost of funds ρ in expectation. Because arm's-length creditors do not acquire insider information, they effectively cannot contract on management or monitoring $\boldsymbol{m}$. Instead, they will anticipate insiders' equilibrium choice $\boldsymbol{m}^*$:[71]

$$\max_{\boldsymbol{m},R_a} E\Big[V_i(\boldsymbol{m},R_a)\Big] \quad \text{s.t.} \quad E\Big[V_a(\boldsymbol{m}^*,R_a)\Big] \geq \rho\alpha \tag{2.B.1}$$

The following assumptions clarify the structure and distribution of $V_i(\cdot)$ and $V_a(\cdot)$.

Investment outcomes and information structure. Investment success depends on management and monitoring $\boldsymbol{m}$ as well as unobserved factors. Agents learn the investment outcomes *after* the implementation of $\boldsymbol{m}$ and common ex ante beliefs about the distribution of unobserved factors imply a success probability of $p(\boldsymbol{m})$ and a failure probability of $1-p(\boldsymbol{m})$. Success yields cash flows Φ while failure cash flows ϕ fall between $\underline{\phi}$ and $\overline{\phi}$ with uniform probability. The variability of ϕ is key: While everybody is able to observe investment success and infers failure otherwise, arm's-length creditors do not observe the exact realisation of ϕ upon failure: the actual extent of the economic malaise is insider information. Figure 2.B.1 summarises key features of the investment process.

Management and monitoring $\boldsymbol{m}$ is associated to cost $c(\boldsymbol{m})$ born privately by insiders. I assume that cost grow with management and monitoring quality, specifically:

$$p(\boldsymbol{m}_1) > p(\boldsymbol{m}_1) \implies c_i(\boldsymbol{m}_1) > c_i(\boldsymbol{m}_1), \tag{2.B.2}$$

70. The literature on conflicts between shareholders, management and creditors is vast and particular attention is given to information asymmetries and agency frictions between entities which I refer to as insiders in this chapter. Without trivialising the economic importance of these frictions, my assumption rules out that they *interact* with arm's-length creditor rights. Exploring such interactions appears to be an interesting route for future research. The notion that insiders share value in various states of the world is consistent with important practical features of distressed restructurings as well as bargaining power of relationship creditors over firm profits (Rajan, 1992).

71. This is the key characteristic of arm's-length lending. No monitoring can be desirable because i) it taps the credit supply of dispersed investors each holding small positions due to a diversification objective given limited funds, making monitoring prohibitively costly or ii) to reduce ex-post hold-up associated to relationship lending (Rajan, 1992).

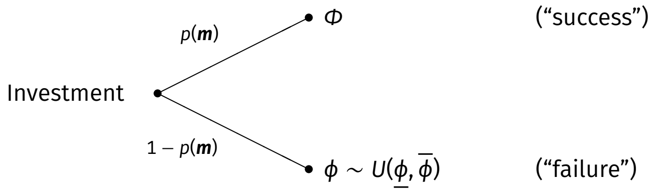


Figure 2.B.1. Investment outcomes

Perfect management and monitoring is infinitely costly, while insider behaviour without costs is completely ineffective:

$$p(\boldsymbol{m}) \rightarrow 1 \iff c_i(\boldsymbol{m}) \rightarrow \infty \tag{2.B.3}$$

$$p(\boldsymbol{m}) = 0 \iff c_i(\boldsymbol{m}) = 0 \tag{2.B.4}$$

In-court debt restructuring. I assume that investment failure always implies insolvency by setting $\overline{\phi} < \rho$ such that available cash flows will always fall short of even the lightest contractual debt obligations that could possibly be compatible with creditor participation.

Insolvency can be resolved in front of a bankruptcy court at the cost of δ. In this case, the court learns the realisation of ϕ and distributes value remaining after covering the verification costs δ according to absolute priority

$$\hat{R}_a \alpha = \phi - \delta, \tag{2.B.5}$$

leaving $\phi - \delta - R_a \alpha = 0$ to firm owners. Naturally, I assume that the bankruptcy court can bind hold-outs and order arm's-length creditors to relinquishing their original claims R_a and accept $\hat{R}_a$.

Without loss of generality, I assume that $\underline{\phi} \geq \delta$, implying bankruptcy being always an economically viable option. Both insiders and arm's-length creditors can initiate a bankruptcy procedure.

Out-of-court debt restructuring. Insolvency can alternatively be resolved out-of-court through a private debt exchange offer. An out-of-court resolution saves the verification costs ϕ of court procedures.[72] Because arm's-length creditors do not know the actual value of the firm ϕ, they would agree to exchange their claims $R_a \alpha$ against devalued debt securities $\tilde{R}_a \alpha$ if the value of new securities is greater or equal to what they can *expect* to extract from a bankruptcy process. Such debt exchanges face two complications.

72. Thus, out-of-court resolution is always increases ex-post efficiency.

First, I assume that arm's-length creditors are dispersed in the sense of individually holding very small positions with prohibitively costly coordination. As a result, arm's-length creditors have the incentive to free-ride on the debt hair-cuts of the others. Without coercion, all creditors will thus hold out, making out-of-court restructuring infeasible. By contrast, if the firm is able to coerce hold-out creditors to accept a return of Λ, offers $\tilde{R}_a > \Lambda$ become viable. I assume that Λ is set by the legislator ("arm's-length creditor rights").[73] Arm's-length creditors are always free to drag a failed firm before the bankruptcy court and realise $\hat{R}_a \alpha = E_a[\phi] - \delta$. Hence, effective out-of-court coercion implies

$$\tilde{R}_a \geq \max\left(\Lambda, \frac{E_a[\phi] - \delta}{\alpha}\right) \tag{2.B.6}$$

Second, the fact that an offer $\tilde{R}_a$ is made can reveal information to arm's-length creditors about ϕ. I denote the mapping between the state ϕ and insiders' choice to make an offer by the binary $W(\phi) \in \{0,1\}$.[74] This information will update their expectations of bankruptcy payoffs and hence possibly shift effective out-of-court coercion, on which insiders depend to bind hold-outs. Arm's-length creditors expect insiders to play the strategy that maximises their payoff. In equilibrium, thus, they know insiders' mapping between ϕ and $(W, \tilde{R}_a)$ and can use it to back-out information about ϕ. Ultimately, arm's-length creditors are willing to leave value to insiders in exchange for saving bankruptcy cost δ. This ability of debt exchange offers to make arm's-length creditors better off by saving the cost of formal bankruptcy procedure is what makes it viable and efficient.

Payoff structure. Based on assumptions above, agents form rational expectations about potential future payoffs at the time of contracting:

$$E\Big[V_i(\boldsymbol{m}, R_a)\Big] = p(\boldsymbol{m})(\Phi - R_a\alpha) + \Big(1 - p(\boldsymbol{m})\Big)E\Big[W(\phi)(\phi - \tilde{R}_a(\phi)\alpha)\Big] - c_i(\boldsymbol{m}) \tag{2.B.7}$$

$$E\Big[V_a(\boldsymbol{m}^*, R_a)\Big] = p(\boldsymbol{m}^*)R_a\alpha + \Big(1 - p(\boldsymbol{m}^*)\Big)E\Big[W(\phi)\tilde{R}_a(\phi)\alpha + \Big(1 - W(\phi)\Big)(\phi - \delta)\Big] \tag{2.B.8}$$

Solution and predictions. The model can be solved via backward induction. Details are described in the following appendix subsection. The core implications of aforementioned assumptions are the following:

Upon investment failure and conditional on remaining value ϕ, the firm decides whether to make a debt exchange offer ($W(\phi)$) and if so, how generous it shall be ($\tilde{R}_a(\phi)$). In equilibrium, arm's-length creditors rationally anticipate insiders' strategies $W(\phi)$ and $\tilde{R}_a(\phi)$ and can use realisations to back-out information about ϕ. Hence, insiders will make the level of $\tilde{R}_a$ independent of ϕ to reveal no information through the generosity of the exchange and fully extract its informational rent. For levels of ϕ for which the equilibrium offer $\tilde{R}_a$ would induce losses,

73. Λ may vary with verifiable firm characteristics, such as its contractual structure. But cannot depend on ϕ because the government and its courts do not know ϕ (without incurring the bankruptcy cost δ).

74. $W = 0$ implies resolution via the bankruptcy court.

insiders will rather choose for file for bankruptcy ($W(\phi) = 0$)—and receive nothing.[75] Hence, the value offered has to be larger than what creditors can expect from bankruptcy *conditional* on the signal that an exchange offer has been actually made ($W(\phi) = 1$).[76] As I show in the appendix, insiders' information rent—the value they can extract out-of-court although the firm is insolvent—equals

$$\min\left(\delta, \frac{\overline{\phi} - \underline{\phi}}{2}\right) \tag{2.B.9}$$

that is, the firm's information rent increases in the distance $(\overline{\phi} - \underline{\phi})/2$, i.e., the creditors' uncertainty about the state, up to the full gain from avoiding bankruptcy, δ. In the extreme case of a degenerate distribution ($\overline{\phi} = \underline{\phi}$), there is no information asymmetry and hence no information rent.

Importantly, the legislator can redistribute the value of private debt workouts by changing Λ. In the case that arm's-length creditor rights Λ are strong enough ($\Lambda > E_a[\phi|W(\phi)] - \delta/\alpha$), arm's-length creditor recovery increases, eating into the information rents of insiders. Importantly, insiders will change when to offer to exchange debt in response, leading to fewer out-of-court restructuring and thus *additional* bankruptcy costs in expectation of

$$\delta\left(\Lambda\alpha - \max(\underline{\phi}, \overline{\phi} - 2\delta)\right) > 0 \tag{2.B.10}$$

The first-order conditions to the problem of choosing ex-ante business strategy and credit return then imply

$$\boldsymbol{p}'(\boldsymbol{m}^*)\left(\Phi + \frac{(1-p(\boldsymbol{m}^*))V_a^f - \rho\alpha}{p(\boldsymbol{m}^*)} - V_i^f\right) = \boldsymbol{c}_i'(\boldsymbol{m}^*) \tag{2.B.11}$$

$$R_a^* = \frac{\rho\alpha - (1-p(\boldsymbol{m}^*))V_a^f}{p(\boldsymbol{m}^*)} \tag{2.B.12}$$

Re-distribution of value from insiders to arm's-length creditors in the state of investment failure increases the bracketed term in (2.B.11). If $p(\cdot)$ is more concave than $c(\cdot)$—common and plausible assumptions—the first order condition dictates an increase in the success probability $p(\cdot)$. Intuitively, a more dreadful outcome upon investment failure incentivises insiders to exert privately costly effort to increase the probability of investment's success. This is the key rationale

75. Insider's debt exchange policy will not involve mixing because of the following considerations: i) Any shift away from the optimal jump location in $W(\phi)$ as well as any shift in the optimal $\tilde{R}_a$ yields lower payoff, hence, mixing such levels is suboptimal. ii) Any increase of $W(\cdot)$ to values larger than 0 in regions where $\phi - \tilde{R}_a$ is negative, as well as and reductions in regions where $\phi - \tilde{R}_a$ is positive reduces the insiders' payoff. Hence, mixing such levels reduces payoffs as well.

76. Arm's-length creditors will in never play mixing strategies. For each creditor it is not individually rational to mix between tendering and taking the coercion pay-out Λ. By assumption of dispersion, it is also no equilibrium to mix between tendering and filing for bankruptcy: Dispersion as assumed earlier prevents coordination and implies an infinite number of identical creditors and thus any mixing of bankruptcy implies bankruptcy with certainty.

for protecting arm's-length creditor rights in out-of-court debt restructuring. There is a countervailing force, however. When the expected costs of bankruptcy filings increase by more than what arm's-length creditors can expect to gain out-of-court, R_a has to rise ex-ante to compensate. This undermines the desirability of investment *success* from the point of view of insiders, discouraging effort and hence reducing the value of investment. Overall, protecting arm's-length creditors may thus back-fire.

To illustrate these forces, I use a numerical example based upon the following additional functional form assumptions with $b > 0$ and $\theta > 0$:

$$\begin{aligned} p(b) &= \frac{b}{1+b} && \in [0,1) \\ c(b) &= \theta b && > 0 \end{aligned}$$

The explicit model solution then allows to assess ex-ante expected values of investment $E[V_i(\cdot)]$ across different calibrations of arm's-length creditor protection Λ.[77] Figure 2.B.2 illustrates the trade-off for insider incentives set by arm's-length creditor rights: Up to the point where arm's-length creditor protection is sufficiently weak—i.e., out-of-court coercion is weaker than in-court coercion—private workouts are unaffected as shown by a flat expected investment value. In this calibration, arm's-length creditor rights start to bite at $\Lambda = 0.8$. At first, the redistribution unfolds positive effects on insider incentives to labour for the investment's success ex-post of contracting. However, when creditor protection start to frustrate too many private debt exchange offers, arm's-length creditor's gain on the surviving ones get swamped by the increasing dead-weight cost of bankruptcy—and lending rates grow again to the point where they revert insider incentives to labour for the good state (in which these high debt obligations are to be honoured in full).[78]

2.B.1 Solution of the model with asymmetric information

The model can be solved via backward induction.

Investment outcome: Failure. Upon investment failure and conditional on remaining value ϕ, the firm decides whether to make a debt exchange offer ($W(\phi)$) and if so, how generous it shall be ($\tilde{R}_a(\phi)$).

In equilibrium, arm's-length creditors know the firm's mapping between ϕ and $\tilde{R}_a$ and can use its to back-out information about ϕ. Hence, the firm will make the level of $\tilde{R}_a$ independent

77. Note that the net value of arm's-length creditors $E[V_a(\cdot)] - \rho\alpha$ will be zero in equilibrium, such that the total value of investment and the incentive for the firm to undertake coincide.

78. Obviously, the size of possible gains depends on the calibration. In fact, under some constellations, gains can be enormous while for others, there never can be any benefits from additional legislative interference. That is, Marblegate might have benefited some firms and not others and the questions primarily concerns the average firm exposed to the verdict.

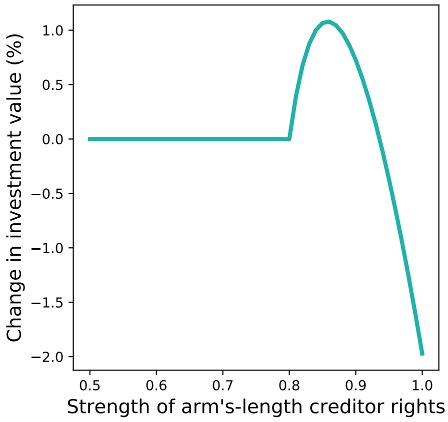


Figure 2.B.2. Arm's-length creditor rights and the value of investment

Notes: Functional form assumptions of $p(b) = b/(1+b)$ and $c_i(b) = \theta b$ with $b \geq 0$. Plot shows expected value of investment ($E[V_i]$) relative to laissez-faire level at $\Lambda = 0$ across degrees of arm's-length creditor protection (Λ). All other parameters are held fixed at the following levels: $\alpha = 1$, $\rho = 1.01$, $\Phi = 1.3$, $[\underline{\phi}, \overline{\phi}] = [0.2, 1.0]$, $\delta = 0.1$ and $\theta = 0.0025$. Across calibrations, arm's-length creditors contract for a gross rate R_a between 1.07 and 1.08; success probability $p(\cdot)$ ranges from 85 to 90%.

of ϕ to fully extract its informational rent. For levels of ϕ for which the equilibrium offer $\tilde{R}_a$ induces losses, the firm will rather choose for file for bankruptcy ($W(\phi) = 0$)—and receive nothing.[79] Hence, the value offered has to be larger than what creditors can expect from bankruptcy *conditonal* on the signal that an exchange offer has been actually made. Adding the constraint of effectively feasible out-of-court coercion, such an equilibrium strategy solves the following problem:[80]

$$\max_{\tilde{R}_a \in \mathbb{R}_+, W(\phi) \in \{0,1\}} \Big(W(\phi)(\phi - \tilde{R}_a \alpha) \Big) \tag{2.B.13}$$

$$\text{s.t.}$$

$$W(\phi)\tilde{R}_a \alpha \;\geq\; W(\phi)\Big(E_a[\phi | W(\phi)] - \delta\Big) \tag{2.B.14}$$

$$W(\phi)\tilde{R}_a \;\geq\; W(\phi) \max\left(\Lambda, \frac{E_a[\phi | W(\phi)] - \delta}{\alpha}\right) \tag{2.B.15}$$

79. Firm's debt exchange policy will not involve mixing because of the following considerations: i) Any shift away from the optimal jump location in $W(\phi)$ as well as any shift in the optimal $\tilde{R}_a$ yields lower payoff, hence, mixing such levels is suboptimal. ii) Any increase of $W(\cdot)$ to values larger than 0 in regions where $\phi - \tilde{R}_a$ is negative, as well as and reductions in regions where $\phi - \tilde{R}_a$ is positive reduces the firm's payoff. Hence, mixing such levels reduces payoffs as well.

80. Arm's-length creditors will in never play mixing strategies. For each creditor it is not individually rational to mix between tendering and taking the coercion pay-out Λ. By assumption of dispersion, it is also no equilibrium to mix between tendering and filing for bankruptcy: Dispersion as assumed earlier prevents coordination and implies an infinite number of identical creditors and thus any mixing of bankruptcy implies bankruptcy with certainty.

Firm's payoff strictly decreases in $\tilde{R}_a$, hence the first constraint will bind. Upon receiving an offer ($W(\phi) = 1$), arm's-length creditors learn that the residual value $\phi - \tilde{R}_a\alpha$ is non-negative. Thus:[81]

$$\begin{aligned}
E_a[\phi | W(\phi) = 1] &= E_a[\phi | \phi \geq \tilde{R}_a\alpha] \\
&= \frac{\max(\underline{\phi}, \tilde{R}_a\alpha) + \overline{\phi}}{2} \\
&= \begin{cases} \frac{\tilde{R}_a\alpha + \overline{\phi}}{2} & \text{if } \tilde{R}_a\alpha > \underline{\phi} \\ E_a[\phi] & \text{if } \tilde{R}_a\alpha = \underline{\phi} \end{cases}
\end{aligned} \tag{2.B.16}$$

Given the first constraint, the second constraint either becomes redundant or will be binding for exchange offers. If the second constraint does not bind (and hence becomes redundant), the optimal generosity of debt exchange offers can be determined by substituting 2.B.16 into the first constraint (still with $W(\phi) = 1$):

$$\begin{aligned}
&\text{If } \tilde{R}_a\alpha > \underline{\phi} : & \tilde{R}_a\alpha &= \frac{\tilde{R}_a\alpha + \overline{\phi}}{2} - \delta \\
&\iff & \tilde{R}_a\alpha &= \overline{\phi} - 2\delta \\
&\iff & \tilde{R}_a &= \frac{\overline{\phi} - 2\delta}{\alpha} \\
&\text{else} & \tilde{R}_a &= \frac{\underline{\phi}}{\alpha} \\
&\implies & \tilde{R}_a^* &= \frac{\max(\underline{\phi}, \overline{\phi} - 2\delta)}{\alpha}
\end{aligned} \tag{2.B.17}$$

For which ϕ will the firm actually offer to exchange debt?

$$W^*(\phi) = \mathbb{1}(\phi - \max(\underline{\phi}, \overline{\phi} - 2\delta) > 0) \tag{2.B.18}$$

That is, upon investment failure and under sufficiently weak arm's-length creditor rights, firm owner can expect to extract an information rent of

$$\begin{aligned}
E[W^*(\phi)(\phi - \tilde{R}_a^*\alpha)] &= E[(\phi - \max(\underline{\phi}, \overline{\phi} - 2\delta) | \phi > \max(\underline{\phi}, \overline{\phi} - 2\delta))] \\
&= E[(\phi | \phi > \max(\underline{\phi}, \overline{\phi} - 2\delta))] - \max(\underline{\phi}, \overline{\phi} - 2\delta) \\
&= \frac{\max(\underline{\phi}, \overline{\phi} - 2\delta) + \overline{\phi}}{2} - \max(\underline{\phi}, \overline{\phi} - 2\delta) \\
&= \frac{\overline{\phi} - \max(\underline{\phi}, \overline{\phi} - 2\delta)}{2} \\
&= \min\left(\delta, \frac{\overline{\phi} - \underline{\phi}}{2}\right)
\end{aligned} \tag{2.B.19}$$

81. Using that i) ϕ is uniformly distributed, ii) in equilibrium, firms cannot offer less than $\underline{\phi}$ without provoking a bankruptcy filing by arm's-length creditors.

That is, the firm can increase an information rent that increases in the distance $(\overline{\phi}-\underline{\phi})/2$, i.e., the creditors' uncertainty about the state, up to the full gain from avoiding bankruptcy. In the extreme case of a degenerate distribution ($\overline{\phi}=\underline{\phi}$), there is no information asymmetry and hence no information rent.

In the case that arm's-length creditor rights Λ are strong enough ($\Lambda > E_a[\phi|W(\phi)] - \delta/\alpha$), the second constraint will be binding (again, because firm's payoff strictly decreases in $\tilde{R}_a$), implying

$$W(\phi)\tilde{R}_a = W(\phi)\Lambda \quad \Longleftrightarrow \quad \tilde{R}_a^{**} = \Lambda$$

Specifically, arm's-length creditor rights Λ are "strong enough" if[82]

$$\begin{aligned} & \Lambda > \frac{E_a[\phi|W(\phi) = 1] - \delta}{\alpha} \\ \Longleftrightarrow \quad & \Lambda > \frac{\max(\underline{\phi}, \tilde{R}_a^{**}\alpha) + \overline{\phi} - 2\delta}{2\alpha} \\ \Longleftrightarrow \quad & \Lambda > \frac{\max(\underline{\phi}, \Lambda\alpha) + \overline{\phi} - 2\delta}{2\alpha} \\ \Longleftrightarrow \quad & \Lambda > \frac{\max(\underline{\phi}, \overline{\phi} - 2\delta)}{\alpha} \end{aligned} \tag{2.B.20}$$

Intuitively, strong arm's-length creditor rights increase their recovery ($\tilde{R}_a^{**} > \tilde{R}_a^{*}$), eating into the information rents of firm owners. Importantly, firms will also change when to offer to exchange debt:

$$W^{**}(\phi) = \mathbb{1}(\phi - \Lambda\alpha > 0) \tag{2.B.21}$$

Ultimately, the re-distributional effect comes at the expense of fewer out-of-court restructuring and thus *additional* bankruptcy costs in expectation:

$$\begin{aligned} \delta E[(1 - W^{**}(\phi)) - (1 - W^{*}(\phi))] &= \delta E[W^{*}(\phi) - W^{**}(\phi)] \\ &= \delta E\Big[\mathbb{1}(\phi - \max(\underline{\phi}, \overline{\phi} - 2\delta) > 0) - \mathbb{1}(\phi - \Lambda\alpha > 0)\Big] \\ &= \delta E\Big[\mathbb{1}(\max(\underline{\phi}, \overline{\phi} - 2\delta) < \phi < \Lambda\alpha)\Big] \\ &= \delta P(\max(\underline{\phi}, \overline{\phi} - 2\delta) < \phi < \Lambda\alpha) \\ &= \delta\Big(\Lambda\alpha - \max(\underline{\phi}, \overline{\phi} - 2\delta)\Big) > 0 \end{aligned} \tag{2.B.22}$$

Investment outcome: Success. Upon investment success, there are no choices and cash flows are distributed according to ex-ante contracts.

82. Using that $\max(\underline{\phi}, \Lambda\alpha) = \Lambda\alpha$ as otherwise the information set binds the firm's exchange offer, not the law.

Ex ante contracting and choice of business strategy. Because firm owners' expected payoff strictly falls in R_a, they will offer interest such that arm's-length creditors are just willing to lend, i.e., their participation constraints binds:

$$E\Big[V_a(R_a,\boldsymbol{b}^*,\boldsymbol{\sigma},\phi)\Big] = \rho\alpha \tag{2.B.23}$$

Substituting transforms the firm's ex-ante objective into

$$\max_{\boldsymbol{b}} p(\boldsymbol{b})\left(\Phi - \frac{\rho\alpha-(1-p(\boldsymbol{b}^*))V_a^f}{p(\boldsymbol{b}^*)}\right)+\big(1-p(\boldsymbol{b})\big)V_e^f - c_e(\boldsymbol{b}) \tag{2.B.24}$$

where V_a^f and V_e^f denote the expected payoffs in case of investment failure for both agent types, which are independent of $\boldsymbol{b}$:

$$V_e^f = E\big[W(\phi)(\phi-\tilde{R}_a(\phi)\alpha)\big] \tag{2.B.25}$$

$$V_a^f = E\big[W(\phi)\tilde{R}_a(\phi)\alpha+\big(1-W(\phi)\big)(\phi-\delta)\big] \tag{2.B.26}$$

Using previous solutions on the firm's debt exchange policy, these values can be expressed in terms of model parameters only. Recall that in equilibrium, offered amounts are actually independent of ϕ. If arm's-length creditor rights are sufficiently strong to affect out-of-court exchanges ($\Lambda > \max(\underline{\phi},\overline{\phi}-2\delta)/\alpha$), expected failure payoffs become

$$\begin{aligned} V_e^f &= E\big[W^{**}(\phi)(\phi-\tilde{R}_a^{**}\alpha)\big] \\ &= \frac{\overline{\phi}-\Lambda\alpha}{2} \end{aligned} \tag{2.B.27}$$

$$\begin{aligned} V_a^f &= E\big[W^{**}(\phi)\tilde{R}_a^{**}\alpha+\big(1-W^{**}(\phi)\big)(\phi-\delta)\big] \\ &= \Lambda\alpha\frac{\overline{\phi}-\Lambda\alpha}{\overline{\phi}-\underline{\phi}}+\frac{\underline{\phi}+\Lambda\alpha}{2}-\delta \end{aligned} \tag{2.B.28}$$

otherwise they are

$$\begin{aligned} V_e^f &= E\big[W^{*}(\phi)(\phi-\tilde{R}_a^{*}\alpha)\big] \\ &= \min\left(\delta,\frac{\overline{\phi}-\underline{\phi}}{2}\right) \end{aligned} \tag{2.B.29}$$

$$\begin{aligned} V_a^f &= E\big[W^{*}(\phi)\tilde{R}_a^{*}\alpha+\big(1-W^{*}(\phi)\big)(\phi-\delta)\big] \\ &= \max(\underline{\phi},\overline{\phi}-2\delta)\frac{\overline{\phi}-\max(\underline{\phi},\overline{\phi}-2\delta)}{\overline{\phi}-\underline{\phi}}+\frac{\underline{\phi}+\max(\underline{\phi},\overline{\phi}-2\delta)}{2}-\delta \end{aligned} \tag{2.B.30}$$

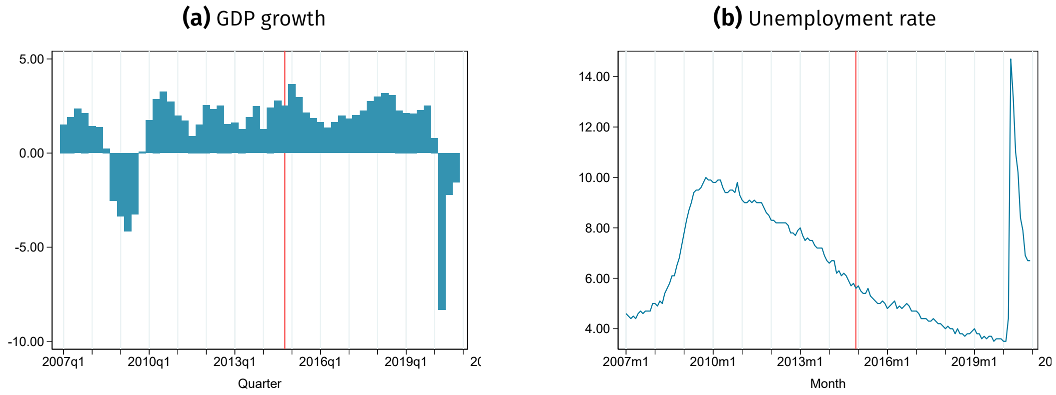
First-order conditions pin down $\boldsymbol{b}^*$ implicitly

$$\boldsymbol{p}'(\boldsymbol{b}^*)\left(\Phi+\frac{(1-p(\boldsymbol{b}^*))V_a^f-\rho\alpha}{p(\boldsymbol{b}^*)}-V_e^f\right) = \boldsymbol{c}_e'(\boldsymbol{b}^*) \tag{2.B.31}$$

Appendix 2.C Auxiliary evidence

2.C.1 Macroeconomic tranquility

In its opinion underpinning the Marblegate ruling, the court did not refer to an economic motive. Yet, macroeconomic shocks might coincidentally confound the effects of the verdict. Fortunately, Figure 2.C.1 confirms that the macroeconomic environment was stable and healthy around the Marblegate ruling at the end of 2014, right in the middle between the Great Financial Crisis and the Pandemic Recession.

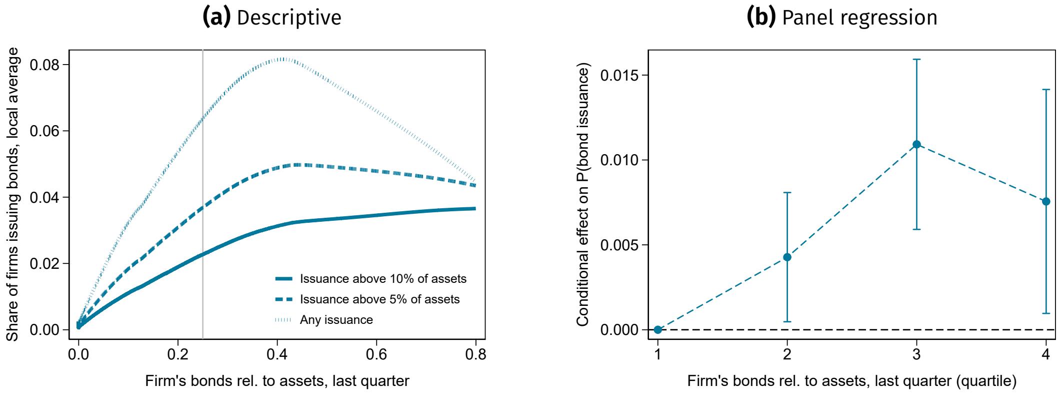


Notes: Left panel shows year-on-year growth of quarterly real GDP measured by expenditure. Right panel shows monthly unemployment rate seasonally adjusted as reported by the U.S. Bureau of Labor Statistics. Red line marks date of the Marblegate ruling.

Figure 2.C.1. Macroeconomic environment around the Marblegate ruling

2.C.2 Bond intensity and the propensity to issue new bonds

Marblegate changed (i) cost default cost and (ii) moral hazard risk associated with bond financing. Accordingly, firms heavily reliant on bonds should react the most. However, to facilitate empirical analysis it is important that observed bond intensity is predictive of future bond finance as well. Figure 2.C.2 presents evidence in that vein. In particular, firms above median intensity—the cut-off used throughout the chapter—are substantially and significantly more likely to issue bond in sizable volumes.



Notes: The left panel shows local averages by bond intensity for bond issuance, by size of issuance. Estimates are based on the cross-section of compustat firms of 2013. Bond issuance data matched from FISD. The right panel shows coefficients for dummies marking the full-sample distribution of bond intensity from a linear probability panel regression of future bond issuance of at least 5% of assets controlling 16 lags of past bond issuance as well as quarter and firm fixed effects. Effect for the first quartile is normalized to zero. Sample is 2010Q1 to 2018Q4.

Figure 2.C.2. Bond issuance probability by bond intensity

2.C.3 Hold-outs in bond exchanges

At the time of the ruling, a wide-spread concern was that stronger protection would embolden minority bondholders to hold out of agreements, be it because they deemed the offer unfair or out of strategic considerations. Examining detailed information on distressed bond exchanges from Moody's Default and Restructuring Database allows to shed light on whether hold-outs did indeed become more prevalent under the Marblegate regime. For each distressed bond exchange covered in the data, Figure 2.C.3 shows that the volume of bonds being exchanged was indeed about 20 percentage points smaller under Marblegate, conditional on the recovery rate offered (x-axis). Note that unobserved selectivity of bond exchanges offers—only a subset of holders, such as "qualified institutional investors", being eligible to participate—is unlikely to drive this result unless the data misspecifies the total volume of eligible bonds.

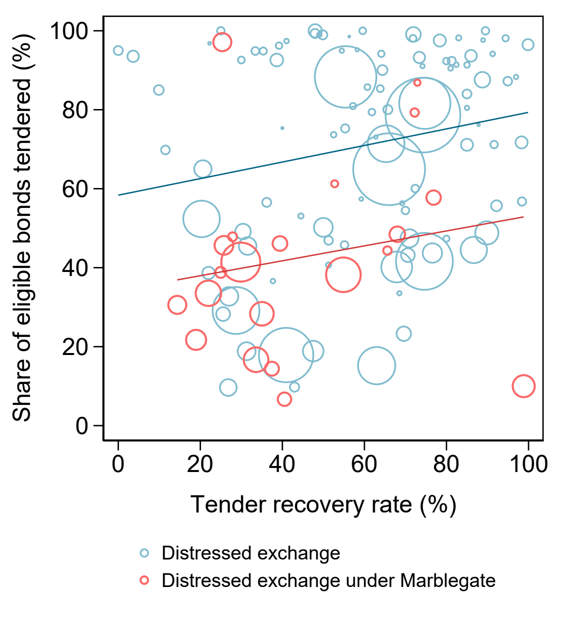


Figure 2.C.3. Marblegate and bond exchange offer hold-outs

Notes: Recovery rate information for 130 out-of-court distressed bond exchanges between 1990 and 2020 in the US from Moody's Default and Restructuring Database. Marblegate denotes the period between Dec 31, 2014 and Jan 16, 2017. Circle areas represent the total volume of debt outstanding before default.

2.C.4 Investment drop among treated or increase among control group?

I find that after the Marblegate ruling, quarterly interest rates diverge between bond-intensive and other firms. In principle, this may be driven by an investment rate cut among the exposed firms or an increase of investment rates among the less exposed firms (or any mix thereof).

To test, I also examine the evolution of investment rates among the control group as estimated by the quarter fixed effects and compare it with the path of the treated firms by adding the treatment effect. Trajectories shown in Figure 2.C.4 confirm that adjustments took place predominantly among the exposed firms. This is consistent with the interpretation that exposed firms were forced to deviate from their desired capital structure while others were much less affected.

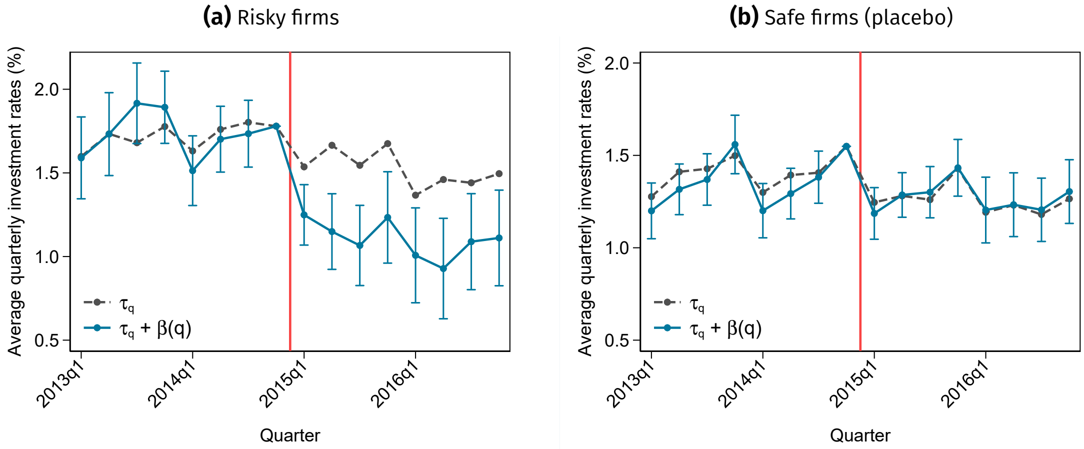


Figure 2.C.4. Marblegate's effect on firm investment rates

Notes: Estimates of average investment rates—net of firm-fixed effects—by quarter and bond intensity from Equation (2.16) within compustat non-financial firms. The left panel shows results for risky firms with a S&P high-yield rating. The right panel shows results for safe firms with a S&P investment-grade rating. Whiskers mark 95% CI for $\beta(q)$ based on standard errors clustered at the firm level.

2.C.5 Reactions in daily stock price data

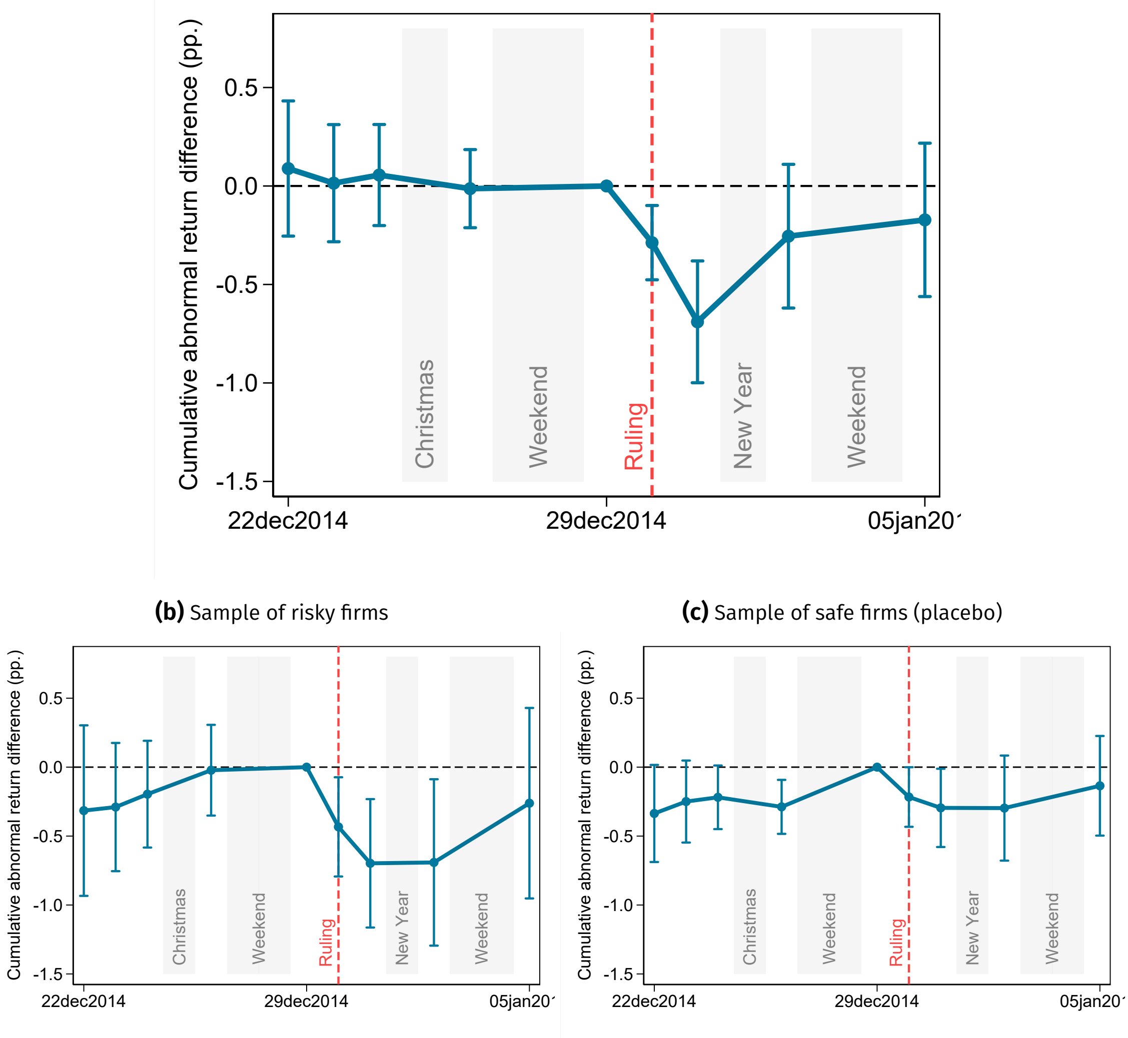
Did capital markets actually care about the Marblegate ruling? And were market reactions consistent with effects I estimate at lower frequencies? To obtain high-quality high-frequency data, I turn to stock market.

I obtain daily returns on common stock from CRSP, time series of Fama and French (1992) as well as momentum factors from WRDS and match quarterly capitalIQ financials and rating data via compustat identifiers. I estimate daily abnormal stock returns as residuals of stock-specific regressions on factors and cumulate them relative to Dec 29, 2014, the day before the Marblegate ruling. For each trading day of the week before as well as after Marblegate, I estimate the difference in cumulated abnormal returns (CAR) between firms with high and low bond intensity using the following regression:

$$\mathrm{CAR}_{f,d}^{\text{Dec 29}} = \beta(d) B_{f,2014Q4} + \delta_{d\times\text{industry}(f)} + e_{f,d} \tag{2.C.1}$$

(f, d) index firms and days. Bond intensity $B_{f,q(d)}$ is the quarter-end value of outstanding bond debt relative to assets and is defined to be "high" when it exceeds a value of 25%—analogous to all other empirical specifications. To control for any concurrent industry-specific news, I filter day × 3-digit NAICS industry fixed effects.

Figure 2.C.5 plots date-specific coefficients $\beta(d)$ which measure the difference in cumulative abnormal returns around the ruling between firms of different bond intensity, within narrow industries. While both groups of stocks deliver identical average returns during any trading day of the preceding week, stock prices of bond-intensive firms drop when the court's opinion became public on December 30. Importantly, I obtain point estimates which are larger in absolute terms



(a) Full sample

(b) Sample of risky firms

(c) Sample of safe firms (placebo)

Figure 2.C.5. Daily stock returns around Marblegate

when zooming in on the sample of firms with a speculative-grade credit rating. The difference narrows later the following week, possibly driven by additional shocks unrelated to the ruling.

2.C.6 Bond pricing

I examine bond prices to see whether bond investors price the changes brought about by Marblegate. In particular, by restricting the possible set of exit-consent strategies, which would couple bond exchanges with a vote over stripping the original bond issue off protective guarantees or covenants, Marblegate should have increased the value of these provisions in the eyes of investors. To test this, I run an OLS regression of monthly bond returns on month fixed effects and the full set of their interactions with a dummy G_b indicating the presence of a guarantee, insurance or letter of credit, as measured in FISD. To purge bond price from common movements in narrowly defined risk × maturity classes, I follow the literature and construct abnormal monthly bond returns $\tilde{R}_{bm}$ as the difference of a bond's return above and beyond its benchmark portfolio. Monthly benchmark portfolio returns are constructed as the monthly average within a rating × maturity bin spanned by the rating classes AAA, AA, A, BBB, BB, B, CCC, CC and worse one the one hand and ten maturity classes on the other, yielding 90 different portfolios in total.[83]

$$\tilde{R}_{bm} \;=\; \tau_m + \beta(m)G_b + e_{bm} \tag{2.C.2}$$

To prevent outlier returns from driving the OLS estimate, I winsorize the entire sample of abnormal returns by 1%. As common in the literature, I also restrict the sample of bonds to publicly traded, non-convertible, unsecured senior bonds issued by domestic non-financial firms before Dec 30, 2014 with remaining maturity of 12 to 120 months—however, non of these individual criteria turns out to be crucial for the estimates.

Figure 2.C.6 presents the month-specific estimates of $\beta(m)$, normalized by the return in the month before the Marblegate verdict, November 2014. Recall that these estimate the difference in monthly returns between two bonds within the same rating × maturity class where one of the bonds is guaranteed by another entity (typically the parent) while the other is not. None of the estimates is significantly different from the average return in November—except during the months of the the Marblegate verdicts: December 2014 and June 2015. Consistent with the reading of secondary sources, the shock was larger in December 2015, raising monthly abnormal returns by as much as 50 basis points. By contrast, the final verdict in June 2015 was largely anticipated, showing a smaller excess impact on bond returns, which is barely significant at the 5% level.

Figure 2.C.7 illustrates that these effects are indeed driven by risky bonds, consistent with the notion that Marblegate should have stronger effects on financial distress is more likely.

83. Maturity classes are 0-3 months, 3-12 months, 1-2 years, 2-3, 3-4, 4-5, 5-7, 7-10, 10-20 and above 20.

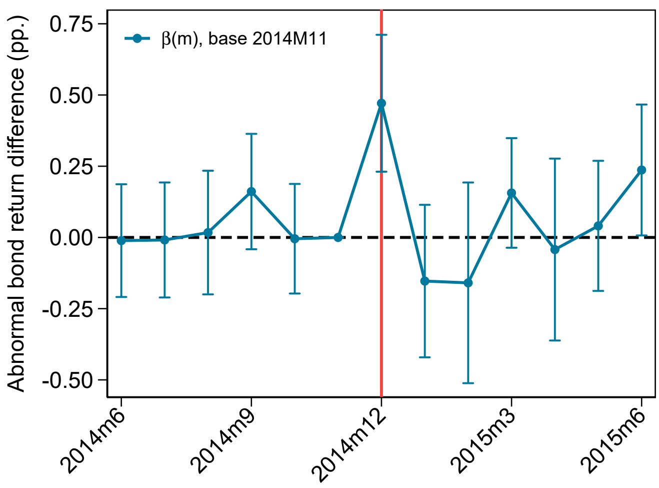


Figure 2.C.6. Marblegate's effect on bond pricing

Notes: TRACE-FISD sample of publicly traded, non-convertible, unsecured senior bonds issued by domestic non-financial firms before Dec 30, 2014 with remaining maturity of 12 to 120 months. Whiskers mark 95% CI based on robust standard errors clustered at the issuer level.

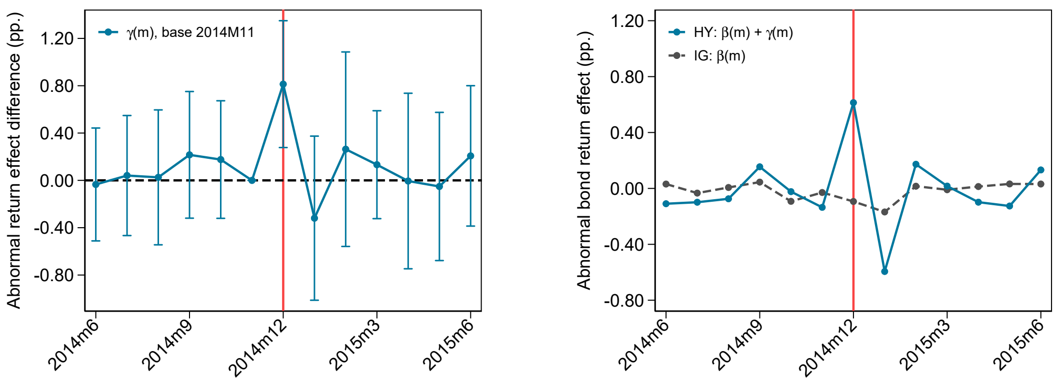


Figure 2.C.7. Effects on bond prices are driven by high-yield bonds

Notes: OLS estimates of the model $\tilde{R}_{bm} = \tau_m + b_m HY_{bm-1} + \beta(m) G_b + \gamma(m)\big(G_b \times HY_{bm-1}\big) + e_{bm}$. HY_{bm-1} indicates bonds issues rated worse than BBB in the previous month. TRACE-FISD sample of publicly traded, non-convertible, unsecured senior bonds issued by domestic non-financial firms before Dec 30, 2014 with remaining maturity of 12 to 120 months. Whiskers mark 95% CI based on robust standard errors clustered at the issuer level.

2.C.7 Loan issuance

I estimate firms' loan issuance around Marblegate using the specification below, analogous to how I estimate bond issuance effects in Section 2.2.5.3:

$$\mathbb{1}(\text{Issuance}_{fq}) = \phi_f + \tau_q + \beta(M_q \times B_{f,2014Q3}) + \boldsymbol{x}_{fq}\boldsymbol{\gamma} + e_{fq} \tag{2.C.3}$$

I proxy loan issuance using quarterly loan data from CapitalIQ. Analogous to the estimation of bond issuance effects, the indicator $\mathbb{1}(\text{Issuance}_{fq})$ will mark firm-quarters in which the increase in loans exceed $+5\%$ of assets and controls $\boldsymbol{x}_{fq}$ include four lags of asset growth, lagged Tobin's Q and the firm's lagged liquidity ratio.

Table 2.C.1 presents estimates of Equation . Columns mirror specifications tested for bond issuance Estimates of β are significantly positive, indicating that bond-reliant firms increased the quarterly probability of new loans significantly by about 2 percentage points after to the ruling—except among the placebo sample of investment-grade companies, where effects are not statistically different from zero. Given average issuance rates of almost 10%, these estimates imply a considerable but moderate increase of about 20%. I find no effect at the intensive margin.

Table 2.C.1. Marblegate's effect on loan issuance

	(1) Plain	(2) Baseline	(3) Placebo	(4) Time × Industry	(5) Beyond Ratings	(6) Int. Margin
Marblegate × Bond-intensive	0.035***	0.022*	-0.000	0.025*	0.032***	0.007
	(0.012)	(0.012)	(0.010)	(0.013)	(0.009)	(0.038)
Firm dynamics		Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	
Quarter FE	Yes	Yes	Yes	Yes	Yes	
Quarter × Industry FE				Yes		
Level effects						Yes
Average dependent, bond-intensive	0.084	0.083	0.031	0.083	0.093	0.290
Average dependent, not bond-int.	0.099	0.095	0.050	0.095	0.104	0.294
R^2	0.11	0.11	0.13	0.15	0.19	0.10
N	9461	8445	6527	8438	21572	748

Notes: Estimates of Equation (2.C.7) using compustat sample of non-financial firms covering quarters 2013Q1 to 2016Q4. Dependent variable is a binary indicator for a loans increase >5% of assets, except column (6) showing results for loans relative to assets. Sample restricted to firms with a S&P rating of BB+ or worse; except column (3) and (5), which focus on investment grade-rated firms and all firms with a below-median Z-score, respectively. The binary variable *Marblegate* indicates quarters 2015Q1-2016Q4. Firms are considered to be "bond-intensive" if their bond debt relative to assets exceeded 25% a quarter before Marblegate. Firm controls include four lags of asset growth, lagged Tobin's Q and the firm's lagged liquidity ratio. Industry refers to 2-digit NAICS sectors. Standard error in parentheses clustered at the firm level. *** p <0.01, ** p <0.05, * p <0.10.

Appendix 2.D Details on back-of-the-envelope calculation

The estimated change in capital expenditures after Marblegate is considerable, ranging between -10% and -30% among bond-intensive and risky firms relative to other risky firms with little or no bond debt. I suggest that firms reacted to higher cost of default, based on evidence of higher bankruptcy risk. But can the estimated increase in bankruptcy risk plausibly trigger investment effects of this magnitude? I assess the quantitative plausibility using a back-of-the-envelope calculation which I describe below.

Bankruptcy risk and financing cost. I first gauge how elevated bankruptcy risk would translate into financing costs. The cost of borrowing from the bond market over a given time interval—denoted by r—is composed of investors' opportunity cost of funds r_f and expected cost of a potential default during that period r_d:

$$r = r_f + r_d \tag{2.D.1}$$

Bonds' cost of default r_d may include various components of which I focus on risk of bankruptcy:

$$r_d = \frac{1}{1+\tilde{\rho}}\left(\beta \frac{\partial P(\text{bankruptcy})}{\partial \text{bond debt}} + \omega\right) \tag{2.D.2}$$

where $\tilde{\rho}$ denotes the applicable discount rate, β is the cost of a bankruptcy process and ω captures other possible default cost components. The derivative captures the notion that coordination frictions among bondholders increase firm's propensity to resolve distress in court. Default costs can be incurred by the debtor directly—e.g., junior equity standing first in line to absorb the dead-weight costs of bankruptcy. They may also be incurred by bondholders or other creditors, who will raise financing rates accordingly, however. Ultimately, default costs are thus borne by the debtor. Depending on the distribution of default costs, the discount rate $\tilde{\rho}$ will be a composite of creditors' and the debtor's discount rate and capture by corresponding risk preferences.

Arguably, Marblegate changed r_d but not r_f. Moreover, I assume that bankruptcy risk is the only default cost component that reacted to Marblegate, i.e., $\partial\omega/\partial\text{Marblegate} = 0$. Because Marblegate did not change bankruptcy *procedures*, I assume their costs β to be constant here. Likewise, I abstract from any potential change in the discount rate. The impact on the marginal cost of bond finance then obtains as

$$\frac{\partial r}{\partial \text{Marblegate}} = \frac{1}{1+\tilde{\rho}}\beta \underbrace{\frac{\partial\left(\frac{\partial P(\text{bankruptcy})}{\partial \text{bond debt}}\right)}{\partial \text{Marblegate}}}_{A} \tag{2.D.3}$$

I plug in the following (quarterly) values:

ρ: I set the applicable quarterly discount rate to 5%, i.e., deliberately high to be conservative.

β: I compute effects for a range of values that plausibly reflects the range of estimates in the literature (Hotchkiss et al., 2008; Lubben, 2012; Epaulard and Zapha, 2022): $[0.02a, 0.05a, 0.10a]$, where a is the value of the firm's assets.

A: Based on estimates from Table 2.1 Column (2), Marblegate increased the quarterly probability of a bankruptcy filing for firm-quarters with z-score below the median by 0.0056 (0.0011) for bond-intensive (not bond-intensive) firms. The differences between the median bond-to-asset ratio across both groups is 0.3583. Compustat firms rated speculative grade have a below-median z-score with a probability of 0.7276. Hence, the change in the marginal bankruptcy risk—conditional on having a below-median z-score—can be estimated by $0.7276 \times (0.0056 - 0.0011)/0.3583a = 0.0091/a$, where a is the value of the firm's assets.[84]

The firm size variable, a, cancels as I compute

$$\begin{aligned}
\frac{\partial r}{\partial \text{Marblegate}} &= \frac{0.02a}{1+0.05}\frac{0.0091}{a} \approx 0.00017 \\
\frac{\partial r}{\partial \text{Marblegate}} &= \frac{0.05a}{1+0.05}\frac{0.0091}{a} \approx 0.00043 \\
\frac{\partial r}{\partial \text{Marblegate}} &= \frac{0.10a}{1+0.05}\frac{0.0091}{a} \approx 0.00087
\end{aligned}$$

Accordingly, Marblegate increased the quarterly marginal cost of bond finance by +1.7 to +8.7 basis points.

By how much did total financing costs increase? Before Marblegate, the relevant sample of bond-intensive and risky compustat firms had an average bonds-to-asset ratio of 47%. I estimate that those firms reacted to Marblegate by halving the probability of bond issuance, translating a lower bond intensity going forward. If all bonds were perfectly substituted by loans or equity, $47\%/2 = 23.5\%$ of fresh finance would be in bonds. This underestimates the true share because substitution was imperfect and investment shrank as well. However, I will stick with 23.5% to be conservative.

Multiplying the increase in the cost of bond debt with the share of bond in fresh finance among risky and bond-intensive firms, I calculate that Marblegate increased their *quarterly* corporate discount rate, henceforth denoted by ρ, by around +0.4 to +2 basis points.

Financing cost and investment. I use a simple q model to link changes in the corporate discount rate to firm investment. In the model, firms set their investment policy, $\{k_t\}_0^\infty$ to maximize the stream of earnings $\Pi(k_t)$ less investment expenditures $k_t - (1-\delta)k_{t-1}$ and adjustment costs $\Phi(k_t, k_{t-1})$, discounted by the corporate discount rate ρ:

$$\max_{\{k_t\}} \sum_{t=0}^{\infty} \frac{\Pi(k_{t-1}) - \Big(k_t - (1-\delta)k_{t-1}\Big) - \Phi(k_t, k_{t-1})}{(1+\rho)^t} \equiv V(k_{t-1}, \rho) \tag{2.D.4}$$

Parameter δ is the depreciation rate of capital. Adjustment costs are quadratic in net investment rates and are governed by the cost parameter ϕ:

$$\Phi(k_t, k_{t-1}) = \frac{\phi}{2}\frac{(k_t - k_{t-1})^2}{k_t - 1} \tag{2.D.5}$$

84. Firms might have taken additional measures to avoid financial distress after Marblegate. In this case, observed bankruptcies underestimates the original increase in bankruptcy risk. That is, the net effect on bankruptcy risk, $(0.0056 - 0.0011)/0.3583a$, is conservative with respect to its investment impacts. At the same time, the probability to observe a below-median z-score would increase by approximately the same factor by which bankruptcy risk is underestimated, compensating the aforementioned error in this calculation.

The firm's optimal investment rate is given by

$$\frac{k_t - (1-\delta)k_{t-1}}{k_{t-1}} = \frac{1}{\phi}\Bigg(\underbrace{\frac{1}{1+\rho}\frac{\partial V(k_t,\rho)}{\partial k_t}}_{\equiv q_t} - 1\Bigg) + \delta \tag{2.D.6}$$

The derivative of this expression with respect to ρ involves an infinite sum of horizon-weighted and discounted future net earnings. To obtain a tractable formulation whose components can be measured from the data, I build on Gormsen and Huber (2023): I add the standard assumptions of Hayashi (1982), to approximate the marginal value of capital, q_t, with its average value measured by Tobin's Q. Then, I relate Q to the duration of net earnings via the Gordon growth model (Gormsen and Lazarus, 2023) :

$$q_t = Q_t = \frac{1}{\rho - g}\frac{y_{t+1}}{k_t} \tag{2.D.7}$$

where $y_{t+1} = \Pi(k_t) - \Big(k_{t+1} - (1-\delta)k_t\Big) - \Phi(k_{t+1}, k_t)$ and g is the (long-run) growth rate of y_{t+1}. Intuitively, the value of capital depends on the earnings yields and how fast earnings grow relative to the discount rate in the long term. Plugging (2.D.7) into (2.D.6) allows me to derive the sensitivity of investment rates with respect to discount rates as

$$d\frac{k_t - (1-\delta)k_{t-1}}{k_{t-1}} = -\frac{1}{\phi}\frac{Q_t}{\rho - g}d\rho \tag{2.D.8}$$

and I quantify its components as follows:

- ϕ The literature on q models offers a range of estimates for the adjustment cost parameter (Gilchrist and Himmelberg, 1995; Hall, 2004; Cooper and Haltiwanger, 2006; Philippon, 2009; Groth and Khan, 2010; Eberly, Rebelo, and Vincent, 2012; Lin et al., 2018). I compute investment effects under three different values that enclose estimates from the aforementioned literature. Since these estimates concern adjustment costs for *annual* investment, corresponding quarterly adjustment cost should be approximately four times as large: $[0.5 \times 4, 1 \times 4, 3 \times 4]$
- Q_t In the sample of risky and bond-intensive compustat firms in 2013, Tobin's Q is about 1.498.
- $\frac{1}{\rho - g}$ For the average compustat firm, Gormsen and Lazarus (2023) calculate this value—the duration of earnings—to be around 20 (years) using annual discount and growth rates. Adapting to quarterly frequency, I set a value of 20×4.
- $d\rho$ I plug in values computed in the first step, based on three different assumptions about bankruptcy cost: $[0.00017 \times 0.235, 0.00043 \times 0.235, 0.00087 \times 0.235]$.

Taken together, I obtain a grid of possible investment effects, depending on assumptions about bankruptcy cost β and the adjustment cost ϕ. To ease interpretation, I divide effects by the average investment rate of 0.016 and multiply by 100 to obtain percent values. Resulting elasticities are presented in Table 2.5: They span a large range of -2.5% to -75%, reflecting inconclusive evidence about two important parameters. This means that under plausible economic assumptions, my estimates of bankruptcy risk from Section 2.2.5 can rationalize investment cuts in the range of -10% to -30% which I document in Section 2.2.4.

2.D.1 Robustness checks

Table 2.D.1. Marblegate's effect on investment across alternative specifications

	(1) Trend	(2) *B* at 20%.	(3) *B* at 30%.	(4) *B* at 2013Q4	(5) Excl. Oil	(6) Triple DiD
Marblegate × Bond-intensive	-0.0039***				-0.0014**	-0.0048***
	(0.0011)				(0.0007)	(0.0010)
Marblegate × Bond-int.$_{>20\%}$		-0.0040***				
		(0.0009)				
Marblegate × Bond-int.$_{>30\%}$			-0.0040***			
			(0.0011)			
Marblegate × Bond-int.$_{2013Q4}$				-0.0042***		
				(0.0010)		
Safe × Marblegate						-0.0011*
						(0.0007)
Safe × Marblegate × Bond-intensive						0.0058***
						(0.0011)
Time trend × Bond-intensive	-0.0001					
	(0.0001)					
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Dependent variable, mean	0.0155	0.0155	0.0155	0.0155	0.0117	0.0139
R^2	0.71	0.71	0.71	0.73	0.65	0.73
N	8475	8475	8475	7850	7516	15034

Notes: Estimates of Equation (2.17) with the following variations of the baseline specification presented in the main text in companion Table 2.2: Column (1) controls for group-specific time trends. Column (2) categorizes firms to be *bond-intensive* if their bond debt relative to assets exceeds 20% a quarter before Marblegate, instead of 25%. Column (3) categorizes firms to be *bond-intensive* if their bond debt relative to assets exceeds 30% a quarter before Marblegate. Column (4) measures bond intensity a year before Marblegate instead of a quarter. Column (5) excludes firms engaged in oil or gas extraction, refinement or distribution. Column (6) includes both safe and risky firms and estimates a triple-DiD specification. As in the companion table, standard error in parentheses are clustered at the level of a firm. *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

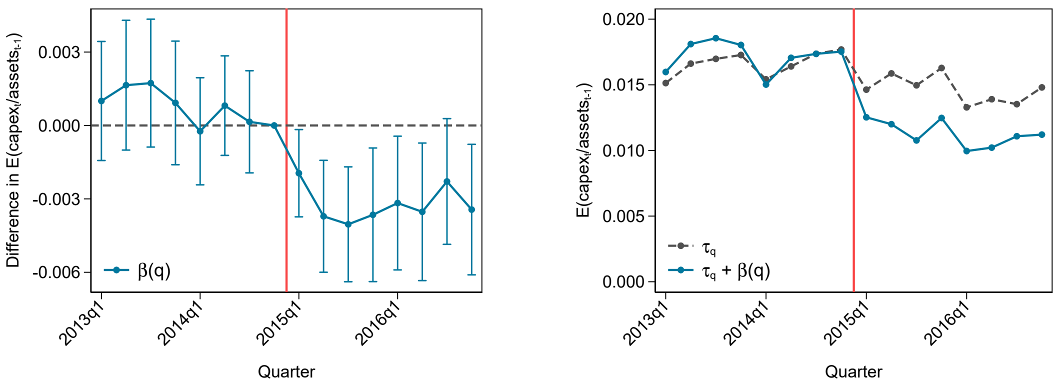


Figure 2.D.1. Splitting firms according to quarter-specific bond intensity

Notes: OLS estimates of $\frac{\text{capex}_{f\,q}}{\text{assets}_{f,q-1}} = \phi_f + \tau_q + \beta(q)B_{f,q} + e_{f,q}$. Compustat sample of non-financial firms with S&P investment-grade rating (BBB+ or better). Left panel illustrates how capex of bond-intensive firms drops relative to other firms after Marblegate verdict. Right panel plots average investment rates for each group. Whiskers mark 95% CI based on standard errors clustered at the firm level.

Table 2.D.2. Marblegate's effect on bond issuance under alternative assumptions

	(1) Any Issues	(2) *B* at 20%.	(3) *B* at 30%.	(4) *B* at 2013Q4	(5) W/ time trend	(6) Excl. Oil	(7) Triple DiD
Marblegate × Bond-intensive	-0.032***				-0.021***	-0.038***	-0.035***
	(0.009)				(0.007)	(0.009)	(0.010)
Marblegate × Bond-int.$_{>20\%}$		-0.031***					
		(0.008)					
Marblegate × Bond-int.$_{>30\%}$			-0.033***				
			(0.009)				
Marblegate × Bond-int.$_{2013Q4}$				-0.039***			
				(0.009)			
Safe × Marblegate							0.007
							(0.006)
Safe × Marblegate × Bond-intensive							0.019*
							(0.011)
Time trend × Bond-intensive					-0.002***		
					(0.000)		
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$\hat{P}$(issuance), bond-intensive	0.072	0.056	0.063	0.058	0.055	0.054	0.062
$\hat{P}$(issuance), not bond-int.	0.027	0.017	0.027	0.027	0.020	0.021	0.034
R^2	0.13	0.11	0.11	0.11	0.10	0.11	0.10
N	8484	8484	8484	7862	12104	7525	15046

Notes: Estimates of Equation (2.19) with the following variations of the baseline specification presented in the main text in companion Table 2.4: Column (1) changes the dependent variable to be a binary indicator for any bond issuance, i.e., also those with volume below 5% of total assets. Column (2) categorizes firms to be *bond-intensive* if their bond debt relative to assets exceeds 20% a quarter before Marblegate, instead of 25%. Column (3) categorizes firms to be *bond-intensive* if their bond debt relative to assets exceeds 30% a quarter before Marblegate. Column (4) measures bond intensity a year before Marblegate instead of a quarter. Column (5) controls for group-specific time trends and adds the two years after Marblegate was overturned. Column (6) excludes firms engaged in oil or gas extraction, refinement or distribution. Column (7) includes both safe and risky firms and estimates a triple-DiD specification. As in the companion table, standard error in parentheses are clustered at the level of a firm. *** p <0.01, ** p <0.05, * p <0.10.

2.D.2 Effects of the Second Circuit ruling on Jan 17, 2017

The Marblegate verdict was filed for review at the Second Circuit Court of Appeals. In a contentious two-vs-one decision, the higher court overturned Marblegate on January 17, 2017, about two years after the original verdict. The Second Circuit ruling does not provide a policy shift as sharp as the original for three reasons. First, the Court of Appeals left uncertainty as to whether exit-consent transactions could target parent guarantees in the same way as they used to do (Millar, 2017; Bratton and Levitin, 2018). Second, market participants might have become wary about similar policy shifts of judge discretion in the future, given that the Second Circuit ruling was indeed not unanimous. Third, the anticipation effect as well as and adjustment measures undermine the statistical value of the January 2017 decision. Nevertheless, I repeat key analyses in this appendix, using January 17, 2017 as an additional treatment date.

Figure 2.D.2 confirms that the elevated propensity to restructure distressed bond debt in bankruptcy indeed reverses after the Second Circuit ruling. The overall filing propensity is above the pre-Marblegate level in the lowest quartile of the Z-score distribution. But the ratio of filing rates across firms split by bond intensity is very similar again.

Figure 2.D.3 extends the time horizon for the analysis of Equation (2.16), adding the two years after the Second Circuit ruling. Indeed, investment rates start reverting to their pre-Marblegate benchmark, becoming statistically indistinguishable from 2017Q3 onwards. The reversal is not as sharp as the original drop and point estimates never fully reach the pre-Marblegate benchmark by 2018Q4. This might reflect that the January 2017 ruling was perceived to not refute all aspects of the original reasoning in the Southern District of New York (Millar, 2017; Bratton and Levitin, 2018).

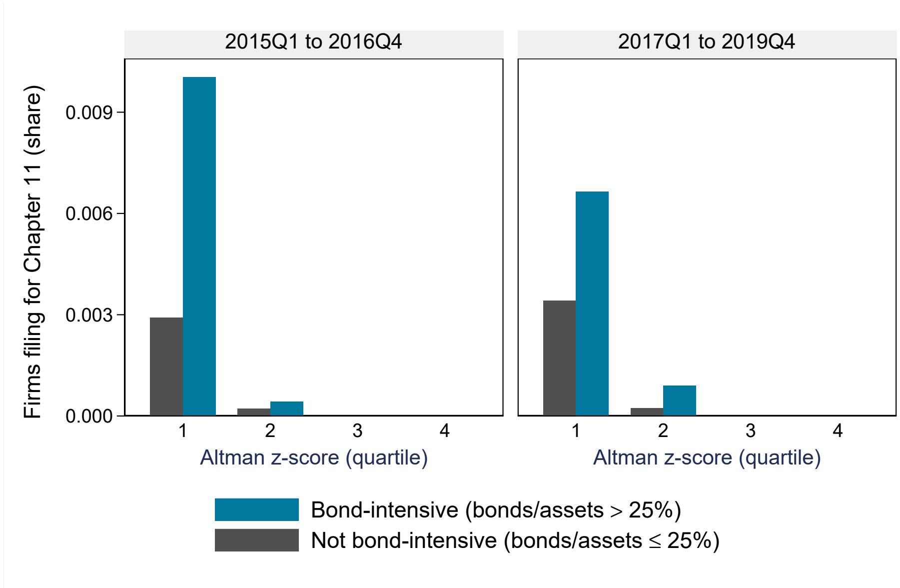


Figure 2.D.2. Marblegate overturning reduced bankruptcy filings by bond-intensive firms

Notes: Shares of non-financial compustat firms filing for bankruptcy between 2015Q1 and 2018Q4 across quartiles of the distribution of distress Z-scores Altman (1968). Marblegate marks the period 2015Q1 to 2016Q4.

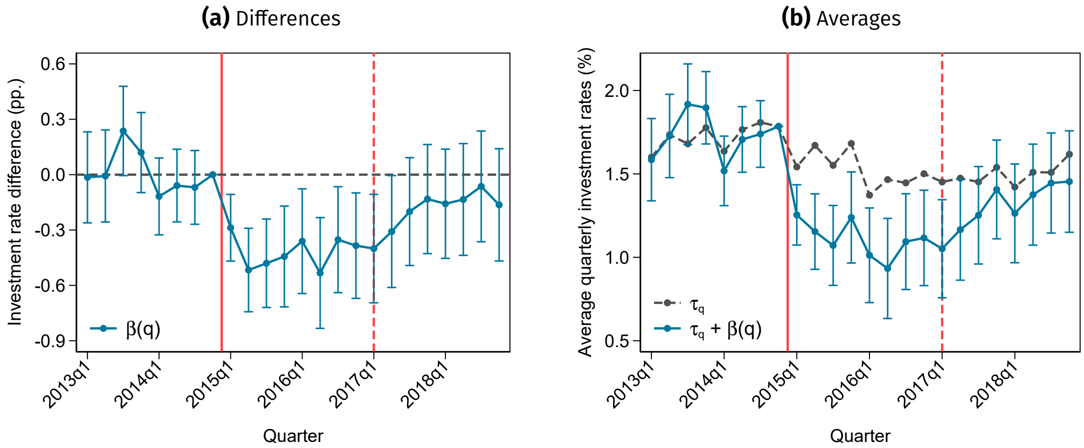


Figure 2.D.3. Marblegate's effect on firm investment rates beyond January 2017

Notes: Estimates of Equation (2.16) using the compustat sample of non-financial firms with an S&P rating BB+ or worse including quarters 2013Q1 to 2018Q4. Left panel illustrates how capital expenditure of bond-intensive firms first drops after the original Marblegate verdict and then recovers relative to other firms after its overturning; estimates $\hat{\beta}(q)$ are shown relative to $\hat{\beta}(2014Q4)$. Right panel plots average investment rates—net of firm-fixed effects—for bond-intensive firms in green and other firms in blue. Whiskers mark 95% CI based on standard errors clustered at the firm level.

Appendix References

Altman, Edward. 1968. "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy." *Journal of Finance* 23 (4): 589–609.

Bratton, William, and Adam Levitin. 2018. "The new bond workouts." University of Pennsylvania, mimeo.

Cooper, Russell, and John Haltiwanger. 2006. "On the nature of capital adjustment costs." *Review of Economic Studies* 73 (3): 611–33.

Eberly, Janice, Sergio Rebelo, and Nicolas Vincent. 2012. "What explains the lagged-investment effect?" *Journal of Monetary Economics* 59 (4): 370–80.

Epaulard, Anne, and Chloé Zapha. 2022. "Bankruptcy costs and the design of preventive restructuring procedures." *Journal of Economic Behavior & Organization* 196: 229–50.

Fama, Eugene, and Kenneth French. 1992. "The cross-section of expected stock returns." *Journal of Finance* 47 (2): 427–65.

Gilchrist, Simon, and Charles Himmelberg. 1995. "Evidence on the role of cash flow for investment." *Journal of Monetary Economics* 36 (3): 541–72.

Gormsen, Niels, and Kilian Huber. 2023. "Corporate discount rates." University of Chicago Booth School of Business, mimeo.

Gormsen, Niels Joachim, and Eben Lazarus. 2023. "Duration-driven returns." *Journal of Finance* 78 (3): 1393–447.

Groth, Charlotta, and Hashmat Khan. 2010. "Investment adjustment costs: An empirical assessment." *Journal of Money, Credit and Banking* 42 (8): 1469–94.

Hall, Robert E. 2004. "Measuring factor adjustment costs." *Quarterly Journal of Economics* 119 (3): 899–927.

Hayashi, Fumio. 1982. "Tobin's marginal q and average q: A neoclassical interpretation." *Econometrica* 50 (1): 213–24.

Hennessey, Christopher A., and Toni M. Whited. 2005. "Debt dynamics." *Journal of Finance* 60 (3): 1129–65.

Hotchkiss, Edith, Kose John, Robert Mooradian, and Karin Thorburn. 2008. "Bankruptcy and the resolution of financial distress." In *Handbook of Empirical Corporate Finance,* edited by B. Espen Eckbo, 235–87. Handbooks in Finance. San Diego: Elsevier.

Kermani, Amir, and Yueran Ma. 2022. "Asset specificity of non-financial firms." *Quarterly Journal of Economics* 138 (1): 205–64.

Lin, Xiaoji, Chong Wang, Neng Wang, and Jinqiang Yang. 2018. "Investment, Tobin's q, and interest rates." *Journal of Financial Economics* 130 (3): 620–40.

Lubben, Stephen. 2012. "What we 'know' about Chapter 11 cost is wrong." *Fordham Journal of Corporate & Financial Law* 17 (1): 141–87.

Millar, James. 2017. *Marblegate v. EDMC: What does the Second Circuit's opinion say (and not say) about releasing a guarantee.* Faegre Drinker Client Brief.

Philippon, Thomas. 2009. "The bond market's q." *Quarterly Journal of Economics* 124 (3): 1011–56.

Rajan, Raghuram. 1992. "Insiders and outsider: The choice between informed and arm's-length debt." *Journal of Finace* 47 (4): 1367–400.

Chapter 3

The Safety Net: Central Bank Balance Sheets and Financial Crises

Joint with Niall Ferguson, Paul Schmelzing, and Moritz Schularick

Central bank balance sheets have played a prominent role in the response to the financial and macroeconomic upheavals of the past decade. In a bid to shield financial markets from the most severe economic strains, both the response to the Global Financial Crisis (GFC) of 2008-9 and the more recent response to the COVID-19 pandemic of 2020-2 featured large-scale asset purchases and the extension of significant amounts of liquidity to the financial sector. In these times of financial stress, major central banks chose to deploy their balance sheet to prevent market freezes and collateral damage to economic activity.

These policies revived a longstanding debate about the effectiveness and side effects of central banking liquidity support, a controversy tracing back to at least the 19th century (Thornton, 1802; Bagehot, 1873). A new literature emerged to analyze recent interventions (Gertler and Karadi, 2011; Smets and Potter, 2019; Bernanke, 2020, among others). Yet, the pre-2008 experience with the use of central balance sheets remains understudied. Our paper is the first to provide historical panel data that reconstructs annual central bank balance sheets for advanced economies over multiple centuries—including the full breakdown of asset and liability components for many episodes. This long-run historical view yields a sample size sufficient to systematically analyze rare financial disasters and estimate the macroeconomic effects of central bank balance sheet operations.[1]

We show that time and again, central banks deployed their power to create liquidity in a bid to insulate economies from disasters.[2] While such deployments first began to be linked to geopo-

1. While long-run chronologies for different financial tail events exist in the literature—including for financial crises (Reinhart and Rogoff, 2009; Jorda, Schularick, and Taylor, 2016; Baron, Verner, and Xiong, 2021), or for wars (Clodfelter, 2017)—the history of central bank interventions has not been studied systematically due to the lack of corresponding intervention data. Ferguson, Schaab, and Schularick (2014) is concerned with aggregate long-run balance sheet trends, but focused on a more restricted historical sample and did not isolate the causal effects of balance sheet expansions, either.

2. Conventional wisdom assumes that central banks' utilization of their balance sheets was limited prior to the 1970s. This is partly due to the emphasis on the interest rate as the primary operational tool in the treatises

litical shocks during the 17th and 18th centuries—occurring with increasing regularity during wars and revolutions—we find that the trigger for central bank liquidity support gradually but consistently shifted towards financial crises. This shift was not only driven by the relative frequency of these events, but also by the shifting sensitivity of central banks. Especially after the Great Depression, central bank liquidity operations became a systematic response to financial crises.

We develop a novel empirical strategy to study the causal effects of central bank liquidity support during financial crises. In general, such analysis is subject to an endogeneity bias: only severe crises warrant liquidity support in the first place. Existing literature starting with Bordo et al. (2001) posited that banking crises observed since the late 19^{th} century over a sample of about 80 countries were on average associated with larger GDP *losses* when accompanied by open-ended liquidity support. This finding has been confirmed by Honohan and Klingebiel (2003), showing that public liquidity support has been associated with longer crises, larger output losses and slower growth of sectors depending on external finance.[3] By comparing crises with and without liquidity support, Bordo et al. (2001) and Honohan and Klingebiel (2003) most likely compare crises of different severity such that their estimates might be driven by reverse causality.

We disentangle the effects of crisis severity and liquidity provision by exploiting beliefs of central bank governors about the desirability of crisis liquidity support: Governors emphasizing costs over benefits of such operations will be less likely to intervene—conditional on a given crisis situation. Recent research has established close links between personal beliefs of political decision-makers, their policy preferences, and aggregate economic outcomes (Gohlmann and Vaubel, 2007; Mishra and Reshef, 2019; Monnet and Puy, 2020; Malmendier and Wachter, 2022; Bordo and Istrefi, 2023; Giuliano and Spilimbergo, 2024). In this paper, we assess the ideological proximity of central bank governors to schools of thought that advocated against liquidity support to distressed institutions—either based on concerns about moral hazard or loss of institutional credibility due to discretionary policy rules deviations. We define a "hawk" as a governor who disapproves of liquidity support, and classify other governors as "doves/pragmatists".

We characterize a governor's ideological beliefs prior to the outbreak of the crisis based on a narrative analysis of historical sources. We utilize the extensive records of debates, speeches, and statements to locate each governor in the context of the ideological climate of his time but prior to a financial crisis.[4] Our sources include historical newspaper articles, records of speeches

by Walter Bagehot and others in the late 19th century, and partly due to central banks' alleged "passive" mandates (Sayers, 1956; Volcker, 2004; Carlson and Wheelock, 2015; Shafik, 2016).

3. Romer and Romer (2018) have recently reached a more benign assessment of the use of monetary policy space during crises on output, they use only a post-1970s event sample, and focus on policy-rate reductions.

4. In addition to the discussion in section 4.1, see Table 3.A.1 in Appendix 3.A, where we discuss in detail primary and secondary source material commenting on each individual governor in office during a banking crisis over 1870-2019, and also adopt alternative existing approaches to rank policy preferences of decision makers, including a three-way classification scheme. Table 3.A.2 also contains further professional and demographic background on all governors in our sample, with table 3.I.2 testing for their potential role in a first-stage regression setup, and section E containing a random governor classification assignment (Figure A.18).

and written statements, national biographical dictionaries, auto-biographies, and other relevant personal information.[5] We double-check our results against the relevant secondary literature in the history of economic thought, history, and political science—fields in which the majority of governors left traces—and also take into account shifts of governors' policy beliefs between crises.

We confirm that beliefs of central bank governors correlate strongly with central bank actions during crises: dovish governors were 34% more likely to expand the central bank's balance sheet in a crisis, indicating that central bank policy reactions corresponded to governor beliefs formed before the crisis. This provides us with a relevant instrument to identify variation in crisis liquidity support and circumnavigate the inherent endogeneity entangling monetary policy and the macroeconomy. Crucially for our identification, such beliefs are plausibly uncorrelated with other factors driving any given crisis. It possible that the anticipation of dovish crisis management could encourage financial risk-taking ex ante. However, this would aggravate crises raise the bar for finding positive macroeconomic effects of dovish central bank liquidity policy.

We can show that central bank liquidity support systematically cushioned the economic effects of financial crises throughout the modern history of advanced economies. Using governor beliefs as a statistical instrument, we estimate that a central bank balance sheet expansion of at least +15% during the first or second year after a financial crisis outbreak bolsters real GDP by +28 percentage points cumulatively over the subsequent three years relative to the counterfactual without liquidity support. Correspondingly, we document the stabilization of asset prices and aggregate investment. On average, this stabilization has been achieved without runaway inflation while crises without support were often followed by stagnant monetary aggregates and protracted deflation. In our data, liquidity support seems to have been effective in the form of lender of last resort (LLR) action with Bagehot-style private asset purchases operations rather than through supporting public borrowing with intervention in government bond markets. Our results are consistent with the hypothesis that risk absorption by the public sector matters for stimulation of private sector activity.

Finally, we present evidence that these positive short-run effects come with an important medium-term caveat. Hawkish central bank governors often invoke moral hazard prior to, and after the outbreak of a banking crisis. History shows that such concerns have merit. Central bank liquidity support in crises is associated with a rising probability of future episodes of excessive risk-taking by financial intermediaries that end in another financial crisis. If central banks refrained from using their balance sheet to support markets in the previous crisis, episodes of renewed excessive risk taking are much rarer. These insights on the long-term effects of liquidity support on repeated risk-taking in financial markets complement evidence on moral hazard

5. Appendix 1 documents our classification rationale governor-by-governor in our country sample during financial crisis episodes over the period 1870-2021. We also describe our process for dealing with "borderline" cases, or disagreements across different sources. National biographical dictionaries were particularly relevant in our approach given their nature as extensive peer-reviewed compendia and include, in the case of the Netherlands, for instance, the "Nieuw Nederlands Biografisch Woordenboek"; the Italian equivalent is the "Dizionario Biografico degli Italiani"; in Sweden, we fall back on the "Svenskt biografiskt lexikon" in this category.

concerns relating to other "safety nets" such as deposit insurance schemes (e.g. Cordella and Yeyati, 2003; Duchin and Sosyura, 2014; Drechsler, Drechsel, Marquez-Ibanez, et al., 2016).

Previous literature: Our paper adds new evidence to a mature theoretical literature on the lender of last resort. In its classic version envisioned by Thornton (1802) and popularized by Bagehot (1873), LLR policy works through bilateral lending by the central bank to illiquid but solvent private institution against good collateral at high rates.[6] Building on the insights of Diamond and Dybvig (1983) into creditor runs, also modern scholarship has placed liquidity at the heart of theories of financial crises—and their mitigation (Caballero and Krishnamurthy, 2008; Brunnermeier, 2009; Acharya and Skeie, 2011; Ashcraft, McAndrews, and Skeie, 2011; Bolton, Santos, and Scheinkman, 2011; Gertler and Karadi, 2011; Guerrieri and Shimer, 2014; Benmelech, Meisenzahl, and Ramcharan, 2016; Negro et al., 2017). Accordingly, adverse shocks and pessimism about asset returns can spiral into a collective flight to liquid assets—central bank reserves and close substitutes—to meet potential shortfalls in cash flows or creditor runs. As markets dry up and liquidity premia spike, the financial system's intermediation capacity dwindles and even sound institutions risk illiquidity and default. Unless the monetary authority meets the elevated desire to hold liquidity, wide-spread financial distress threatens a potentially severe real economic downturn. However, adverse selection effects and moral hazard can increase banks' risk taking (Drechsler, Drechsel, Marques-Ibanez, et al., 2016; Behr and Wang, 2020), financial frictions hampering the distribution of liquidity can foster credit misallocation (e.g. Bleck and Liu, 2018) and the monetary authority risks being trapped by overdosed liquidity (Benmelech and Bergman, 2012; V. Acharya et al., 2022). We provide evidence on the effect of these interventions both in the short run and over the long term.

Our evidence corroborates and generalizes various case study findings of Richardson and Troost (2009), Giannetti and Simonov (2013), Nakabayashi (2017), and Benmelech, Meisenzahl, and Ramcharan (2019)—all of whom evaluated particular liquidity constraints and provisions during financial crises. Our measure of liquidity support based on central bank balance sheet expansions complements the policy chronologies of Calomiris (2011) and Bindseil (2019). Metrick and Schmelzing (2024) provided a recent overview of banking sector interventions across 20 categories over multiple centuries, including 540 historical central bank liquidity provisions across 138 economies. Since the GFC in particular, a more specialized literature has investigated unconventional monetary policy (Bernanke, Reinhart, and Sack, 2004; Gagnon et al., 2011; Joyce et al., 2011; Engen, Laubach, and Reifschneider, 2015; Sims and Wu, 2020), with big-picture contributions by Bernanke (2020) and Bailey et al. (2020). Another strand of literature considers the specific risk-mitigating role of large-scale asset purchases (LSAPs) at the macro level (Caballero and Simsek, 2021). The literature has offered positive evaluations of LSAPs as they appear to have succeeded in reducing financial market uncertainty, supported aggregate demand, lowered borrowing costs for households, corporations,

6. While it could appear controversial whether open market operations qualify as LLR interventions (Goodhart, 1999; Tucker, 2014; Calomiris, Flandreau, and Laeven, 2016; Praet, 2016), our measure of aggregate liquidity provisions encompasses more narrowly defined LLR operations and as such relates to the works surveyed in Bordo (1990) or Buiter and Sibert (2007).

and sovereigns, boosted asset prices, and meaningfully raised inflation against the counterfactual scenario.[7] Analyses of the ECB's LTRO and OMT programs, in particular, have motivated assessments of liquidity provisions at the micro (bank) level. V. V. Acharya et al. (2019), Jeanne and Korinek (2020), and Crosignani, Faria-e-Castro, and Fonseca (2020): Drechsler, Drechsel, Marquez-Ibanez, et al. (2016), however, highlighted the adverse crowding-out effects of these programs.

Our classification of governors builds on and develops a wider interdisciplinary literature attempting to formalize policymakers' economic preferences in the context of competing political ideologies (Hibbs, 1977), including monetary policymakers (Rogoff, 1985; Alesina and Sachs, 1988; Havrilesky, 1995; Chang, 2003). This literature equally proposes time-invariant frameworks to distinguish between "hawkish" and "dovish" policy preferences, and to rank their relative importance of employment and growth as well as price and exchange rate stability, and moral hazard concerns. Financial markets also routinely group central bank governors in "hawkish" vs. "dovish/pragmatic" policy categories, based on the assessment of governors' public statements (Kuttner and Posen, 2010).

The structure of the paper is as follows. Section 2 introduces our new data and explores the historical evolution of central bank balance sheets. Section 3 analyzes shifts in how central bank balance sheets responded to multiple types of macroeconomic shocks over the past 400 years. Section 4 focuses on financial crises, and studies the macroeconomic effects of central bank liquidity support. Section 5 concludes.

3.1 International central bank balance sheet data since 1600

We assemble balance sheet data for central banks in 17 advanced economies.[8] For five countries we are able to trace de facto central banks back to the 1600s.[9] In this section, we explain the construction of the database and present international long-term trends in central bank balance sheets.

3.1.1 Data

We collected historical data on both de jure national central banks as well as their de facto predecessor institutions. These institutions could be privately owned (as the Bank of England was prior to 1946), or publicly owned, as long as they are recognized as occupying a de facto

7. For summaries of studies and the posited financial and macroeconomic effects, see for instance Borio and Zabai (2018) or Smets and Potter (2019): both also document the wide range of estimates on some variables: the ECB's SMP program, for one, is credited with having less than a 100 basis point impact on Eurosystem government bond yields according to one study, while another credits the program with a 550 basis point impact (Smets and Potter, 2019, 29). Of course, there are selected contributions that negate any overall positive impact of balance sheet expansions, including Greenlaw et al. (2018)—those views, however, are thus far not widely echoed.

8. Our dataset covers: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

9. Figure 3.4 visualizes the coverage of our data for on a country-year basis.

position as a "bank among banks" with a de facto monopoly on note issuance or government financing. While we can reconstruct a substantial number of early modern de facto central banks, there are data limitations that affect a number of early well-known banks: in Appendix 3.B, we detail our definition of proto central banks and survey various de facto central bank institutions that fulfill our criteria but were excluded given a lack of satisfactory data.

The institutional organization of central banks varies across advanced economies even in modern times. The Federal Reserve System is technically composed of twelve regional Federal Reserve Banks with their own balance sheets. The European Central Bank has not eliminated the national-level balance sheet accounting in the Eurosystem, currently comprising 19 national central banks. In both cases, the institutions' balance sheet expansion decisions are reached at the centralized level, and balance sheet items are reported on a consolidated basis that aggregates regional Federal Reserves, and Eurosystem central banks, respectively (Stella, 2009; ECB, 2012). As we are interested in the aggregate-level macroeconomic and financial responses of balance sheet dynamics, it is most appropriate to use these consolidated balance sheet definitions as our benchmark series.[10]

Our early data cover the Public Banks of Naples (1587-1805, Balletta, 2008), the Bank of Amsterdam (1611-1814, Dillen, 1934), the Sienese Monte (1626-1725, Camaiti, 1956), the Bank of Hamburg (1665-1770, Sieveking, 1934), the Swedish Riksbank (since 1668, Simonsson, 1931; Fregert, 2014), the Bank of England (since 1700, Dimsdale and Thomas, 2017), the Bank of the United States (1792-1848, Baker et al., 2019), the Bank of Finland (since 1813, Asp, 1898), the Danish Nationalbanken (since 1865, Svendsen et al., 1968), the Bank of Netherlands (since 1815, Borght, 1896, and the Dutch *Nationaal Archief*, F1100212/2013), the Royal Bank of Prussia (since 1817, Niebuhr, 1854; Bankverwaltungsrat, 1851-1872), the Banque de France (since 1800, Courtois, 1881; Baubeau, 2018) and the Banco de San Fernando/Banco d'España (since 1830, Lorca, 1999; Martín-Aceña, 2017), and for Italy the Banca Nazionale (1856-1892,

10. Notably, Richardson and Troost (2009) argue that the liquidity provision of the Atlanta Fed during 1930—as opposed to the restrictive St. Louis' policy in the neighboring Federal Reserve district during the same period—can be associated with stabilizing outcomes in the former's banking sector. Any changes in the Atlanta Fed's balance sheet in such a case are reflected in the Fed's consolidated balance which we focus on: while our approach is not designed to pick up potential variations in the macroeconomic and financial response on the regional level, it is not "missing" such underlying expansion dynamics, therefore, and if influential enough on the aggregate level, will correspond to measurable impulse response results. Broad policy outlines, even at the Atlanta Fed, were still determined by the FOMC before, during, and after the 1930 episode, including the type of collateral eligible for regional Fed discounting. A corresponding case is a Eurosystem national central bank's provision of emergency liquidity assistance (ELA) lines, which are reflected in consolidated form in the Eurosystem balance sheet, and the broad eligibility of which is set by the ECB governing council, rather than the national level (ECB, 2020).

Pozzo and Felloni, 1964).[11] From 1870, we add data from the national central banks in Belgium, Finland, Norway and Portugal.[12]

Our post-1870 central bank balance sheet data are sourced from a wide variety of country-level primary and secondary literature detailed in Appendix 3.P. For large parts of this sample, we were also able to study the composition of central bank assets and liabilities in more detail. Our dataset provides full coverage for the 17 advanced economies from 1920 onwards.

For analysis presented in the main text, we merge the following additional panel datasets. Macroeconomic and aggregate financial data for the period 1870-2020 are sourced from the *Macro-History Database* of Jorda, Schularick, and Taylor (2017). We date financial crises post 1870 following Baron, Verner, and Xiong (2021) and following Metrick and Schmelzing (2024) before 1870. Data on the incidence and severity of wars is sourced from Clodfelter (2017). And we merge series of nominal GDP prior to 1870 for the UK (Broadberry et al., 2015), Sweden (Edvinsson, 2014), Holland (Smits, Horlings, and Zanden, 2000; Zanden and Leeuwen, 2012), the Spanish Kingdom (Alvarez-Nogal and Escosura, 2013), Kingdom of Naples (Malanima, 2011), Hamburg and Prussia (Pfister, 2022) and France (Ridolfi and Nuvolari, 2021). Government debt series prior to 1870 cover the UK (Dimsdale and Thomas, 2017), Sweden (Edvinsson, 2014), Netherlands (**Fritschy2017**), and France (Vuehrer, 1886). Additional data used in appendix analyses are detailed in the corresponding Appendices.

Table 3.1 summarizes our data through the distribution of annual balance sheet fluctuations. We split statistics by three major sub-periods: pre-1870, 1870-1949 and post-1949. The variation in annual growth rates was substantial across all historical episodes, suggesting that balance sheets were in principle able to behave elastically, even under the constraints of metal-based currencies.

Table 3.1. Distribution of central bank balance sheet fluctuations

				Percentiles				
	N	$\hat{\mu}$	$\hat{\sigma}$	5	25	50	75	95
1600 to 1869	1174	0.07	0.93	-0.21	-0.04	0.02	0.09	0.36
1870 to 1949	1011	0.12	0.49	-0.09	-0.01	0.05	0.14	0.50
1950 to 2020	1168	0.10	0.19	-0.10	0.01	0.07	0.15	0.38

Notes: Descriptive statistics—sample size N, sample average $\hat{\mu}$, sample standard deviation $\hat{\sigma}$ and percentiles—of annual nominal central bank balance sheet growth by sub-sample.

11. There are a select quasi-central banks for the modern period that existing literature treats as such but which we do not cover, mainly because empirical records are either fully lacking or are non-continuous, such as those for the Genoese *Banco di San Giorgio*, or Barcelona's *Taula Di Canvi* (for which few ledgers survived): for the moment, we are also leaving out a few select early series which are not entirely transparent about the full range of balance sheet items covered, such as Tucci (1973)'s data for the Venetian *Banco Giro*, and the Milanese *Banco S. Ambrogio* (Cova, 1972).

12. All of our twelve early modern central banks have been treated in the literature as de facto predecessors to contemporary central banks.

3.1.2 Historical evolution of central bank balance sheets

Our data reveals the historical variation in the economic size of central banks across countries and time.In this section, we analyze time series of year-specific cross-sectional data moments. The full set of country-specific series as well as estimates of year fixed effects are shown in Appendix 3.C.

3.1.2.1 Central bank balance sheets relative to output

Figure 3.1 shows the cross-sectional mean and quartiles of total central bank assets relative to GDP of the corresponding jurisdiction for each year between 1600 and 2020.[13] We observe that the inception period of central banks in the 17th and 18th centuries saw sharp growth in this measure followed by international dispersion taking hold during the second half of the 18th century. Significant variation in this time period is driven by war finance or geopolitical competition for overseas trade routes.[14, 15]

For much of the 19th century, aggregate central bank assets-to-GDP ratios varied in tight ranges, both across countries and across time. They rarely surpassed 15% of GDP, even during costly macroeconomic and financial shocks such as the Crimean War (1853-56) or the 1857 and 1866 international financial crises. But from the 1880s our series once more records an acceleration of aggregate central bank assets relative to output, partly induced by new ideas about central banking, such as those of Bagehot (1873), which triggered monetary policy reforms, notably in the UK (Calomiris, 2011).

The upheavals of modern history left a major imprint on central bank balance sheets. Despite the clear majority of our country-level constituents being involved in both World War I and World War II, central bank balance sheet patterns differ markedly. Aggregate expansion during the latter were much more pronounced, setting new international and historical records. Such a finding accords with the work of previous scholars who emphasized the private-market financing basis of World War I (Strachan, 2004). Figure 3.1 shows how assets/GDP reached 20th century lows by the mid-1990s. Since then, central bank balance sheets grew especially in the wake of the Great Financial Crisis, the European Sovereign Debt Crisis and the Pandemic Recession.[16] The exceptional rise in assets from 2008 on this basis represents an "unprecedented"

13. As denominator. we use the political entity which achieves the highest degree of conceptual consistency over time, and reflects the historical reality of market integration. For details, see Section 3.1.1.

14. For example, the Bank of England's balance sheet grew substantially after it assumed government debt previously financed through the semi-public South Sea Company failing 1720. In Sweden, the treasury borrowed heavily from the Riksbank to finance military outlays during the Russo-Swedish war 1741-1743. These debts were rolled over until 1778, when the government forced the Riksbank to write off most of them.

15. We note that central have have not been created alike and their institutional features and context were instrumental for these dynamics. For example, we find that central bank balance sheets have in principle been greater relative to GDP under monarchies or when the sovereign—be it a monarch or a republican—had major ownership stakes.

16. Reactions to financial shocks stemming from the burst of the tech bubble 2001 or the 9/11 terrorist attacks did not provoke major central bank balance sheet responses.

break in multi-century dynamics, with average central bank asset-to-GDP ratios recently reaching almost double their World War II peaks.[17]

Overall, we observe that bullion standard regimes did not necessitate static balance sheets relative to output, but went hand-in-hand with different "balance sheet regimes". Assets/GDP, in other words, evolved opportunistically, more flexibly than rigid "rules of the game" would imply, and depending on specific demand for a publicly provided safety net. The floating era—when balance sheet sizes were freed from any remaining gold coverage ratios—did not unleash a sustained acceleration of central bank asset growth. However, it certainly contributed to greater elasticity of central bank balance sheets in response to disaster events.

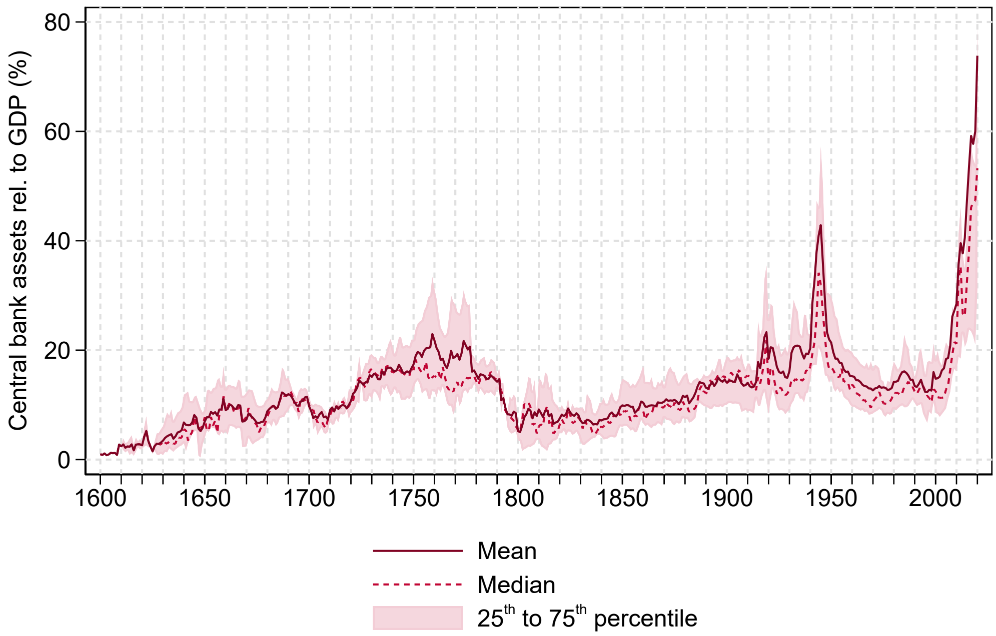


Figure 3.1. Central bank assets relative to GDP, 1600-2020

Notes: The figure shows the year-specific cross-sectional mean and quartiles of total central bank assets relative to GDP of the corresponding jurisdiction. Sample composition and underlying sources are detailed in Section 3.1.1.

3.1.2.2 Central bank balance sheets relative to the size of the financial sector

It is not clear that GDP is the right denominator to benchmark the size of the central bank. Indeed, the picture changes drastically when we normalize aggregate central bank assets by the size of the private financial system. Figure 3.B.1 visualizes the annual cross-sectional distribution of central bank balance sheets relative to aggregate private bank lending to the private

17. None of these pattern highlighted in the text are driven by sample composition effects: Estimates of year fixed effects controlling for country fixed effects in Appendix 3.C trace out a very similar time series.

non-financial sector.[18] While central bank played a major role in pre-WW2 financial systems, private financial intermediation out-grew public central banks thanks to financial deepening, innovation and deregulation. From average levels below 50% in 1960, the ratio falls almost uninterruptedly to all-time lows by 1998, of just 15.4% on average. From this perspective, the recent growth of central bank balance sheets looks but a normalization in which central bank re-establish the role they used to play. This suggests that larger central bank balance seets may be here to stay.[19]

Another important factor behind the relative decline of central bank size, however, was the widespread adoption of an alternative "safety net" for the banking sector: mandatory deposit insurance.[20] While the United States is an outlier, introducing an explicit deposit insurance scheme as early as 1934, all other countries in our sample (bar Australia, which relied on an implicit scheme) introduce explicit deposit insurance schemes between 1961 (Norway) and 1996 (Sweden). In consequence, central bank balance sheets were no longer the only safety net for the banking sector. And the 1970s and 1980s saw a substantial uptick in the share of deposit insurance responses, and an associated decline in traditional liquidity assistance interventions by monetary authorities (Demirguc-Kunt and Detragiache, 2002; Metrick and Schmelzing, 2024).

These developments changed the nature of financial crises over time. Baron, Verner, and Xiong (2021) document that between 1870-1940, for a panel of 46 countries, banking crises almost exclusively featured actual "panics", defined as depositor runs. However, the share of banking crises "without panics" rose gradually from the 1960s when shadow banking began to grow in importance (Adrian and Shin, 2009; Antill, Hou, and Sarkar, 2014). By 2010 the overwhelming share of banking crises feature no panics. While deposit insurance prevented classical depositor runs, a larger shadow banking system created new financial stability risks.[21]

3.1.2.3 Central bank holdings of public debt

Figure 3.3 shows a subset of total central bank assets -– namely government debt assets — as a share of total government debt outstanding, and as a share of total central bank assets. As a share of total government debt outstanding, central bank balance sheet holdings of government

18. Due to data limitations on financial sector loan volumes, we show figures only from 1870.

19. None of these pattern highlighted in the text are driven by sample composition effects: Estimates of year fixed effects controlling for country fixed effects in Appendix 3.C trace out a very similar time series.

20. See Demirguc-Kunt and Huizinga (1999) and Calomiris (2011) for relevant "safety net" discussions. Identifying recourse to emergency liquidity as a form of financial sector "safety net" repeatedly occurs in previous literature: Calomiris (1997), Calomiris (1999), Mishkin (2000), or Gorton and Metrick (2013) refer to the Fed's LLR facility as a "safety net" for the financial sector, the more prominent one in existing literature being deposit insurance / the FDIC.

21. In the US, deposit-taking institutions were outstripped by financial institutions without deposit insurance coverage in the 1990s—requiring a shift towards a new role that might be characterized as the "market maker of last resort" function. After initially attempting to re-run a traditional LLR response to the crisis, the 2008 central bank balance sheet expansions overwhelmingly targeted assets held by the *shadow banking sector*, which were unable to fall back on the deposit insurance safety net (Buiter and Sibert, 2007; Gertler and Karadi, 2011).

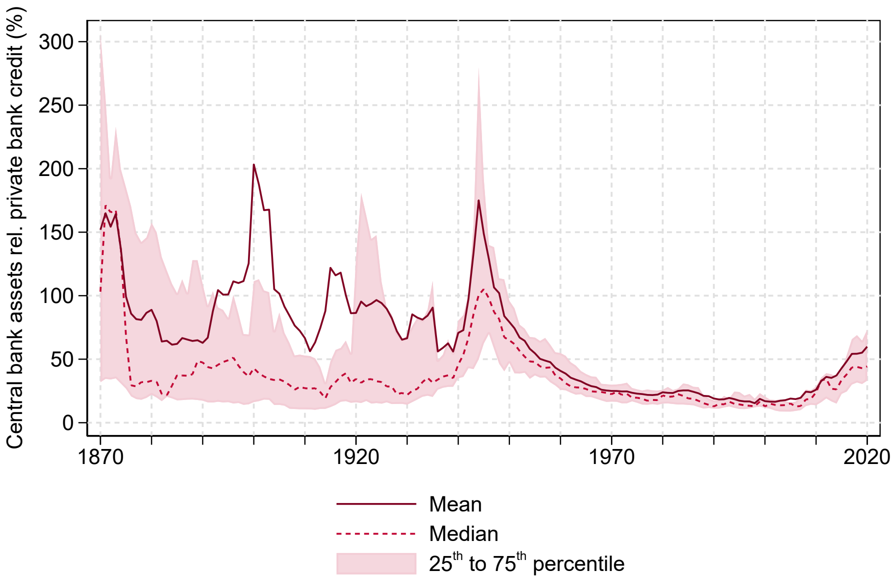


Figure 3.2. Central bank assets as a share of total bank lending to the non-financial private sector

Notes: The figure shows the year-specific cross-sectional mean and quartiles of total central bank assets relative to the stock of bank debt owed by private nonfinancial businesses and households. Sample composition and underlying sources are detailed in Section 3.1.1.

debt have increased somewhat in recent years, but still fall notably short of the peaks observed during the Seven Years' War and the Napoleonic Wars. The data make it clear that asset purchase operations since 2008 have sharply reversed the post-1945 trend of a "withdrawal" of central banks vis-a-vis growing public financial asset volumes. However, at 17.5% they remain a far cry from classical "debt monetization" episodes, when individual central banks held close to 80% of all outstanding public debt.[22] We also observe that international financial regimes—whether featuring fixed, floating, or intermediate exchange rate arrangements—do not appear to necessitate a specific asset/debt range. Once again, sharp breaks appear to be event-specific and typically associated with major macroeconomic shocks.[23]

In Figure 3.3b, we display central bank government debt assets as a share of aggregate central bank assets, in other words, the central banks' concentration of government assets in their portfolios over time across countries. Echoing the previous measure, present fears over "fiscal dominance" appear not to be borne out. Current levels indicating close to half of aggregate central bank assets in the form of public debt are not out of line with historical experience. In this sense, private sector recourse to the central bank "safety net" appears to have been dominant

22. None of these pattern highlighted in the text are driven by sample composition effects: Estimates of year fixed effects controlling for country fixed effects in Appendix 3.C trace out a very similar time series.

23. In 1711, amid financial volatility and fears of a more systemic event, the government provided the Bank of England with GBP 45,000 to buy Exchequer Bills in the open market and reduce the prevailing discount rate. The operation was deemed a success on account of the successful reduction of short-term market rates. See Hill (1971).

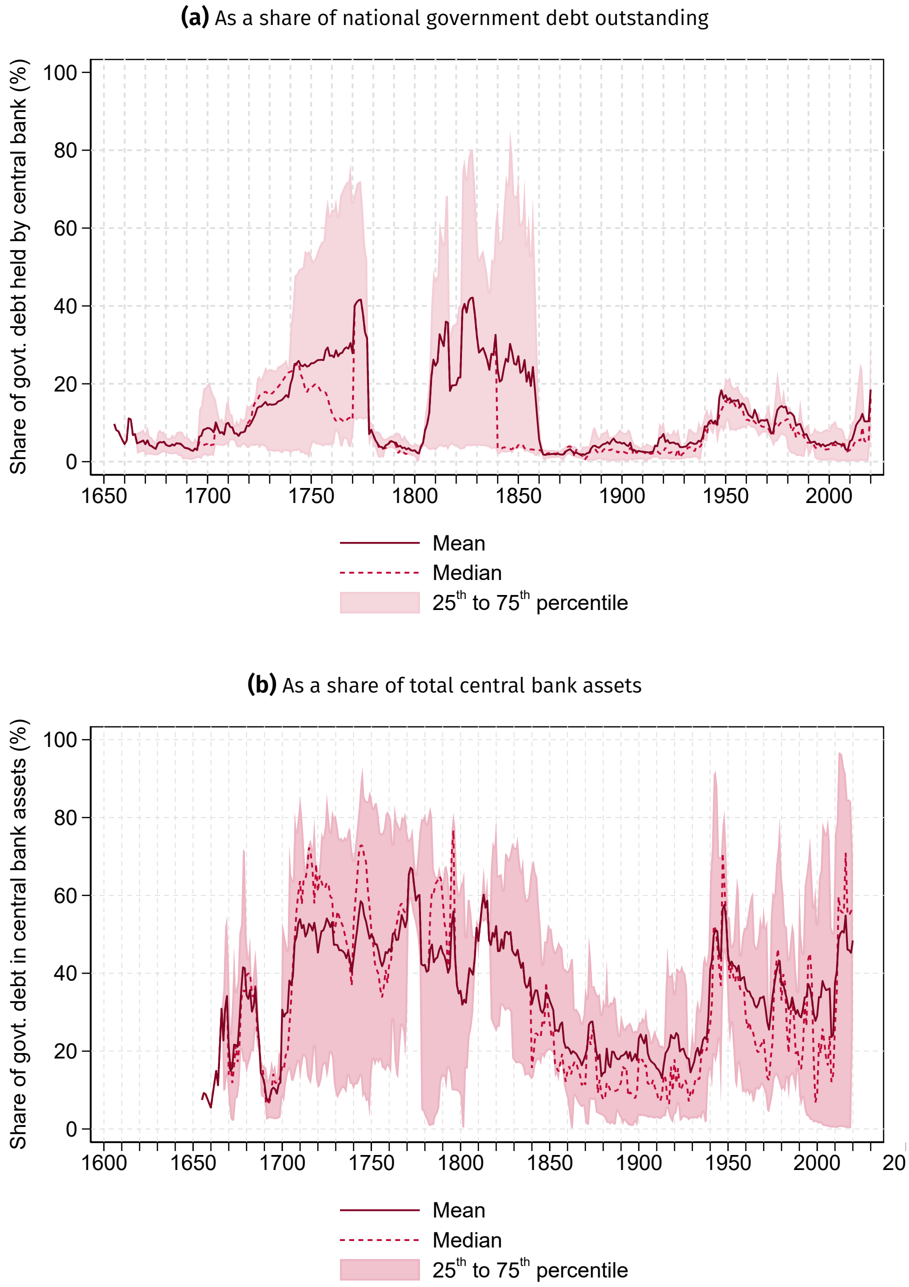


Figure 3.3. Government debt held by central banks, 1652-2020

Notes: The figure shows the year-specific cross-sectional mean and quartiles of total central bank holding of government debt relative total government debt outstanding in Panel (a) and relative to total central bank assets in Panel (b). Sample composition and underlying sources are detailed in Section 3.1.1.

during the classical gold standard (an era lacking deposit insurance schemes, but featuring high capital mobility).

Overall, therefore, aggregate balance sheet trends across advanced economies do not monotonically track trends in transactions or financial asset volumes. Regardless of influential "real bills" policy frameworks and the rules of fixed or floating exchange rate regimes, central bank balance sheets did not consistently fluctuate with output variables. A more plausible interpretation relates central bank balance sheet trends to the utilization of their safety net function, which ebbed temporarily with the emergence of alternative insurance mechanisms and overall demand for a publicly provided safety net. The rise of the shadow banking sector from the mid-1990s appears to have once more revived financial sector demand for a traditional safety net provision.[24]

3.2 The central bank balance sheet as a safety net

What drove central bank balance sheet expansions? While the previous section surveyed broad international patterns, we turn to a more rigorous quantitative analysis here. We determine the policy motivation and event context for each central bank balance sheet expansion, defining a "major balance sheet expansion" as an individual country-year during which total nominal central bank asset grew by at least 15% year-on-year. However, all our key conclusions in this section are robust to other cut-offs. Over the period 1600-2020, 742 country-years fulfill our 15% criterion (out of 7,157 total country-year observations).[25] All such expansion dates are visualized for each country in Figure 3.4. For around 16.3% of country-years pre-1870 (23.7% post-1870), annual balance sheet growth exceeded +15%.

3.2.1 Triggers of central bank balance sheet expansions

Previous literature has offered some guidance on how to distinguish between different central bank balance sheet drivers, classifying types from the operational side. According to Bindseil (2004), central bank balance sheet expansions can be a function of (a) currency issuance; (b) an FX operation; (c) an investment of own funds; (d) liquidity assistance; or (e) a monetary policy operation.

We seek to assess the relative importance of different motives to expand central bank balance sheets and the types of macro shocks that prompted a major balance sheet expansion. We distinguish four main underlying macro shock categories which have led to major balance sheet expansions (as defined above), all of which have historically been associated with the opera-

24. None of these pattern highlighted in the text are driven by sample composition effects: Estimates of year fixed effects controlling for country fixed effects in Appendix 3.C trace out a very similar time series.

25. We recognize that a liquidity provision event can be neutral with regards to the overall central bank balance sheet size if the intention is merely to swap "risky" assets held by the private sector for "safe" assets held by the public sector—or if lending is sterilized. Note further that in general, our identifications are robust in nominal and real terms.

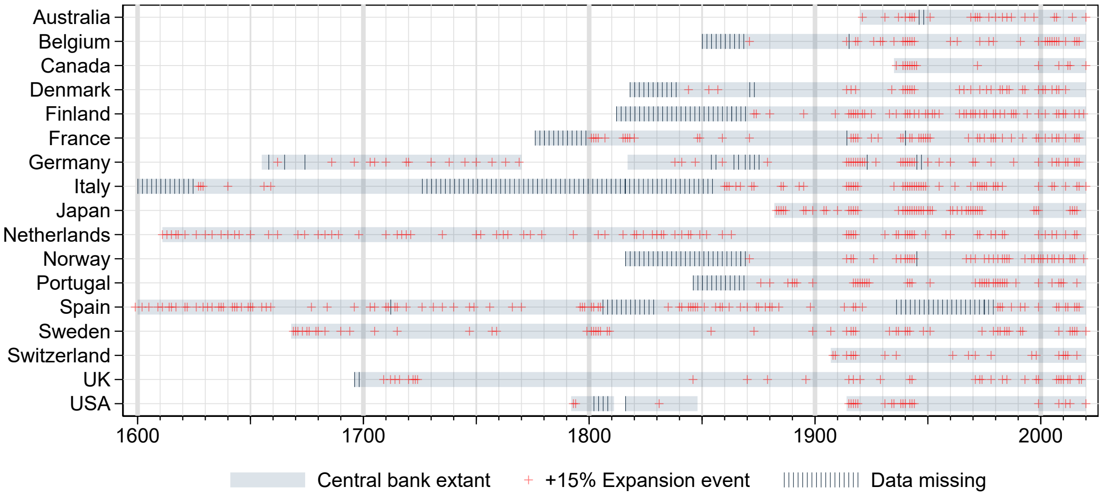


Figure 3.4. Data coverage and expansion events, 1600-2020

Notes: This figure shows the coverage of the central bank data on a country-year basis. In addition, red crosses mark expansion events defined by +15% year-on-year total nominal asset growth or more.

tional responses in Bindseil (2004).[26] The first three represent instances where either public or private sector stress prompted an active deployment to the central bank balance sheet with the intention of reducing short-term liquidity or re-financing risks. Hence, these categories were instances of recourse to a publicly provided "safety net" function of the central bank balance sheet. The fourth category, in contrast, represents a residual "passive" expansion category: events in this group were not designed actively to reduce short-term risk premia or re-financing stress, but exclusively reflected transactional fluctuations, operational idiosyncratic events (such as the TARGET system introduction across central banks in 1999), or other internal needs of the bank itself.[27]

26. While we focus on summary statistics here, in the appendix, section 2.1, we provide full background historical evidence for the "top 25" largest historical expansion events, and respective sources, to illustrate our classification rationale.

27. This fourth category of events, hence, does not relate to any of the above "tail events". We aggregate these country-years into a residual category—"Revaluation/Residual/Commercial driver"—to denote country-years where the expansion of the central bank balance sheet is primarily of a passive or commercial nature: these expansions are never designed to alleviate private financial or political pressure, or reduce risk premia, and often relate to the balance sheet categories (a)—(c) in Bindseil (2004), currency issuance, FX operations, and investments of own funds. In total, just over a third (36%) of all expansions fall into this residual category—given such proportions, it is clear that this category did not primarily determine either long-run central bank balance sheet trajectories, or short-term asset spikes. Since there are typically no "active" policy decisions at the central bank level related to these expansions, we disregard this expansion category for many of our subsequent exercises. We count 140 country-years in this category, and the average year-on-year nominal expansion in this category across country-years stands at 55.9%.In this group, the German hyperinflation year of 1922 represents a significant outlier. Reichsbank nominal

- **“Financial crisis”**: We use this category to denote country-years that were primarily associated with financial market volatility, to which the central bank actively responded. Existing chronologies provide a robust picture of several types of volatility in this context, including stock market crashes, bank runs, systemic liquidity shortages, or other threats to the systemic health of the private financial sector. Our classification concentrates on standard banking crisis chronologies (Reinhart and Rogoff (2009), Schularick and Taylor (2012), and Baron, Verner, and Xiong (2021), rather than exclusive sovereign or currency crises, to capture more narrowly traditional LLR events. We count 83 country-year events in this category—mainly representing private sector-driven recourse to the safety net -, of which 47 were in the post-2007 period. The average country-year in this category saw a 44.6% annual balance sheet expansion.[28] For a discussion of measuring LLR operations using annual aggregate balance sheet movements, see Appendix 3.H.
- "**War or revolution”**: We use this category to denote country-years that were primarily related to major geopolitical events, during which either rising military spending led to explicit or implicit requests by fiscal authorities to monetize ensuing deficits, or domestic political uncertainty motivated monetary policymakers to monetize fiscal outlays, or provide private sector liquidity.[29] War and revolutionary events are identified on the basis of long-run military history reference chronologies (Clodfelter, 2017).[30] Over the long-run, this category constitutes by far the most important one: we count 142 country-year events in this category since 1588, of which 39 occurred during World War I and 47 are during World War II. The average country-year in this category saw a 50.8% balance sheet expansion.
- "**Pandemics or natural disasters”**: This is a category with limited pre-2020 significance because in no previous pandemic was there anything resembling the fiscal and monetary response to that seen in 2021-2.[31] Our sample for this category is therefore comparatively small (n=19), and—with the exception of the 1656-8 pandemic in Naples, in response to

total assets in 1922 were expanding at 1186% year-on-year, mainly driven by sharply rising commercial bill discounting activity. Webb (1985, 480–3) argues the Reichsbank behaved passively through this phase, effectively letting the market decide its balance sheet size.

28. For all exercises involving the pre-1870 period, we use banking crisis definitions in Metrick and Schmelzing (2024). Twin crises—as long as they include a banking crisis event as classified by these chronologies—are part of our ’financial crisis’ sample.

29. In practice, public asset purchases clearly dominate historically during these episodes. In Appendix 2.2, we break down expansion events by public/private asset types and analyze general trends. We note that "war or revolution" events are repeatedly associated with a "sovereign default" classification in financial crisis chronologies: for instance, Germany 1943, which Reinhart and Rogoff (2009) classify as a sovereign default event; unless also accompanied by a quantitatively dominant banking crisis, these events remain in the "war or revolution" category despite these overlaps.

30. Our observations are based on the timeline via Clodfelter (2017) remain robust when other approaches are employed, for instance the well-known data in Levy (1983) or Brecke (1999).

31. We note that even major previous natural or health-related disasters, such as the 1918-19 Spanish influenza, the 1957-58 “Asian flu”, or the 1906 San Francisco Earthquake, did not typically engender a measurable monetary policy response. Anderson, Chang, and Copeland (2020) argue that the Federal Reserve met extra liquidity demand from member banks affected by the 1918 influenza. However, such assistance was sporadic and did not feature prominently in the annual reports, either by the Federal Reserve Board or the New York Fed, as opposed to the

which the viceroyalty launched a grain purchase program (Fusco, 2007)—restricted to the most recent central bank policy actions over 2020-21. Country-years in this category have on average so far experienced a 48% balance sheet expansion.

How has the relative importance of these expansion types changed over time? Figure 3.5 addresses this question, by classifying the context in which a particular type of "tail event" required a decision for a balance sheet expansion—irrespective of the specific policy aim for which this expansion was then deployed (whether an asset market stabilization, or a debt monetization).

On the basis of this evidence, it can be confirmed that the drivers of central bank balance sheet expansions have undergone fundamental shifts over the long-run. Over time, geopolitical and financial crises events account for six out of ten of all balance sheet expansions: but the relative importance of the two main drivers has undergone a substantial shift, partly a consequence of shifting event *frequencies*.[32] While almost half of all balance sheet expansions in the pre-1870 era (48.5%) can be linked to wars, revolutions, or other geopolitical events, such motivations have become rare in the post-1945 world. In turn, more than 40% of all central bank balance sheet expansions after World War II were linked to financial crises, whereas the share was less than 15% in the years prior to 1870 and remained of secondary importance even during the interwar period.[33]

3.2.2 Sensitivity of central bank balance sheets to wars and crises

The previous section documents a shift from war-related expansions to financial crisis-related expansions. Is this merely driven by a shift in the relative incidence of these events? Arguably, wars have been more frequent in the past, while financial crises only occurred later after financial systems became larger. Have policymakers become more inclined to respond to a particular type of tail event per se?

To test, we estimate a probit model for a binary variable $m_{i,t}$ indicating an annual expansion of the central bank balance sheet of at least +15% during the current or the next year:[34]

$$P(m_{i,t} = 1|\cdot) = \Phi\Big(\gamma_{e,i} + \alpha_e \text{war}_{i,t} + \beta_e \text{crisis}_{i,t}\Big) \tag{3.1}$$

prominent role of the War. We would also consider events such as the 9/11 balance sheet expansion in the U.S. under this category, but the y-o-y growth for 2001 does not pass our 15% threshold: see Martin (2009, 400).

32. For the long-run evolution in "bank stress", see (Metrick and Schmelzing, 2024, 31), who on the basis of advanced economy GDP-weighted data identify a doubling of bank stress frequency between the 18th and the mid-19th century, a further doubling between the mid-19th century and the interwar period, and a continued increase in the post-Bretton Woods period. For wars, conflict deaths per million population for our 17-country sample stands at 122.5 per country-year between 1650-1945, dropping to 2.12 for 1946-2020; 90.5% of country-years since 1946 are fully conflict-free, all on the Clodfelter (2017) basis.

33. We generally focus attention on banking crises, as opposed to other types of financial crises for which chronologies exist. We note that the association between currency crises and major balance sheet expansions is less firm. Bordo et al. (2001), for one, classically record a sharp rise in the latter category for DM economies in the period 1945-71, a period with low DM balance sheet expansion frequency. Subsequent chronologies distinguishing between currency and banking crises confirm the general patterns, including Reinhart and Rogoff (2009).

34. Estimates are virtually identical when using a linear probability model.

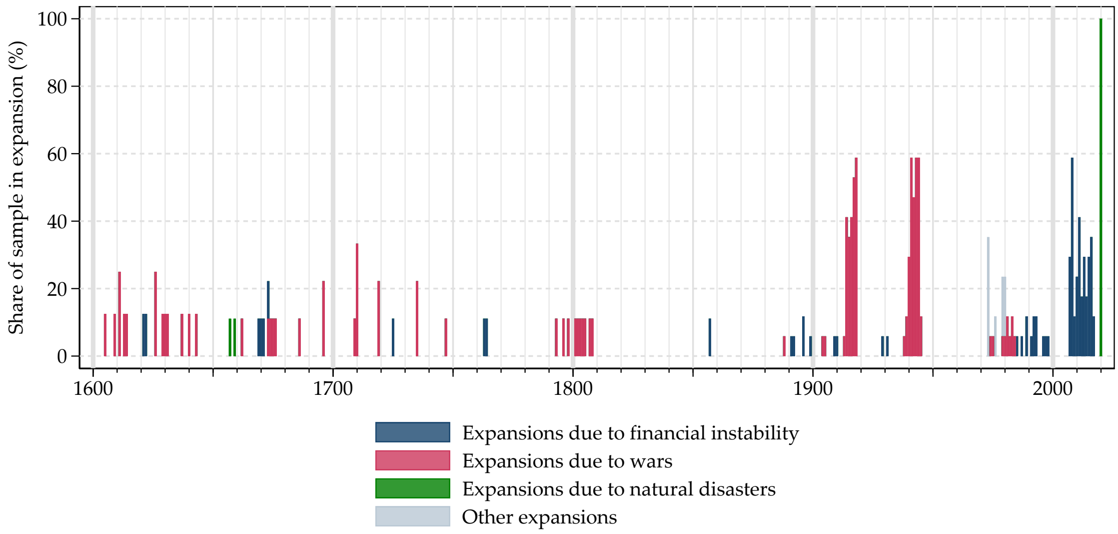


Figure 3.5. Major balance sheet expansion events, by type, 1600-2020

Notes: Balance sheets expansions expansion events defined as +15% year-on-year total nominal asset growth.

where Φ is the standard normal distribution function, t indexes the year, i indexes the country and $\text{war}_{i,t}$ and $\text{crisis}_{i,t}$ represent binary variables indicating a war or a financial crisis. The chronology of wars comes from Clodfelter (2017) and we restrict attention to war-years with at least 50 casualties per million of population. Financial crises are dated following Metrick and Schmelzing (2024) for the period until 1870 and Baron, Verner, and Xiong (2021) for the period 1870-2020. Moreover, e indexes five distinct historical episodes: pre-industrialization (prior to 1750), industrialization (1750-1869), first globalization (1870-1913), world wars (1914-1945) and post-WW2 (after 1945). That is, $\gamma_{i,e}$ controls era-specific country fixed effects while α_e and β_e measure the era-specific sensitivity of central banks towards wars and financial crises.

Figure 3.6 plots the average marginal effects of wars and crises on central bank balance sheet expansions, together with their 95% confidence intervals and separately for each episode. Hence, it visualizes the sensitivity with which central banks in our sample react with a major balance sheet expansion to geopolitical or financial tail events. First, we can observe that up until World War II, central banks have been notably more sensitive towards wars than towards financial crises. The probability of a major expansion increased by up to 40% upon a war, outstripping the sensitivity to financial crises of at most 8%. The statistical insignificance of the *average* reaction probability in the case of financial crises does not rule out that central bank did occasionally react, or even systematically so in a few countries and episodes, e.g., the Bank of England in the late 19$^{\text{th}}$ century (cf. Humphrey, 1989; Capie et al., 1995; Calomiris, 2011). However, after the World War II, central bank became systematically more sensitive to finan-

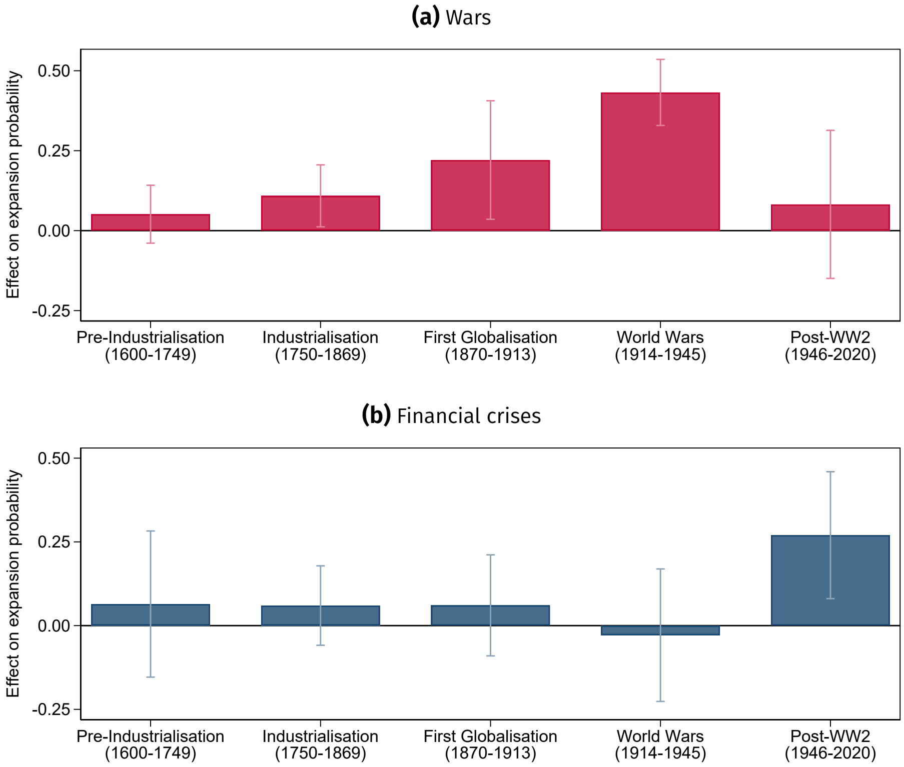


Figure 3.6. Central bank balance sheet sensitivity to disasters, by historical episode

Notes: The figure plots the average marginal effects on the probability of a central bank balance sheet expansion of +15% or more during the current or the next year. The units are percentage points divided by 100. Estimates based on the probit model of Equation (3.1). The chronology of wars is sourced from Clodfelter (2017) and we restrict attention to war-years with at least 50 casualties per million population. Financial crises are dated following Metrick and Schmelzing (2024) for the period until 1870 and Baron, Verner, and Xiong (2021) for the period 1870-2020.

cial crises, raising average expansion probabilities by about 30% while the sensitivity to wars collapsed to about 10%.[35]

In Appendix 3.E we test sensitivity toward conventional recessions and confirm, that the time pattern is financial crisis sensitivity is not driven by shifts in ordinary monetary policy aimed at business cycle stabilisation. Likewise, our analysis rejects the hypothesis that pre and post-World War II differences can be explained by constraints of the Gold Standard or currency pegs more generally.

35. In additional tests, we confirm that the central bank's sensitivity to crises is especially high in country-years without deposit insurance, following the classification of Demirguc-Kunt and Detragiache (2002). In other words, this speaks to the partial substitutability of safety net functions provided by the central bank one the one hand, and deposit insurance on the other. However, given the widespread adoption of deposit insurances post World War II, these estimates are only based on five crisis observations.

3.3 The macroeconomic effects of liquidity support during crises

Time and again, central banks sought to mitigate systemic financial distress by expanding balance sheets to keep markets liquid. The potential to stabilize the financial sector became more valuable as economies' financial deepening magnified the destructive power of financial crises. However, warnings about moral hazard and future instability have made these interventions controversial from the start and consensus about overall benefits remains elusive to this date.

Systematic and reliable empirical quantification of stabilization effects has to overcome an inherent identification problem: The central bank's propensity to intervene grows with the severity of the crisis. Bordo et al. (2001) and Honohan and Klingebiel (2003) documented that across countries and history, central bank liquidity support predicts *worse* crises outcomes. In fact, we find the same in our data: Figure 3.7 visualises the average real GDP trajectories around financial crises dated by Baron, Verner, and Xiong (2021), split by whether the central bank responded with large-scale liquidity support $m_{i,t}$ defined as

$$m_{i,t} \;=\; \mathbb{1}\Big(\text{annual central bank balance sheet growth} \;\geq\; 15\% \text{ in } t \text{ or } t-1\Big) \tag{3.2}$$

i.e., indicating whether the central bank expanded its balance sheet by $+15\%$ or more during the first two years of the crisis.[36] Economic activity shrinks notably for treated crises while it barely slows down for untreated ones. Even four years after crisis start, real GDP is two percentage points lower when the central bank intervened compared to the no-intervention case. However, only severe crises warrant liquidity support in the first place, so comparing crises with and without liquidity support is prone to suffer from reverse causality bias.

To properly identify the macroeconomic effects of central bank liquidity injections during crises, we use exogenous variation induced by the *central bank governor's beliefs about the benefits and costs of liquidity support to distressed financial institutions* held prior to the crisis. We argue that governors emphasizing costs over benefits will be reluctant use the central bank balance sheet to backstop struggling financial intermediaries. Accordingly, we define a "hawk" as a governor who disapproves of liquidity support, and classify other governors as "doves/pragmatists". We assess the ideological proximity of central bank governors to schools of thought that advocated against liquidity support to distressed institutions—either based on concerns about moral hazard or the loss of institutional credibility through discretionary policy rules deviations. Corresponding beliefs have evolved over decades of life experience, but they are developed prior to and independent of an acute crisis situation, though of course previous crises have contributed to that experience. We analyze these beliefs following a narrative approach detailed in the next section and use the resulting binary classification of governors as a statistical instrument to identify the macroeconomic effects of central bank liquidity injections.

36. By focusing on central bank balance sheet expansions, we capture any operation that monetizes parts of the economy's aggregate asset portfolio at the source, that is any absorption of financial assets by the central bank in exchange for base money.

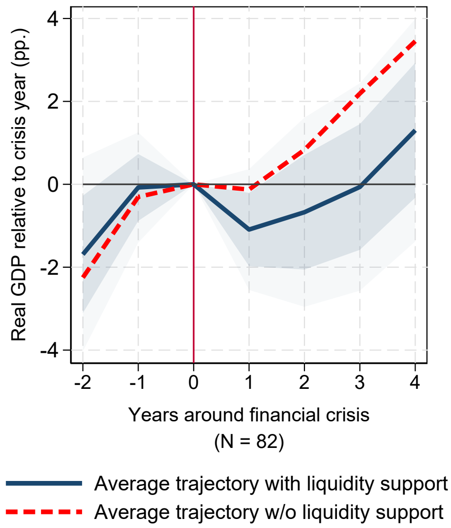


Figure 3.7. Central bank liquidity support predicts worse crisis outcomes

Notes: The figure shows the average change of log real GDP relative to financial crisis start, split by large scale central bank liquidity injection (balance sheet expansion of +15% or more during the current or the next year). Estimates are based on a series of regressions indexed by horizon $h \in [-2, ..., 4]$ on the sample of financial crises dated by Baron, Verner, and Xiong (2021): $\Delta_h \log(\text{real GDP}_{i,t+h}) = \alpha_h + \beta_h m_{i,t+1} + e_{i,t+h}$ where i indexes the country and t indexes the year. We plot coefficients $\hat{\alpha}_h$ and $\hat{\alpha} + \hat{\beta}_h$. Lightly shaded areas mark 90% confidence interval based on robust standard errors of β_h; ± one standard error is marked in dark.

3.3.1 Classification of central bank governor beliefs

It is increasingly understood how past occupational, educational, and other biographical experiences of individuals shape long-lasting economic preferences—for instance, individuals that experience a recession during the ages of 18 to 25 have distinct lifelong political and economic beliefs (Giuliano and Spilimbergo, 2014). A relatively new body of literature has explored the impact of personal attitudes and individual preferences of economic policymakers, their formation through particular experiences or formative life episodes (e.g. the "impressionable years" hypothesis), and their subsequent impact on decision-making and macroeconomic variables—with a consensus forming that such attributes are relevant for institutional policy (e.g. Gohlmann and Vaubel, 2007; Mishra and Reshef, 2019; Monnet and Puy, 2020; Malmendier and Wachter, 2022; Bordo and Istrefi, 2023).

We build on insights from this literature, using evidence of stated personal policy preferences to classify central bank governors as either hawks or doves/pragmatists as defined earlier. We develop a classification algorithm that incorporates information available to the public as closely as possible prior to the outbreak of a banking crisis, and allow for the fact that governors may have undergone ideological shifts during their careers (i.e., governors who preside during multiple banking crises). We focus on advanced economy central banks during financial tail-event years across the 17 countries since 1870, using the comprehensive crisis coding by (Baron, Verner, and Xiong, 2021, BVX hereafter). BVX define a country-year to experience a crisis as a cumulative bank equity index decline of at least 30% from the previous peak.[37] Our algorithm to classify governors builds on existing methodologies and incorporates both qualitative and quantitative information, across six main economic variables: *moral hazard*, *full employment*, *economic growth*, *price stability*, *exchange rate stability*, and *income inequality*. A full description of the coding exercise and the material used can be found in the designated appendix.

In essence, we study a wide range of primary and secondary historical material—"National Biographic Dictionaries" represented a particularly useful source—to trace governor attitudes across these categories and to establish a ranking of economic preferences for each, designed as follows:Whenever central bank governors publicly worried about "asset bubbles", "speculative excess", "loose lending standards" or use other catchphrases indicating at least an implicit preference to curb such exuberance over the promotion of growth and/or employment variables, we take that as a hawkish signal: Together with price stability concerns, the evidence of worry about moral hazard receives the highest relative weight in the determination of hawkishness. A hawkish signal is also noted if a governor repeatedly positions himself "conservatively" in matters of budget deficits, wage growth, exchange rate arrangements, or excessive financial sector risk-taking: attaching more importance to their inflationary and/or financially "exuberant" consequences as opposed to their potentially desirable growth and employment effects.

Dovish governors typically either do not comment at all on moral hazard, price stability and excessive risk-taking concerns, or do so in a manner that ranks them as relatively less important than the goals of either fostering employment and/or promoting economic growth, the latter two variables receiving the highest weight in our "doves/pragmatists" classification. A "negative dovish signal" is established when a governor cautions against a rigid interpretation of price stability mandates, or downplays risk-taking concerns—all the while refraining from issuing positive statements on growth or employment variables. One idiosyncrasy of "doves/pragmatists" consists in their occasional reference to income inequality: We attach less weight to this variable than employment and economic expansion statements. In practice, of course, "pure" delineations do not always exist. Cases exist where governors exhibited unconventional preference rankings, or shifted their attitudes and we detail further below how we treat such (by and large rare) cases. We reach a final classification verdict once the following criteria are met:

- We have obtained at least three independent sources consistent with one of the two ideological types, at least two of which are not autobiographical.
- These three sources can contain either "positive" or "negative" signals, but must include at least one signal from one of the four "key categories" (price stability, moral hazard, full employment, economic growth).

37. We choose the BVX crisis chronology as opposed to other chronologies because it allows the distinction of crisis events based on severity, and because of the fact that the inception of a "bank equity crash" in practice constitutes a better proxy of the timing when a governor is first faced with considerations of a potential policy action: in practice, a central bank governor does not wait until the onset of a "systemic" event before facing a potential policy choice. We also test the chronologies in Reinhart and Rogoff (2009) and Schularick and Taylor (2012) for robustness purposes (appendix figures 3.L.8b and 3.L.8a).

- At least one signal (positive or negative) falls within a five-year horizon prior to the BVX crisis outbreak date.
- We have searched for empirical market evidence to accompany the qualitative material. Wherever available, we then supplement such narrative evidence with quantitative evaluations in the secondary literature(e.g., Kuttner and Posen, 2010).

In total, we obtained 231 individual governor source documents: out of this sample, 50 (22%) documents are *ex ante* sources, in which observers or the governor himself assessed financial and macroeconomic priorities prior to the outbreak of the crisis (as measured by the bank equity crash), and the remainder (181) are *ex post* sources, in which observers or the governor himself reflected on variables and preferences after the financial crisis inception.[38]

Details. Naturally, our identification approach raises a variety of practical and theoretical questions. One of them is whether such a two-way classification scheme of governors—though widely used today—is really plausible for earlier monetary periods. In line with previous studies we argue that, while the explicit labels have undergone constant change, a stable set of relative economic preferences among policymakers has indeed existed over time. This preference ranking has attracted influential research in neighboring disciplines—for instance political science.[39]

Chang (2003) proposed a model of central bank governor beliefs that operates with a binary classification of "easy" as opposed to "tight" monetary policymakers based on five macroeconomic variables. Her insight is that although there are "status quo" central bankers—"neutrals" or "pragmatists"—actual voting is typically expressed in a biased direction. The validity of such a bi-partite ("hawk" vs. "dove") or tri-partite ("hawk" vs. "dove" vs. "pragmatist") approach can also be found in the substantial theoretical and empirical literature building on or exploiting such policy orientations, e.g. the "political monetary cycle" (PMC) (Cukierman, Webb, and Neyapti, 1992). From the perspective of financial markets, too, it has been shown that a binary ideological dichotomy applies when assessing monetary executives: Kuttner and Posen (2010) showed that financial markets categorize central bank governors as "hawkish" or "dovish", and incorporate such assessments in macroeconomic and financial prices.

Importantly, our approach does not require us to take a position on whether or not political parties themselves, or appointing governments, are influencing monetary policy. As detailed fur-

38. Using ex post sources can introduce hindsight bias: A hawk might be classified as a dove because the severity of a crisis compelled him to intervene despite his ideological reservations. However, such hindsight bias would invoke the exact same endogeneity problem that previous studies were subject to: on average, governors we classify as doves ex post based on their interventions would simply be associated with more severe crises. Again, this reduces the chances of finding any positive effects from dovish central bank policy. That is, hindsight bias might inflate the first-stage link, but lead to conservative estimation of the second stage main effect.

39. Analyzing macroeconomic outcomes and political preferences in twelve Western nations, Hibbs (1977) argued that a stable set of economic preferences exists among *political parties* in capitalist societies that allows a time-invariant classification of "left-wing" and "right-wing" political economic ideologies: "Left-wing" parties consistently rank full employment and output growth variables above exchange rate and price stability targets; the reverse is true for "right-wing" parties, which consistently tolerate higher unemployment in order to pursue their preference for lower inflation.

ther in the appendix, we reject the idea of simply deducing a governor's leaning from the party affiliation of the nominating government or legislative body.[40] The exceptions are instances where the central bank is not de facto independent. To assess such influences, we not least benchmark our classifications against one of the most recent widely-used "Central Bank Independence" (CBI) indices (Garriga, 2016), and exclude all "weakly independent" central banks during crises, our main results all continue to hold.[41]

How does our classification algorithm work in practice? In conjunction with a detailed treatment of each individual governor case in the appendix (table A.1), the following contours the interdependencies between distinct governor beliefs about liquidity support and moral hazard on the one hand, and the broader context of output, price, and exchange rate preferences on the other:[42]

- During the **pre-1914 period**, central bank governors remained widely indebted to the British divide between "Banking" and "Currency" Schools. Amid a worldwide deflationary environment that emphasized monetary cooperation according to the "rules of the game", governors engaged in the controversies surrounding the merits of "bimetallism". Looming over all other policy delineations was the "real bills" controversy, which revolved around the contention that only trade-based financial paper should be eligible for discounting purposes—and which "hawks" generally interpreted as ruling out open-ended bank liquidity support (Green, 1988; Dimand, 2020). Governors were also shaped by the major British banking crises occurring over the second half of the 19th century, which triggered foundational debates over the merits of banking crises interventions. Hawkish governors subsequently internalized the dictum advanced in 1866 by the Bank of England that "long-term benefits derived from refusing to rescue insolvent institutions may outweigh the temporary fruits of cooperation" (Schneider, 2021). German Reichsbank governor Richard Koch—dubbed by contemporary commentators a "fierce supporter of *gold*, loathed by bimetallists", hailed by conservative contemporaries for his "cleansing of the [Reichsbank] balance sheet

40. Our rationale relies on existing literature, including Simmons (1996), who showed that during the interwar period, for instance, central banks systematically tried to steer against government policies. Havrilesky (1995) formalized similar observations in his concept of the "representational governor". Consistent with such views, the "political leanings" of the nominating government as recently identified by Ommeren and Piccillo (2021) do not accord consistently with the market reactions analyzed by Kuttner and Posen (2010). The unanticipated announcements of Robin Leigh-Pemberton and Eddie George as new Bank of England governors, for instance, generated a dovish market reaction as recorded by the latter – though falling into the "right wing"/"conservative" political category of the former authors.

41. In this sense, we stress that we generally focus on the most relevant single decisionmaker in the monetary executive: at times, this person does not have to be the central bank governor—or the finance minister—but rather a different person within the central bank. In a total of nine cases, either the Garriga CBI index (post-1970) stands below the value of 0.2 during a BVX crisis, or historical sources (pre-1970) indicate clear constraints on the central banks' independence. These cases are flagged in Figure 3.8 and discussed further in the appendix (table A.3), with appendix figure 3.L.11 displaying the LP-IV results. In one case (AUS-1931), strong evidence exists that a different person *within* the central bank wielded de facto authority, a case that is equally included in this flagged sample.

42. We stress that we distinguish these relevant *policy* debates clearly from the *history of economic thought*, with which we are not primarily concerned.

of non-trade bills", and recognized for his "refusal to let the Reichsbank be a cheap source of liquidity" prior to and during the 1907 crisis—combined strong beliefs on price stability, gold standard convictions, and a "liquidationist" attitude to banking crises.[43] His moralistic undertones were echoed by hawkish French counterparts, but opposed by doves such as Banca d'Italia's Giuseppe Grillo, who advocated for silver and objected to the idea of "self-correcting" economic forces.[44]

- Central bank governors during the **1920-1970 period** were occupied by policy debates on the re-establishment of the pre-war gold standard arrangements. Advocates of a transition to free or managed float currency regimes—unambiguous "dove/pragmatists" in our classification—typically downplayed the adverse effects that such a policy decision would engender with regard to price and currency stability. Bonaldo Stringher, the Banca d'Italia governor personified such believes during his three decades in office (1900-30), concurrently supporting a flexible currency arrangement (spearheading the 60% lira devaluation over 1919-20), stubbornly opposing to the deflationary demands of the government during the 1920s (Segreto, 2019), and swiftly though selectively accommodating the 1927-28 banking crisis via LLR (Bonelli, 1982; Molteni and Pellegrino, 2022). Meanwhile, governors favoring a return to traditional fixed exchange rates highlighted the potentially destabilizing capital flow and price effects resulting from floating rates (Mehrling, 1997) and were classic "hawks", who regarded emergency assistance to the financial sector not just as morally wrong ("purging the rottenness"), but also as a complementary threat to both price and exchange rate stability (Meyer, 1954). Junnosuke Inoue, Bank of Japan governor during the 1920s, is one of these representative "hawks". His public warnings about a build-up of speculative asset bubbles (including a key speech in January 1920), motivated his refusal to extend more than symbolic bank support (Shizume, 2018).
- During **the 1970s and early 1980s**, central bank governors across all 17 advanced economies grappled with inflation dynamics and engaged in intense debates about the most efficient remedies Timberlake (1993). In this context, even "dovish/pragmatist" governors could be receptive to certain elements of monetarism without wholly accepting it. An example in this category is the Australian Reserve Bank governor Rob Johnston (1983-89), who experimented with monetary targets in the early phase of his tenure, but then decided to phase out such targets, and moved the bank to inflation targeting. Prior to the Australian crisis of 1989, Johnston adopted a similarly middle-ground attitude, mimicking the poet Arthur Hugh Clough: "Thou may not kill, but need not strive to officiously keep alive." We here see in exemplary fashion how a moderate stance on price stability also coincides with pragmatic attitudes on bank support.[45] Hawks, on the other hand, were early and uncom-

43. For more on Koch see appendix table A.3, and in particular Berliner-Handels-und-Tageblatt (1908).

44. The economic debate during the Third Republic were deeply influenced by moral hazard concerns, with the Banque de France under governors Pierre Magnin and Georges Pallain subscribing to Clement Juglar's dictum that "a crisis for a nation is the operation made necessary to re-establish an equilibrium broken by speculation" (Bordo and James, 2007, 81).

45. Johnston's quote in Johnston (1985). See also Grenville (1997, 129ff.) and Appendix Table 3.A.3.

promising converts to Milton Friedman's ideas and favored tight control over inflation, via the money supply channel (Meltzer, 1997; White, 2012), a stance that led them to reject emergency lending to banks during crises if it violated money growth targets. Characteristically for this group, Rolf Kullberg of the Bank of Finland (1983-92), as a staunch enemy of any Markka devaluation and as disciple of monetarism at the board prior to his executive tenure, repeatedly voiced dire warnings about the moral hazard implications of lax financial conditions prior to the Finnish banking crisis of the 1990s—during which he justified a long hesitation to provide support to banks by the need to wait until institutions "capitulate and submit [themselves] to the bank" on punitive terms (Kuusterae and Tarkka, 2011; Sulkunen, 2015). Kullberg here illustrates the coexistence of an explicit commitment to price and currency stability, with a strong aversion to emergency liquidity provision.

- Finally, **from the 1990s**, governors focused on the designs of new inflation targeting regimes (Goodfriend, 2005), the onset of "great moderation" dynamics, and—in Europe—on the effects of the emerging common currency. These debates again exemplify the coincidence of price and currency stability beliefs on the one hand, and emergency crisis attitudes on the other. In Japan, the Governor Yasushi Mieno sounded dire moral hazard warnings about inflated land values on the eve of a financial crisis, motivating his deployment of the hawkish "Mieno Shock" program (T. S. Times, 1990). Similarly, Governor Mervyn King (2003-13)—having spent years building a personal "arch-inflation hawk mythology" (Herald, 2003)—also long resisted the deployment of emergency liquidity to British banks over 2007-8, when peer institutions including the European Central Bank had long approved them, highlighting the moral hazard implications: "The provision of large liquidity facilities penalises those financial institutions that sat out the dance, encourages herd behaviour and increases the intensity of future crises" (King, 2007). Jean-Claude Trichet (ECB, 2003-13), on the other hand, was representative of "dove/pragmatist" beliefs. Though he had been hawkishly inclined earlier in his career, by 2003 markets were identifying him with a "pragmatic and flexible policy stance" (F. Times, 2003). Prior to the GFC, Trichet explicitly rejected a formalistic leaning against asset price bubbles, advocating a pragmatic stance on moral hazard dynamics and in principle approving of official financial sector support (Trichet, 2003a, 2003b).

Figure 3.8 displays the resulting panorama of governors in charge during banking panics in the BVX sample across our 17 advanced economies since 1870, according to our assessment of policy orientation at the onset of the respective bank equity crashes. Out of 106 banking panic episodes during which a central bank intervened, we classify 37 as being associated with "hawks", and 69 with "doves/pragmatists". Marked with a superscript "N-I" are cases where either historical sources, or the central bank independence scores by Garriga (2016) indicate constraints on the central bank's autonomy. In these cases, we have identified the policy convictions of the de facto decision-maker during the banking crisis.

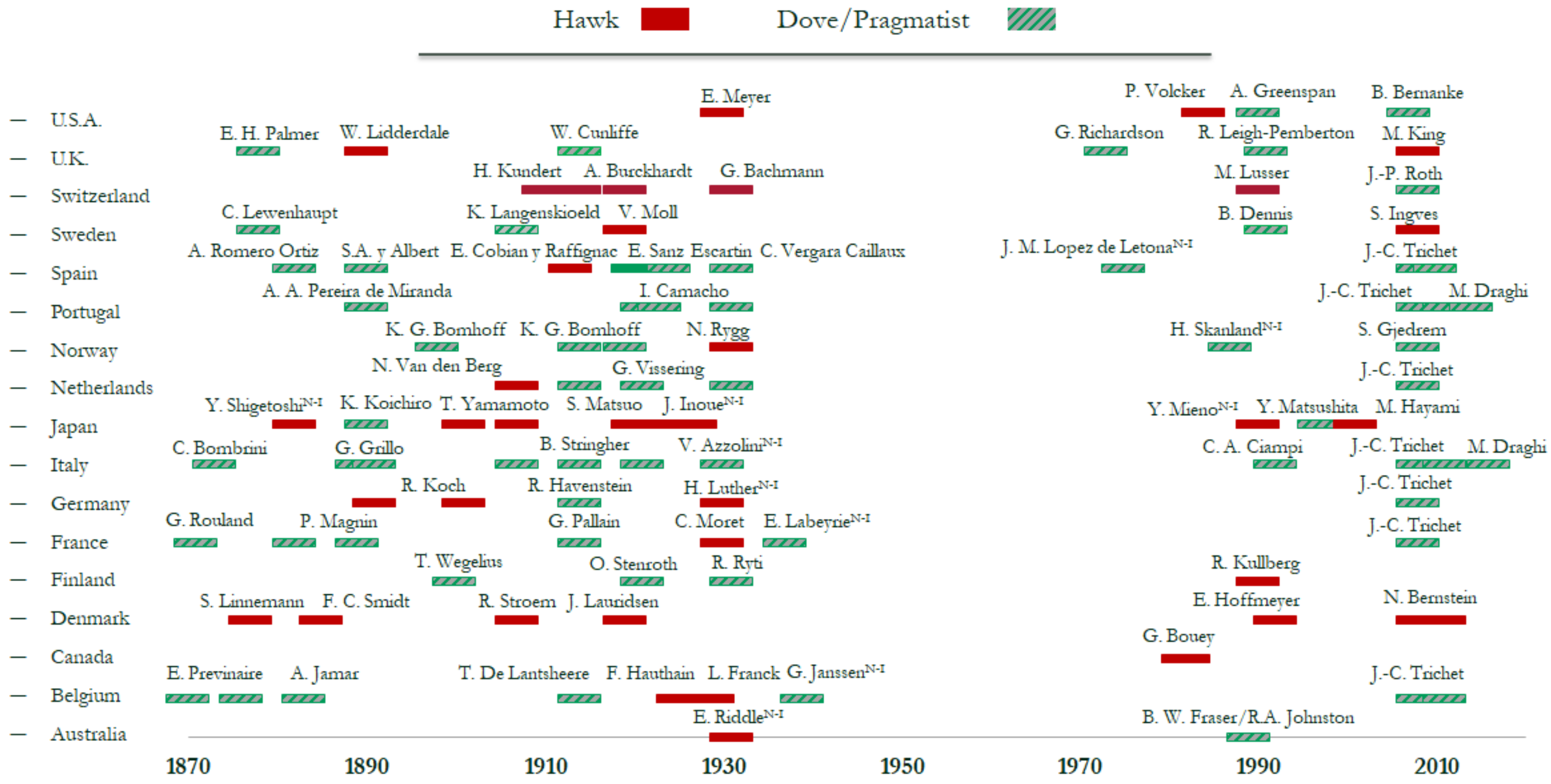


Figure 3.8. Central bank governor classification and banking crises

Notes: Central bank governor policy beliefs at the start of banking crises. Color codes refer to our ideological classification of the respective de jure central bank governor during an identified banking crisis, using the crisis definition in Baron, Verner, and Xiong (2021). In superscript "N-I"$^{(N-I)}$, we denote cases where the central bank is constrained in its independence, as evidenced by either historical sources, or by a value in the Garriga "Central Bank Independence Index" of below 0.2 (Garriga, 2016). In these cases, we test the policy orientation of de facto decisionmakers in the appendix. See the appendix, table A.3, for all individual governor classification sources and further discussion.

3.3.2 Governor beliefs and central bank liquidity support during crises

Did governors' beliefs affect central bank policies during financial crises? Would they even matter for consequential choices such as large-scale liquidity interventions? Or could central bank committees counter-balance and dilute any ideological predisposition of the governor? Can we even reliably identify doves, given that any central bank governor may try to diffuse excessive risk taking by talking tough ex ante? All these questions concern the relevance of our instrument.

Figure 3.9 depicts the reaction of central bank balance sheets to financial crises depending on governor beliefs. It visualizes the probability that, by a given horizon, a given governor type grows the balance sheet beyond +15% during some year since crisis outbreak.[46] Accordingly, only in one in four hawks responded with large scale liquidity support before the second anniversary of the crisis' outbreak. By contrast, every second dove staged such an intervention at this point.[47] So while hawks did react to financial crises, they did so significantly less vigorously than their more dovish colleagues.

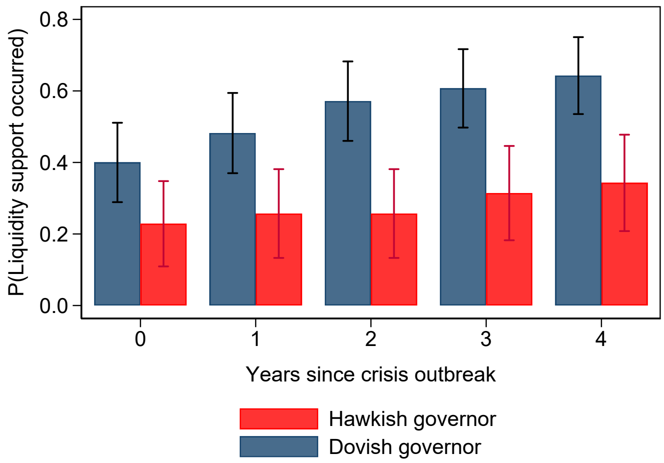


Figure 3.9. Liquidity support in financial crises by governor classification

Notes: The figure shows the share of observations with one or more balance sheet expansions exceeding 15% annually since the start year of a financial crisis, by horizons and governor classification. Whiskers mark 90% confidence intervals. Data from 89 crises dated by Baron, Verner, and Xiong (2021) occurring between 1870 and 2020 in our sample of 17 advanced economies with an operating central bank, excluding 1914-1918, 1939-1945, the German hyperinflation and the Spanish Civil War. Whiskers mark the 90% confidence interval. Differences are statistically significant at the 5% level starting from horizon one.

46. The pattern is robust for other reasonable choices of expansion thresholds, e.g., +10% or +20%.

47. Central banks may expand their balance sheets by different means and governor types may differ not only in their tendency to intervene but also in the manner of how to do it. For example, they may cut interest rates on short term loans, decrease discount rates in repurchase transactions, increase the base of eligible collateral assets or buy assets outright in the open market. Implementation should be targeted to the characteristics of the crisis situation, and some approaches may be superior irrespective of context. In this paper we are largely agnostic about implementation features and focus on measuring average effects, i.e., under average implementation quality. We investigate this further and provide additional evidence in Section 3.3.4.2.

In principle, effects shown in Figure 3.9 could be driven by hindsight bias in the historical sources that underlie our classification. However, such hindsight bias would invoke the exact same endogeneity problem that previous studies were subject to: on average, governors we classify as doves ex post based on their interventions would simply be associated with more severe crises. Again, this reduces the chances of finding any positive effects from dovish central bank policy. That is, hindsight bias might inflate the first-stage link, but lead to conservative estimation of the second stage main effect.

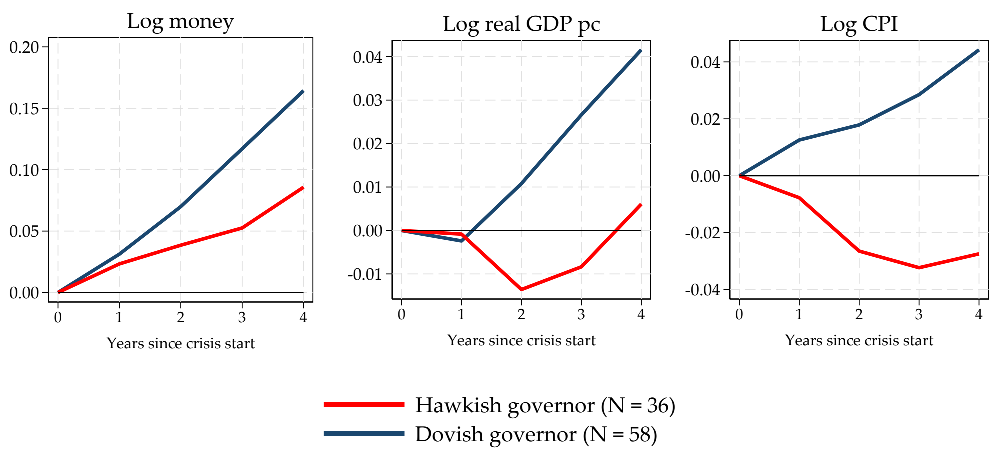


Figure 3.10. Macroeconomic dynamics after financial crises by governor classification

Notes: The figure shows post-crisis average trajectories for money aggregates (M3), real GDP per capita and consumer prices by governor type estimated by the following local projections: $\Delta_h y_{i,t+h} = \alpha_{i,h} + \beta_h g_{i,t} + \varepsilon_{i,t+h}$ for $h = 2, 3, 4$ where $g_{i,t}$ is a binary indicating an hawkish governor and $y_{i,t}$ stands for each of the three different outcome variables. Sample of 89 financial crises that occurred since 1870 in 17 advanced economies with an operating central bank and available macroeconomic data, excluding 1914-1918, 1939-1945, the German hyperinflation and the Spanish Civil War. Averages purged of country fixed effects.

The differential effects of governors' preconceived beliefs on central bank policy also appear to alter macroeconomic outcomes. Figure 3.10 shows average trajectories for the money aggregate (M2), real GDP per capita and consumer prices since the start of a crisis split by ex-ante governor beliefs, controlling for country fixed effects.[48] In the raw data, more dovish policy stances are associated with vigorous money growth, quicker economic recoveries and less deflation. To test these patterns rigorously, we estimate local projections in Section 3.3.4 in which we instrument balance sheet expansions by pre-existing central bank governors beliefs. But first, we elaborate on the argument behind the exclusion restriction of the instrument in the next section.

48. To the degree that historical sources characterize central bank governor not only based on ex-ante statements but also by ex-post crisis policy, we run the risk of introducing the same endogenous crisis-related factors into our governor coding that drive liquidity injections themselves. Such a bias would skew our estimates towards effects reported by the existing literature (Bordo et al., 2001; Honohan and Klingebiel, 2003) which suffer from the endogeneity of liquidity injections. This would make it harder for us to detect positive effects of liquidity injections and hence render our estimates conservative.

3.3.3 Exclusion restriction of the governor beliefs instrument

For our instrument to be valid, governors' beliefs must not affect crisis trajectories through channels other than liquidity support. It is plausible that governors' beliefs are uncorrelated to other factors determining a given crisis outbreak. However, governors are not chosen randomly and their beliefs may interact with the economy in other ways. In the following, we discuss why potential violations of the exclusion restriction will, if anything, render our estimates conservative.

First, financial market participants will learn about the incumbent governor and form expectations about the response to a potential crisis. Anticipation of dovish crisis management could encourage financial risk-taking ex ante. Higher crisis incidence under dovish governors and will not create any bias. However, more severe crises would load the dice against finding positive macroeconomic effects under dovish crisis management because doves face systematically worse situations. Accordingly, estimates of macroeconomic stabilization effects of liquidity support instrumented by dovish governor beliefs would thus be conservative.

Second, distressed financial markets may be calmed by pure *announcements* of liquidity interventions by the central bank. Dovish governors should be more likely to make such announcements (credibly), opening another channel through which doves could speed up the recovery besides actual interventions. However, such announcements have been very rare in the past. Metrick and Schmelzing (2024) surveyed interventions across crises, including "major communications", and found that they occurred in only about 1% of financial crises in their sample—compared to 67% of crises met with liquidity support. We conclude that the quantitative relevance of such a mechanism will be negligible in our setting.

Finally, the presence of certain governor types may correlate with specific fiscal policies or regulatory contexts. For example, the government may nominate a central bank governor that promises to support political goals.[49] Moreover, the political economy producing strict capital requirements for banks may be more conducive to nominate a hawkish governor. Such mechanisms could give rise to systematic differences across governor types in pre-crisis macroeconomic developments or fiscal interventions during the crisis. Since we can measure pre-crisis dynamics, regulatory requirements and fiscal policy, we can test these hypotheses explicitly. We find that fiscal interventions are more likely under *hawkish* governors, which, again, hints at a potential downwards bias that render our estimates conservative and Section 3.3.4.2 discusses related evidence in more detail. We also measure the correlation between governor beliefs and the stringency of banking regulation in Appendix 3.G.2. We find no statistically significant difference in the level nor changes of capital and reserve requirements across governor types. Furthermore, appendix 3.G.1 presents estimates of general pre-trends in macroeconomic and macrofinancial variables for crises managed by either hawkish or dovish governors. We find that average pre-crisis dynamics across all six variables are quantitatively and statistically very similar.

49. Vuletin and Zhu (2011) report that governments of both developing and advanced economies have frequently replaced disobedient central bank governors with political allies to pursue political objectives in conflict with price stability. We tested the predictability of governor turnover using dynamic economic and financial variables. The predictive capacity of these covariates, however, is swamped by a simple variable counting the years of tenure of the previous governor.

3.3.4 Estimating the causal macroeconomic effects of liquidity support

3.3.4.1 Stabilization during financial crises

We use local projections with an instrumental variable (LP-IV) to estimate the macroeconomic effects of large-scale liquidity support during financial crises. As in Equation 3.2, we define large-scale liquidity support as annual central bank asset growth of at least 15% during the current or the past year and encode it in the binary variable by $m_{i,t}$.[50,51,52] We instrument $m_{i,t}$ with the binary variable $h_{i,t}$ which indicates a "hawkish" central bank governor who is overall sceptical about such interventions:

$$h_{i,t} = \mathbb{1}\Big(\text{incumbent central bank governor tends to disapprove of liquidity support}\Big) \quad (3.3)$$

This identification strategy presumes that hawkish governors are less likely to engage in balance sheet expansions than their dovish colleagues facing a similar crisis. This will induce variation in $m_{i,t}$ that is exogenous to the crisis situation itself. Thereby, $h_{i,t}$ can disentangle variation in $m_{i,t}$ from unobserved factors shaping crisis severity. See Section 3.3.3 for a detailed discussion of the exclusion restriction of this instrument.

We restrict the sample to country-years with financial crises—of which we count 115 since 1870 in our sample. We discard country-years affected by World War I and II, the German hyperinflation or the Spanish Civil War.[53] This leaves us 102 country-years of which we have to drop those without a national central bank and where data on GDP, consumer prices, money aggregates and total bank lending to the non-financial sector are missing. We index the final 79 observations by (i,t) and will refer to country-year observations that have experienced the onset of a financial crisis τ years earlier by $(i,t+\tau)$.

Our local projections estimate expected changes of macroeconomic and financial variables relative to levels in $t+1$. LP-IVs are run for horizons $h = 2,3,4$, counting the years since start of the crisis. That is, we will estimate how liquidity support during the early phases of the crisis—measured by $m_{i,t+1}$ and instrumented by $h_{i,t+1}$—changes the crisis aftermath and recovery:

$$\text{First stage:} \qquad m_{i,t+1} = a_i + b h_{i,t+1} + \boldsymbol{c}\boldsymbol{x}_{i,t+1} + e_{i,t+1} \quad (3.4)$$

$$\text{Second stage:} \qquad y_{i,t+h} - y_{i,t+1} = \alpha_{i,h} + \beta_h \hat{m}_{i,t+1} + \boldsymbol{\gamma}_h \boldsymbol{x}_{i,t+1} + \epsilon_{i,t+h} \quad (3.5)$$

50. Using a two-year window accounts for the fact that the probability for exceptional balance sheet expansions is elevated not only in the crisis start year as documented in Figure 3.9.

51. We settle for a binary variable in our baseline for two reasons: First, financial crisis outcomes will react non-linearly to volume of liquidity support. Too little will fail to calm markets and hence show no measurable impacts. In turn, once financial markets are put at rest, additional liquidity will again show little effects. Second, a binary measure helps to limit outlier distortions, especially given the volatile nature of economic variables during crises combined with a relatively small sample. In Appendix 3.L, we run our estimation with a continuous measure of central bank expansion and reach the same conclusions with less statistical precision.

52. There are caveats to measuring liquidity support operations using annual aggregate balance sheet movements. See Appendix 3.H for a detailed discussion.

53. Since we will estimate trajectories after financial crises stretching up to four years into the future, we not only discard financial crises coinciding with these event but also those that take place up to four years before to prevent those event from meddling with the estimated trajectories.

where $y_{i,t}$ denotes a macroeconomic aggregate to be evaluated—M2, real GDP per capita or the index of consumer prices—in natural logarithm to interpret differences as approximate growth rates. We include country fixed effects $\alpha_{i,h}$ to absorb time-invariant but horizon-specific heterogeneity across countries and controls that capture macro-financial dynamics $\boldsymbol{\gamma}_h \boldsymbol{x}_{i,t+1}$. Dynamic controls include the contemporaneous value (in $t+1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis to capture the size of the preceding credit boom. Country fixed effects will be absorbed using within transformations. Appendix 3.L shows results for various alternative control vectors.

The first stage relationship of equation 3.4 shown in Table 3.2 is statistically and quantitatively significant. Interpreting it as a linear probability model, hawkish governors have been roughly 34% less likely to conduct a balance sheet expansion either during a crisis year or one year thereafter. The first stage F-statistic for a test of instrument exclusion is 15.4. The empirical pattern behind the first stage is robust to the inclusion of governor-biographical and macro-institutional controls, see Appendix 3.I.[54]

Table 3.2. First stage relationship

	(1)
	m_{it+1}
Governor holds hawkish beliefs	-0.343***
	(0.087)
Macro controls	Yes
Country FE	Yes
F	15.42
R^2	0.32
Crises	79

Notes: This table presents coefficient estimates and statistics of the first stage regression of Equation (3.4) where the dependent variable is an indicator for liquidity support during the first two years of the crisis. Macroeconomic controls include the contemporaneous value (in $t+1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. We include country fixed effects $\alpha_{i,h}$ to absorb time-invariant but horizon-specific heterogeneity across countries. Robust standard errors are clustered on countries and shown in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

The second stage allows us to gauge the causal effect of liquidity support by contrasting the path with controls at their respective country-specific averages without liquidity support ($m_{i,t+1} = 0$)

$$\hat{\alpha}_h + \hat{\boldsymbol{\gamma}}_h \bar{\boldsymbol{x}}_{i,t+1}, \quad h = 2,3,4 \tag{3.6}$$

54. Appendix 3.I shows that governor beliefs predict liquidity support above and beyond a range of pre-crisis biographical details. Also controlling for the presence of deposit insurance or central bank independence does not blur the link between governor beliefs and liquidity support, while indicating that governor beliefs matters more where central banks are independent or deposit insurance is not in place.

with the trajectory affected by liquidity support ($m_{i,t+1} = 1$):

$$\hat{\alpha}_h + \hat{\boldsymbol{\gamma}}_h \bar{\boldsymbol{x}}_{i,t+1} + \hat{\beta}_h \tag{3.7}$$

where $\hat{\alpha}_h$ denotes the average fixed effect, estimated by the model intercept.[55]

We estimate the LP-IV described by Equations (3.4) and (3.5) separately for three macroeconomic aggregates: the monetary aggregate M2, real GDP per capita or the index of consumer prices, all in natural logarithm to interpret differences as approximate growth rates. Based on estimates, we compute and plot the two trajectories of Equations (3.6) and (3.7) alongside confidence intervals for the treatment trajectory based on estimated standard errors for $\hat{\beta}_h$.

Figure 3.11 visualizes how the macroeconomic aftermath of financial crises is influenced by large-scale liquidity support. The IV strategy detects sizable *positive* effects, indicating that balance sheet expansions stabilize broad money growth, speed up the recovery of real economic activity, and avert deflation spirals. Tables with underlying coefficient estimates are presented in Appendix 3.K. Our evidence corroborates the literature that has posited positive real effects from liquidity support, such as Richardson and Troost (2009). And it attests to a sizable negative reverse causality bias in traditional OLS results visualized in Figure 3.7 (cf. Bordo et al., 2001; Honohan and Klingebiel, 2003).

Specifically, we estimate that liquidity support during financial crises substantially cushioned negative effects on output. With liquidity support, real GDP per capita starts to grow again already during the second year after crisis outbreak ($t+2$) and exceeded counterfactual levels of macroeconomic activity by more than +10% four years after crisis outbreak.[56] Correspondingly, our estimates imply large gains in terms of *cumulative* real aggregate income, amounting to +28% over our projection horizon. Moreover, balance sheet expansions led to *persistent* growth of broad money aggregates and typically prevented protracted deflation. Without central bank interventions, we estimate that financial crises without liquidity support were followed on average by three years of falling prices. By contrast, deflation was typically avoided altogether when the central bank absorbed significant volumes of assets to provide liquidity in exchange. These operations typically did *not* cause runaway inflation, however. On average, prices increase by +14% over three years, implying annual inflation of about 2.4%.

These estimates are qualitatively robust towards a range of alternative control setups, sample restrictions and measurement choices. In Appendix 3.L, we visualize estimates obtained when adding controls indicating the presence of national deposit insurance or horizon-specific episode fixed effects (Figure 3.L.1), dynamic controls policy rate changes or fiscal expenditures (Figure 3.L.2), dynamic controls for banking sector capitalization (Figure 3.L.3), and results obtained when removing all macro-financial controls (Figure 3.L.4). We also test alternative measures of liquidity support, including one based on a 20% expansion threshold, one based on

55. The OLS and 2SLS intercept estimates the average fixed effect absorbed by the within transformation if grand sample averages are added to all model variables after the within transformation removed country-specific averages.

56. Our

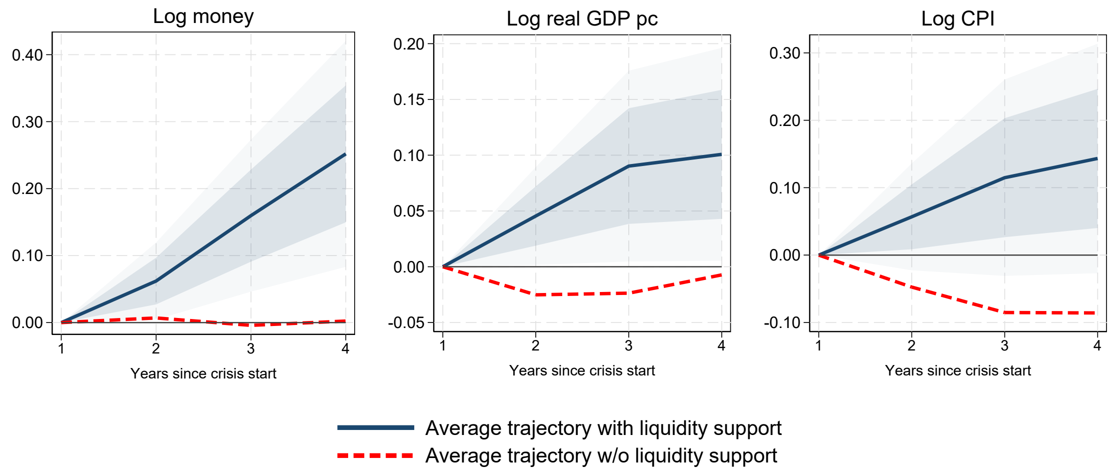


Figure 3.11. Financial crises, liquidity support and macroeconomic stabilization (LP-IV)

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

a 10% expansion threshold or using a continuous measure (Figure 3.L.5), results obtained when measuring liquidity support via central bank deposits rather than aggregate size (Figure 3.L.6), and when using real instead of nominal balance sheets (Figure 3.L.7). And we alter the sample of crises, focusing on those coded by Jorda, Schularick, and Taylor (2017) or those coded by Reinhart and Rogoff (2009) (Figure 3.L.8), dropping the Great Financial and later crises to rule out that our effects are driven by quantitative easing or when dropping the Great Depression (Figure 3.L.9), and results obtained focusing on the subsample of crises that occur during later phases of international clusters to see if our effects hold for crises likely to be international spillovers and hence less related to domestic economic conditions (Figure 3.L.10).

Figure 3.12 presents LP-IV estimates of Equations (3.4) and (3.5) for real stock market valuation and aggregate real investment. Analogous to the baseline, controls include the contemporaneous value (in $t+1$) and two lags of real GDP growth, real investment growth and real stock price growth as well as the three-year growth in real bank lending to the private sector prior to the financial crisis Both variables mirror the macroeconomic stabilization seen already in Figure 3.11. Liquidity support stabilizes the aggregate investment activity while a hawkish approach is estimated to lead to a substantial contraction in real aggregate investment of about -20% below levels observed in $t = 1$. Compared to GDP and investment, real stock market val-

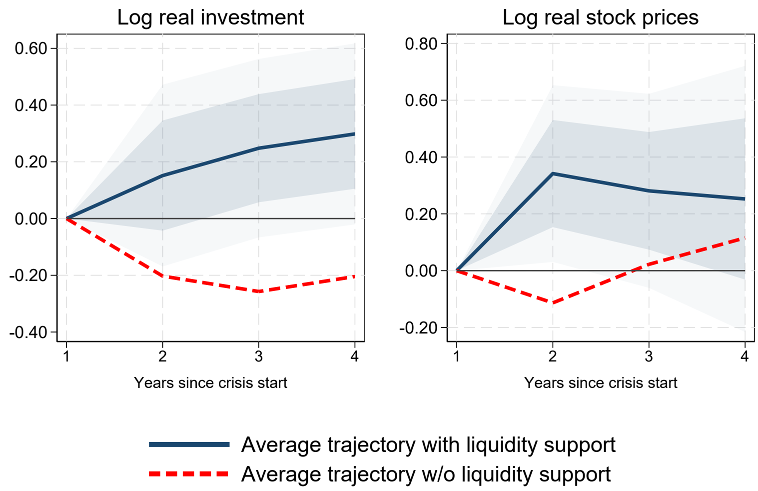


Figure 3.12. Financial crises, liquidity support and business health (LP-IV)

Notes: The figure shows changes in log real investment and log real stock prices after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth, real investment growth and real stock price growth as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

uations react more swiftly to liquidity support, presumably for two reasons. On the one hand, forward-looking investors will anticipate improved future business opportunities. On the other hand, ample liquidity provided by the monetary authority might stop detrimental fire-sale spirals hurting financially distressed banks and funds.[57]

3.3.4.2 Nature and transmission of liquidity support

Central banks can expand their balance sheets in various ways. For example, they may cut interest rates on short term loans, decrease discount rates in repurchase transactions, increase the base of eligible collateral assets or buy assets outright in the open market. Implementation should be targeted to the characteristics of the crisis situation, and some approaches may be superior irrespective of context. So far, we have been agnostic about how central banks engineer the balance sheet expansions estimated average effect across past crises, i.e., effects under av-

57. Our data does not show significant differences in the real growth of the aggregate debt stocks (unfortunately, we do not have credit issuance data). As those stocks grow clearly faster upon intervention in nominal terms, we infer that debt deflation is an important general equilibrium force under hawkish central bank policy. It will increase the real burden of outstanding stocks, thereby limit the balance sheet scope of borrowers, depressing expenditures and the aggregate economy in turn.

erage implementation quality.[58] However, it is important to understand whether our estimates are driven by lender of last report operation that directly bolstered the liquidity position of the banking sector, or whether it operated through the monetization fiscal stimuli. Both interventions involve expansions of central bank balance sheets, but differ in transmission channel as well as policy implications of our results.[59]

Under LLR, the central bank increases the deposits of chartered banks, i.e., reserves, in exchange for eligible assets. Under fiscal monetization, the central bank absorbs government debt and increases the treasury's account at the central bank and to facilitate additional fiscal spending.[60] To understand which type of balance sheet expansion has been more prevalent in our sample, we asses changes in the central bank balance sheet composition as well as concurrent fiscal policy.

We re-estimate LP-IV Equations (3.4) and (3.5) with three modifications to the baseline setup. First, we use alternative dependent variables: bank reserves at the central bank, government debt holdings by the central bank, real public expenditures and real public debt; all in natural logarithm to interpret differences approximately as percentage changes. Second, we include horizons 1 and 0 into the estimations, taking differences with respect to $t-1$. These estimates can be interpreted meaningfully under the assumption that liquidity injections affect central bank balance sheet sub-items as well as fiscal variables but not vice versa. Third, we augment the original control vector by three lagged growth rates of the new dependent variable (at $t-1$, $t-2$ and $t-3$).

Figure 3.13a shows the estimated effects of liquidity support on the trajectory of central bank deposits and holdings of government debt. While deposits increase by up to 200% over the counterfactual without liquidity support, we find much smaller and no statistically significant difference in the volume of government debt held by the central bank. That is, the variation in liquidity support that drive results estimates shown in Figures 3.11 and 3.12 are not linked to systematic purchases of government debt. Responses in fiscal complement these view. Figure 3.13b plots the path of real fiscal expenditures and real public debt under either liquidity regime. We find no statistically significant difference in the response of either variable to central bank liquidity support that would suggest that the stabilization effects presented previously are

58. Balance sheet operations may involve sterilization transactions, which would conceal them from our measurement approach. This problem might be particularly important under currency pegs constraining central bank in their liquidity supply policies. Our granular data on central bank balance sheet subitems allow us to investigate these concerns in a slightly smaller sample, see Appendix Figures 3.H.1 and 3.E.2. We find no differential use of sterilization across governor types, indicating that associated mismeasurement would not undermine our LP-IV estimates. Moreover, we find no evidence currency pegs would have imposed a major constraint. This is consistent with historical accounts of crisis interventions by the Bank of England during the Classical Gold Standard. For a broader discussion of measuring LLR operations using annual aggregate balance sheet movements, see Appendix 3.H.

59. The answer to this question also bears on the debate of whether there are measurable differences in macroeconomic outcomes depending on whether central bank balance sheet expansions involve mainly public assets, or private assets.

60. As the Treasury pays for stimulus programs, central bank liabilities shift from the Treasury's account to banking sector deposits over time. In any case, the central bank ultimately holds an increased amount of government debt.

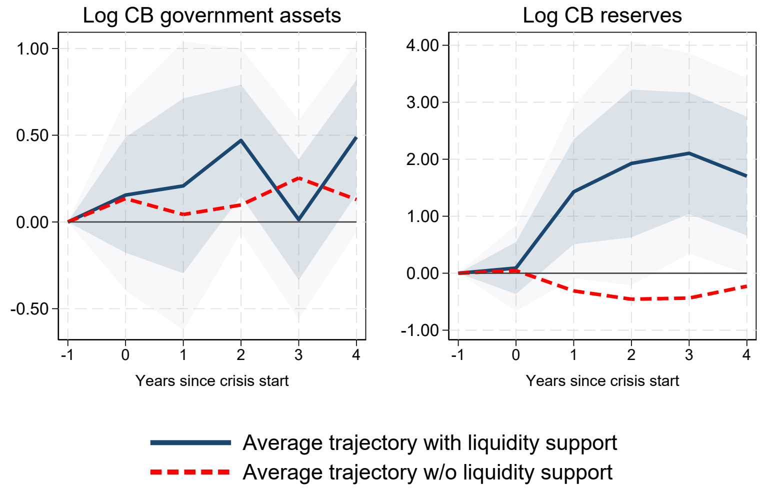
actually driven by fiscal stimuli. If anything, public debt growth is more likely to emerge under *hawkish* central bank policy, suggesting fiscal stimulus through a reduction in tax burdens. This corroborates the notion that fiscal and monetary policy substitute—rather than complement—each other in mitigating financial crises.

In addition, we find that our baseline results Figure 3.11 are largely driven expansions in central bank reserves, see Appendix Figure 3.L.6. By contrast, expansions driven by other liability items are characterized by a very weak statistical link to future macroeconomic dynamics. Similarly, baseline results remain robust when restricting the sample to liquidity support dominated by the purchase of assets *other* than government debt, see Appendix Figure 3.F.2.[61] Finally, Appendix 3.J presents evidence on the reaction of commercial bank balance sheets. Consistent with the view the central bank liquidity support operates via the banking sector, we find document a strong and significantly positive effect on aggregate commercial bank capital and evidence of successful deleveraging.

61. It has been speculated that the asset-specific expansion mix—that is, the breakdown of particular assets being used to extend liquidity support—matters for macroeconomic effects. If investors prefer securities with specific payout dates, the central bank can shape the yield curve by targeting assets of certain maturities (the *preferred habitat* hypothesis, e.g., Vayanos and Vila, 2021). Alternatively, private agents reaction to central bank balance sheet expansions may depend on the overall volume of risk taken off private accounts and absorbed by the public sector (Caballero and Simsek, 2021). Arguably, fixing the aggregate volume of liquidity support and absorbing more risky assets might stimulate private economic activity by more in times of widespread financial distress.

Looking separately at 51 liquidity support events during BVX banking crises which were characterized by relatively small or no government debt purchases, however, we do not find fundamentally different causal effects for money growth, real per capita GDP, and inflation dynamics. The effects continue to stay statistically significant, in the same direction, and at levels closely comparable to our baseline results. This is consistent with the view that the absorption of risky assets matters for macroeconomic stimulation.See further discussion and full results in Appendix Figure 3.F.2.

(a) Changes in central bank balance sheet composition during financial crises



(b) Changes in the fiscal policy stance during financial crises

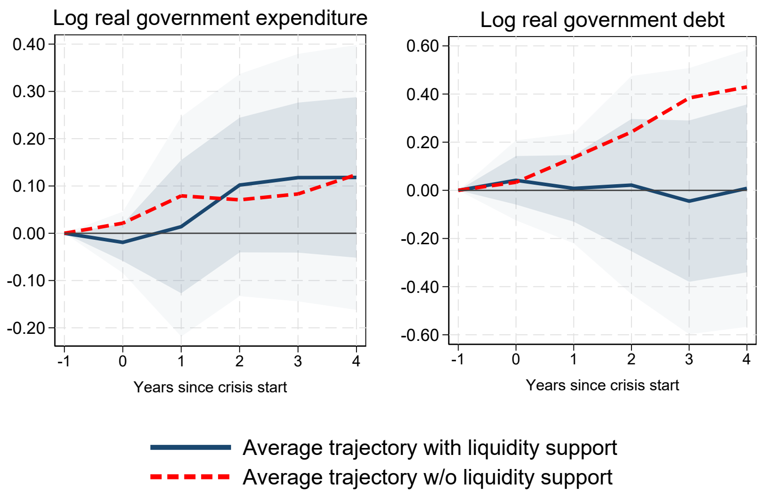


Figure 3.13. Nature and transmission of liquidity support (LP-IV)

Notes: Panel (a) shows changes in log central bank holdings of government debt and log central bank reserves during a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Panel (b) shows change in log real government expenditure and log real government debt during a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth, real investment growth and real stock price growth as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries. In addition, estimation underlying Panel (a) controls for growth in central bank deposits and government debt holdings at $t-1$, $t-2$ and $t-3$ while estimation underlying Panel (b) controls for growth of real public expenditures and real public debt at $t-1$, $t-2$ and $t-3$.

3.3.4.3 Long-run risks to financial stability

Concerns that public liquidity provisioning to distressed financial institutions may encourage excessive risk taking ex ante are widely shared among policy makers and academics.[62] In fact, it is one of the defining characteristics of hawkish central bank governors investigated in this paper.[63] Yet, anticipation about central banks liquidity support might actually foster financial stability as it can suppress fear-driving creditor runs analyzed by Diamond and Dybvig (1983). Empirical quantification of such long-term effects is tricky in standard dataset. Our panel, however, provides a very suitable empirical basis as its long time dimension covers a sequence of financial crises for each country.

Moral hazard implies that investors take excessive financial risks expecting that the central bank bears liquidity risk or even bails out insolvent institutions ex post. This depresses risk premia, eases credit conditions and fuels credit booms that may end in crises (cf. Kirti, 2020; Richter, Schularick, and Wachtel, 2020; Greenwood et al., 2022). Conversely, preempting creditor runs through the expectation of liquidity support can shore up financial stability, especially at the height of a credit boom, and hence have the opposite effect.[64]

To gauge the net effect, we analyze the statistical relationship between central bank liquidity support and future credit boom-bust episodes. Heightened future financial fragility would suggest an important role for moral hazard. Conversely, credit booms going bust less frequently would rather highlight the importance of preventing creditor runs. We operationalize a *credit boom episode* as a three year increase the credit-to-GDP ratio beyond $+0.10$. We define a *boom-bust episode* as a credit boom episode with a financial crisis ensuing during any of the three subsequent years. Around 23% of all country-years belong to a credit boom episode according to the $+10\%$ credit-to-GDP threshold. Roughly quarter of those country-years qualify as a boom-bust episode.

Figure 3.14 shows the raw data. It plots the relative frequency of credit boom episodes as well as boom-bust episodes, binned by horizon since the last crisis and by whether it saw liquidity support, i.e., $m_{i,0} == 1$. The pattern is clear: After financial crises *without* liquidity support, credit booms occurred with a moderate and stable probability. Around 25% of country-years belong to credit boom episode, a fraction only marginally higher than observed across our entire post-1870 sample. By contrast, the probability of credit booms rose after a crisis

62. There are several empirical cross-country studies on the moral hazard effects stemming from deposit insurance (e.g., Cordella and Yeyati, 2003; Duchin and Sosyura, 2014; Anginer and Demirguc-Kunt, 2018). Martin (2006) analyses moral hazard effects from LLR provisions from a theoretical perspective.

63. U.S. Treasury Secretary Andrew Mellon's famous recommendation to use financial crises to "purge the rottenness out of the system"—and therefore not to engage in meaningful public support for struggling banks during the Great Depression Eichengreen (1992, 251)—is quoted time and again in the deliberations of central bank governors during crisis episodes. Similar comments from central bank governors on this topic abound and are listed in Appendix 3.M—though we do not equate them outright with an "Austrian" or "liquidationist" theory of the business cycle (White, 2008).

64. For example, one of the main arguments in the political debate leading up to the foundation of the Federal Reserve has been the need to deal with the frequent liquidity crises shaking the young US financial system back then.

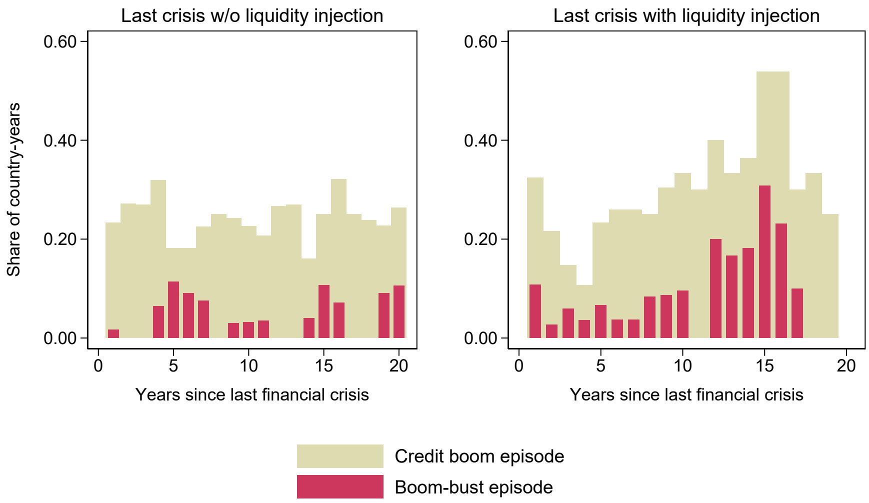


Figure 3.14. Liquidity support, credit booms and crises

Notes: The figure plots the relative frequency of credit boom episodes as well as boom-bust episodes, binned by horizon since the last crisis and by whether it saw liquidity support, i.e., $m_{i,0} == 1$ We define a country-year to belong to a *credit boom episode* if the credit-to-GDP ratio increased beyond +0.10 over the past three years. We label a country-year to be part of a *boom-bust* episode if in addition a financial crisis ensues during any of the three subsequent years.

with liquidity support, peaking 15 years after the crisis with more than 50% of country-years experiencing a credit boom episode.

Importantly, the discrepancy in credit boom probability is almost entirely driven by credit booms going bust. Figure 3.14 marks the fraction of boom-bust observations in red. They do occur occasionally after crises without liquidity support: 4.3% of observations over a 20-year window belong to a boom-bust episode, slightly below the full-sample prevalence rate of 4.7%. After crises with liquidity support, however, the probability of bad booms sharply accelerates, peaking at 30% at the 15-year horizon. Averaged over a 20-year window, the probability almost doubles to 8.4% relative to the no-injection scenario.

Are these differences statistically significant or can they be explained simply by macroeconomic dynamics confounding past liquidity support? Crises that warrant liquidity support may be fundamentally different from those that do not, and it may be these fundamental factors that shape post-crisis credit booms. We estimate the probability of a boom-bust episode depending on past liquidity support using different statistical models. Table 3.3 presents the estimates of the coefficient associated to $m_{i,t}$ across four different specifications. All the models restrict the sample to observations with a financial crisis within the preceding 20 years and control for country fixed effects. Column (1) shows the plain OLS estimate without additional features. Column (2) adds a third-order polynomial of the distance to the last financial crisis alongside macroeconomic controls characterizing both recent macroeconomic dynamics as well as macro dynamics in the run-up to the previous financial crisis.[65,66] Column (3) presents the average marginal effect estimates using a logit model with the same extended vector of controls.[67] And finally, column (4) exploits exogenous variation in liquidity support using our coding of central bank governor beliefs.[68] Across all models, the effect of a liquidity injection during the previous financial crisis significantly increases the probability of experiencing credit boom-bust episode at any point in time within the two subsequent decades by +3.7 to +15.8%.

Overall, therefore, our data do not allow us to reject concerns about moral hazard. Instead, worries about long-run moral hazard voiced by "hawkish" governors in our sample seem justified. This implies that governors in financial crises face a trade-off short-run between financial stability gains and long-run financial stability risks. Our findings tie into recent literature that has studied specific LLR operations and resultant bank behavior, which highlighted elevated risk appetite and neglect of liquidity hazards (Drechsler, Drechsel, Marquez-Ibanez, et al., 2016; Anginer and Demirguc-Kunt, 2018; V. Acharya et al., 2022).

65. The control vector for recent macro dynamics includes contemporaneous and two lags of real GDP growth, inflation, real stock price index growth and changes in the investment-to-GDP ratio. The control vector for macro dynamics in the run-up to the previous financial crisis includes the exact same variables used in the previous analysis: contemporaneous ($t + 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis.

66. Controlling for the use of "penalty rates"—a binary variable indicating above-median changes in policy rates during the last crisis intervention—suggests that they can reduce the probability of fragile credit booms substantially by 3 to 5 percentage points.

67. The drop in observations results from the fact that some fixed effects perfectly predict the dependent; i.e., for some countries, there never is any boom-bust episode within 20 years since the last financial crisis.

68. Except for contemporaneous macro controls and annual frequency of the data (as opposed to crisis frequency), the first stage is identical to the first stage shown previously.

Table 3.3. Liquidity support and boom-bust episodes

	(1) OLS	(2) OLS	(3) Logit	(4) 2SLS
Liquidity support, last crisis	0.037**	0.078**	0.105***	0.158***
	(0.020)	(0.034)	(0.024)	(0.067)
Macro controls		Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
R^2	0.01	0.10		0.06
Pseudo-R^2			0.56	
First-stage F				26.6
N	1109	737	527	679

Notes: The table lists estimates from four different models of the probability to experience a boom-bust episode within 20 years since the last financial crisis at time t of the form $P(B_{i,t+20} = 1 \cup B_{i,t+19} = 1 \cup \ldots \cup B_{i,t+1} = 1) = f(\alpha_i + \beta m_{i,t+1} + \boldsymbol{\gamma}_h \mathbf{x}_{i,t+1})$, where $B_{i,t}$ is a binary variable indicating a boom-bust episode; $m_{i,t+1}$ denotes an annual central bank asset growth of at least 15% during t or $t+1$; α_i denotes country fixed effects and $x_{i,t+1}$ captures dynamic macroeconomic and financial controls. Controls include the contemporaneous value (in t + 1) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. We define a country-year to be in a *boom-bust* episode if the credit-to-GDP ratio increased beyond +0.10 over the past three years and a financial crisis ensues during any of the three subsequent years. Column 3 shows the logit estimate of the average marginal effect on the probability of a fragile credit boom episode. Two-stage-least-squares regression uses the usual instrument of governor attitude $h_{i,t+1}$. Robust standard errors in parentheses. ***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

3.3.4.4 Gauging the net benefit of liquidity support

Our results suggest that central bank liquidity support poses a trade-off: It prevents financial fallout and thus bolsters growth in the short run, but at the same time sows financial stability risks and threatens growth in the long run. Based on our estimates, we assess whether and under which conditions such interventions raise the net present value of output.

Appendix 3.N spells out the assumptions needed to compute meaningful estimate, i.e., the aggregate net present value of liquidity support as a share of current GDP. Since the trade-off is intertemporal in nature, assumptions about the discount rate as well as trend growth are critical. To assess the sensitivity of conclusions to discount rates, we compute changes in net present value of output for three different values: 1%, 3% and 5%. Similarly, we consider three different trend growth rates: 1%, 3% and 5%.

Table 3.N.2 presents the matrix of estimates as a function of assumption about real trend growth and the social discount rate.[69] Strikingly, the aggregate short-term benefits of liquidity support outweigh the long-run costs across almost all assumption combinations under consideration. The net present value is even substantially above 10% of current GDP in many plausible settings. Only where output grows fast during normal times and discount rates are sufficiently

69. Computations are based on the assumption that the central bank would intervene again during potential future crises. However, conclusions are quantitatively very similar when we assume that the central bank never intervenes again, see Appendix 3.N.

low will future crises be costly enough to swamp the benefits of near-term interventions.[70] Irrespective assumptions' accuracy, however, these figures carry no information about the distributional impact: Current gains of stabilization may accrue to different population segments, e.g., cohorts, than the long-term cost.

Table 3.4. Net present value of central bank liquidity support during a crisis

		Discount rate		
		5%	3%	1%
	5%	0.088	0.048	-0.023
Trend growth	3%	0.152	0.145	0.130
	1%	0.182	0.189	0.195

Notes: The table shows the net present value of liquidity support in response to a financial crisis, expressed as a share of pre-crisis GDP, under different assumptions for social discount rates and real trend growth. Calculations account both for short-run stabilization gains as well as long-run financial instability costs and are based on the assumption that the central bank would intervene again during potential future crises. All details on underlying computations are described in Appendix 3.N.

3.4 Conclusion

Despite a recognition of the centrality of central bank balance sheets in the macroeconomy in academic literature, their long-run empirical evolution, their actual size, and the precise economic effects of their deployment have so far not been studied systematically. Our paper closes this gap. We show that balance sheets have not simply traced transaction volumes in economies. Our long-run evidence suggests that while advanced economy central bank balance sheets have indeed assumed unprecedented proportions relative to output in recent years, in the decades prior to 2008, they severely lagged both total private asset, and total public debt asset growth.

We also show that liquidity support via central bank balance sheets during financial tail events has a deep history, with two-thirds of such deployments being associated with geopolitical or financial shocks. A willingness to expand balance sheets in times of geopolitical stress existed as early as the 17th century. We demonstrate how the expansion of central bank balance sheets did not yet constitute a *systematic* response during financial crises during Walter Bagehot's lifetime (1827-1877). Rather, this role evolved gradually. Not until the end of World War Two had central bank balance sheet expansions developed into such a tool. Investors in the post-1945 era could increasingly expect meaningful central bank liquidity support in the event of financial distress.

70. Intuitively, the net present value falls in the trend growth rate as steeper growth mechanically increases the cost of future crises. By contrast, higher discount rates attenuate the (perceived) cost of future crises. Note that for very low growth rates, the cost of future crises becomes so small that higher discount rates primarily delay the benefits of the short run recovery, inverting the effect of discount rates on the net present value.

How much support and with what consequences? Using the policy orientation of the key decision-makers responsible for deploying central bank balance sheets in crisis times—typically central bank governors, but sometimes other officials at the central bank or Treasury—we show how one can address these questions empirically. We show that the deployment of liquidity support during financial crises contributes in a statistically significant and economically relevant way to a faster return to trend inflation, trend real GDP growth, higher stock prices, and stronger real investment. It does not appear to make a difference whether such liquidity support focuses on a particular asset type. Such results stand in contrast with more pessimistic results, notably Bordo et al. (2001) or Honohan and Klingebiel (2003).

We also find an important qualification to such seemingly benign effects, however. For a long time, many economists and central bankers suspected that balance sheet expansions during financial crises could give rise to moral hazard—a concern that demonstrably motivated hawkish governors in the past to reject balance sheet expansions. We find evidence that such a trade-off exists. The time until the next systemic financial crisis is significantly shorter after major balance sheet expansions. According to our calculations, however, such long-run risks to economic activity appear moderate compared to potential short-term stabilization gains.

References

Acharya, Viral, Rahul Chauhan, Raghuram Rajan, and Sascha Steffen. 2022. "Liquidity dependence: Why shrinking central bank balance sheets is an uphill task." Jackson Hole Economic Policy Symposium.

Acharya, Viral, and David Skeie. 2011. "A model of liquidity hoarding and term premia in inter-bank markets." *Journal of Monetary Economics* 58 (5): 436–47.

Acharya, Viral V., Tim Eisert, Christian Eufinger, and Christian Hirsch. 2019. "Whatever It Takes: The Real Effects of Unconventional Monetary Policy." *Review of Financial Studies* 23 (9): 3366–411.

Adrian, Tobias, and Hyun Song Shin. 2009. "Money, Liquidity, and Monetary Policy." *American Economic Review: Papers and Proceedings* 99 (2): 600–605.

Alesina, Alberto, and Jeffrey Sachs. 1988. "Political Paries and the business cycle in the U.S., 1948-1984." *Journal of Money, Credit, and Banking* 20: 63–82.

Alvarez-Nogal, Carlos, and Prados de la Escosura. 2013. "The Rise and Fall of Spain (1270-1850)." *Economic History Review* 66 (1): 1–37.

Anderson, Haelim, Jin-Wook Chang, and Adam Copeland. 2020. "The Effect of Central Bank Liquidity Provision during Pandemics: Evidence from the 1918 Influenza Pandemic." *FEDS Discussion Paper Series, Federal Reserve Board,* nos. 2020-050, 1–42.

Anginer, Deniz, and Asli Demirguc-Kunt. 2018. "Bank Runs and Moral Hazard. A Review of Deposit Insurance." *World Bank Policy Research Working Paper,* no. 8589.

Antill, Samuel, David Hou, and Asani Sarkar. 2014. "Components of U.S. Financial Sector Growth, 1950-2013." *FRBNY Economic Policy Review* 20 (2): 59–83.

Ashcraft, Adam, James McAndrews, and David Skeie. 2011. "Precautionary reserves and the interbank market." *Journal of Money, Credit and Banking* 43: 311–48.

Asp, Thore. 1898. *Die Geschichte des finländischen Bank- und Münzwesens bis 1865.* C. und J. Goeller.

Bagehot, Walter. 1873. *Lombard Street: A Description of the Money Market.* Homewood, Illinois: Richard D. Irwin, 1962.

Bailey, Andrew, Jonathan Bridges, Richard Harrison, Josh Jones, and Aakash Manodi. 2020. "The central bank balance sheet as a policy tool: past, present, and future." *Bank of England Staff Working Papers,* no. 899, 1–52.

Baker, Zackary, George Gulino, Adil Javat, and Kurt Schuler. 2019. "The Balance Sheets of the Bank of the United States." *JHU Studies in Applied Economics Working Paper,* no. 132, 1–18.

Balletta, Francesco. 2008. *La circolazione della moneta fiduciaria a Napoli nel Seicento e nel Settecento.* Edizioni scientifiche italiane.

Bankverwaltungsrat, Verwaltungsrat Königlich-Preussischer. 1851-1872. *Verwaltungsberichte der Königlich-Preußischen Hauptbank, 1851-1872.* Deckersche Geheime Ober-Hofbuchdruckerei.

Baron, Matthew, Emil Verner, and Wei Xiong. 2021. "Banking crises without panics." *Quarterly Journal of Economics* 131 (1): 51–113.

Baubeau, Patrice. 2018. "The Bank of France's balance sheets database, 1840–1998: an introduction to 158 years of central banking." *Financial History Review* 25 (2): 203–30.

Behr, Patrick, and Weichao Wang. 2020. "The (un)intended effects of government bailouts: The impact of TARP on the interbank market and bank risk-taking." *Journal of Banking and Finance* 116 (C): 1–19.

Benmelech, Efraim, and Nittai Bergman. 2012. "Credit traps." *American Economic Review* 102 (6): 3004–32.

Benmelech, Efraim, Ralf R. Meisenzahl, and Rodney Ramcharan. 2016. "The Real Effects of Liquidity During the Financial Crisis: Evidence from Automobiles*." *Quarterly Journal of Economics* 132 (1): 317–65.

Benmelech, Efraim, Ralf R. Meisenzahl, and Rodney Ramcharan. 2019. "The Real Effects of Liquidity During the Financial Crisis: Evidence from Automobiles." *Quarterly Journal of Economics* 132 (1): 317–65.

Berliner-Handels-und-Tageblatt. 1908. *Geldmarkt und Banken: Excellenz Havenstein.* Deutsches Zeitungsportal Digitalisat, August 26, 1908, p.11.

Bernanke, Ben. 2020. "The New Tools of Monetary Policy." *American Economic Review* 110 (4): 943–83.

Bernanke, Ben, Vincent Reinhart, and Brian Sack. 2004. "Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment." *Brookings Papers on Economic Activity,* no. 1, 1–78.

Bindseil, Ulrich. 2004. *Monetary Policy Implementation: Theory, Past, and Present.* Oxford University Press.

Bindseil, Ulrich. 2019. *Central Banking before 1800: A Rehabilitation.* Oxford: Oxford University Press.

Bleck, Alexander, and Xuewen Liu. 2018. "Credit expansion and credit misallocation." *Journal of Monetary Economics* 94 (C): 27–40.

Bolton, Patrick, Tano Santos, and Jose Scheinkman. 2011. "Outside and inside liquidity." *Quarterly Journal of Economics* 126 (1): 259–321.

Bonelli, Franco. 1982. "The 1907 Financial Crisis in Italy: a peculiar case of the Lender of Last Resort in Action." In *Financial Crises - theory, history, and policy,* edited by Charles P. Kindleberger and Jean-Pierre Laffargue, 51–66. Cambridge University Press.

Bordo, Michael. 1990. "The Lender of Last Resort: Alternative Views and Historical Experience." *Federal Reserve Bank of Richmond Quarterly Review,* no. 1, 18–29.

Bordo, Michael, and Harold James. 2007. "From 1907 to 1946: a happy childhood or a troubled adolescence?" In *The Swiss National Bank 1907–2007,* edited by Ulrich Kohli. NZZ Libro.

Bordo, Michael D., Barry Eichengreen, Daniela Klingebiel, and Maria Soledad Martinez-Peria. 2001. "Is the crisis problem growing more severe?" *Economic Policy* 16 (32): 52–82.

Bordo, Michael D., and Klodiana Istrefi. 2023. "Perceived FOMC: The Making of Hawks, Doves and Swingers." *Journal of Monetary Economics* forthcoming.

Borght, Richard van der. 1896. "A History of Banking in the Netherlands." *A History of Banking in all the Leading Nations, vol. 4 (Max Wirth et al., eds.),* 191–324.

Borio, Claudio, and Anna Zabai. 2018. "Unconventional monetary policies: a re-appraisal." In *Research Handbook for Central Banking,* edited by Peter Conti-Brown and Rosa M. Lastra, 398–444. Edward Elgar.

Brecke, Peter. 1999. "Violent Conflicts 1400 A.D. to the Present in Different Regions of the World." *Paper prepared for the 1999 Meeting of the Peace Science Society International at Ann Arbor on October 8-9, 1999,* 1–30.

Broadberry, Stephen, Bruce Campbell, Alexander Klein, Mark Overton, and Bas van Leeuwen. 2015. *British Economic Growth, 1270-1870.* Cambridge University Press.

Brunnermeier, Markus K. 2009. "Deciphering the liquidity and credit crunch 2007-2008." *Journal of Economic Perspectives* 23 (1): 77–100.

Buiter, Willem, and Anne Sibert. 2007. "From Lender of Last Resort to Market Maker of Last Resort." *First Global Financial Crisis of the 21st Century,* 171–78.

Caballero, Ricardo, and Arvind Krishnamurthy. 2008. "Collective risk management in a flight to quality episode." *Journal of Finance* 63 (5): 2195–230.

Caballero, Ricardo J., and Alp Simsek. 2021. "A Model of Endogenous Risk Intolerance and LSAPs: Asset Prices and Aggregate Demand in a "COVID 19" shock." *Review of Financial Studies* 34 (11): 5522–80.

Calomiris, Charles. 1997. *The Postmodern Bank Safety Net: Lessons from Developed and Developing Economies.* AEI Press.

Calomiris, Charles. 1999. "Building an incentive-compatible safety net." *Journal of Banking and Finance* 23: 1499–519.

Calomiris, Charles. 2011. "Banking Crisis and the Rules of the Game." *Essays in the Honour of Forrest Capie,* 88–131.

Calomiris, Charles, Marc Flandreau, and Luc Laeven. 2016. "Political foundations of the lender of last resort: A global historical narrative." *Journal of Financial Intermediation* 28 (C): 48–65.

Camaiti, Romolo. 1956. "L'attivita bancaria a Siena nel seicento attraverso la ricostruzione e l'analisi statistica di cento bilanci del Monte dei Paschi di Siena." *Archivi storici delle aziende di credito* 1: 35–114.

Capie, Forest, Charles Goodhart, Norbert Schnadt, Alan Greenspan, Jean-Claude Trichet, and Yasushi Mieno. 1995. "The development of central banking." In *The Future of Central Banking: The Tercentenary Symposium of the Bank of England,* 1–261. Cambridge University Press.

Carlson, Mark, and David C. Wheelock. 2015. "The Lender of Last Resort. Lessons from the Fed's First 100 Years." In *Current Federal Reserve Policy Under the Lens of Economic History : Essays to Commemorate the Federal Reserve System's Centennial,* edited by Owen F. Humpage, 49–101. Cambridge University Press.

Chang, Kelly H. 2003. *Appointing Central Bankers: The Politics of Monetary Policy in the United States and the European Monetary Union.* Cambridge University Press.

Clodfelter, Micheal. 2017. *Warfare and Armed Conflicts: A Statistical Encyclopedia of Casualty and Other Figures, 1492-2015.* McFarland.

Cordella, Tito, and Eduardo Levy Yeyati. 2003. "Bank bailouts: moral hazard vs. value effect." *Journal of Financial Intermediation* 12 (4): 300–330.

Courtois, Alphonse. 1881. *Histoire des Banques en France. 2nd ed.* Guillaumin et Cie Paris.

Cova, Alberto. 1972. *Il Banco di S.Ambrogio nell'economia milanese dei secoli XVII e XVIII.* A. Giuffre.

Crosignani, Matteo, Miguel Faria-e-Castro, and Luis Fonseca. 2020. "The (uninteded) consequences of the largest liquidity injection ever." *Journal of Monetary Economics* 112: 97–112.

Cukierman, Alex, Steven Webb, and Bilin Neyapti. 1992. "Measuring the Independence of Central Banks and Its Effect on Policy Outcomes." *World Bank Economic Review* 6 (3): 353–98.

Demirguc-Kunt, Asli, and Enrica Detragiache. 2002. "Does Deposit Insurance increase banking system stability? An empirical investigation." *Journal of Monetary Economics* 49: 1373–406.

Demirguc-Kunt, Asli, and Harry Huizinga. 1999. "Market Discipline and Financial Safety Net Design." *World Bank Policy Research Working Paper,* no. 2183, 1–52.

Diamond, Douglas W, and Philip H Dybvig. 1983. "Bank Runs, Deposit Insurance, and Liquidity." *Journal of Political Economy* 91 (3): 401–19.

Dillen, J.G. Van. 1934. "The Bank of Amsterdam." In *History of the Principal Public Banks,* edited by J.G. Van Dillen, 79–124. Martinus Nijhoff.

Dimand, Robert W. 2020. "J. Laurence Laughlin versus Irving Fisher on the quantity theory of money, 1894 to 1913." *Oxford Economic Papers* 72 (4): 1032–49.

Dimsdale, Nicholas, and Ryland Thomas. 2017. "A Millennium of Macroeconomic Data." *OBER Dataset - Bank of England.*

Drechsler, Itamar, Thomas Drechsel, David Marques-Ibanez, and Philipp Schnabl. 2016. "Who borrows from the lender of last resort." *Journal of Finance* 71: 1933–74. 5.

Drechsler, Itamar, Thomas Drechsel, David Marquez-Ibanez, and Philipp Schnabl. 2016. "Who Borrows from the Lender of Last Resort?" *Journal of Finance* 71 (5): 1933–74.

Duchin, Ran, and Denis Sosyura. 2014. "Safer ratios, riskier portfolios: Banks' response to government aid." *Journal of Financial Economics* 113 (1): 1–28.

ECB. 2012. "Financial Reporting in the Eurosystem." *ECB Monthly Bulletin,* no. 4, 87–98.

ECB. 2020. "Agreement on emergency liquidity assistance, November 9, 2020."

Edvinsson, Rodney. 2014. "The Gross Domestic Product of Sweden Within Present Borders, 1620-2012." In *Historical Monetary Statistics of Sweden, Volume II,* 101–82. Riksbank.

Eichengreen, Barry. 1992. *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939.* Oxford University Press.

Engen, Eric M., Thomas Laubach, and David L. Reifschneider. 2015. "The Macroeconomic Effects of the Federal Reserve's Unconventional Monetary Policies." Finance and Economics Discussion Series 2015-5. Board of Governors of the Federal Reserve System (U.S.)

Ferguson, Niall, Andreas Schaab, and Moritz Schularick. 2014. “Central Bank Balance Sheets: Expansion and Contraction since 1900.” *CESifo Working Paper,* no. 5379, 1–51.

Fregert, Klas. 2014. “The Riksbank’s Balance Sheet, 1668-2011.” In *Historical Monetary Statistics of Sweden, Volume II: House prices, stock returns, national accounts, and the Riksbank balance sheet 1620-2012,* edited by Rodney Edvinsson, Tor Jacobson, and Daniel Waldenström, 339–93. Ekerlids Förlag.

Fusco, Idamaria. 2007. *Peste, demografia e fiscalità nel regno di Napoli del XVII secolo.* Franco Agneli.

Gagnon, Joseph E., Matthew Raskin, Julie Remache, and Brian Sack. 2011. “The Financial Market Effects of the Federal Reserve’s Large-Scale Asset Purchases.” *International Journal of Central Banking* 7 (1): 3–43.

Garriga, Ana Carolina. 2016. “Central Bank Independence in the World: A New Data Set.” *International Interactions* 42 (5): 849–68.

Gertler, Mark, and Peter Karadi. 2011. “A Model of Unconventional Monetary Policy.” *Journal of Monetary Economics* 58: 17–34.

Giannetti, Mariassunta, and Andrei Simonov. 2013. “On the Real Effects of Bank Bailouts: Micro Evidence from Japan.” *American Economic Journal: Macroeconomics* 5 (1): 135–67.

Giuliano, Paola, and Antonio Spilimbergo. 2014. “Growing Up in a Recession.” *Review of Economic Studies* 81 (2): 787–817.

Giuliano, Paola, and Antonio Spilimbergo. 2024. “Aggregate shocks and the formation of preferences and beliefs.” NBER Working Paper 32669.

Gohlmann, Silja, and Roland Vaubel. 2007. “The educational and occupational background of central bankers and its effect on inflation: An empirical analysis.” *European Economic Review* 51 (4): 925–41.

Goodfriend, Marvin. 2005. “Inflation Targeting in the United States?” In *The Inflation Targeting Debate,* edited by Ben Bernanke and Michael Woodford, 311–50. University of Chicago Press.

Goodhart, Charles. 1999. “Myths about the lender of last resort.” *International Finance* 2 (3): 339–60.

Gorton, Gary, and Andrew Metrick. 2013. “The Federal Reserve and Panic Prevention: The Roles of Financial Regulation and Lender of Last Resort.” *Journal of Economic Perspectives* 27 (4): 45–64.

Green, E.H.H. 1988. “Rentiers versus Producers? The Political Economy of the Bimetallic Controversy c.1880-1898.” *English Historical Review* 103 (408): 588–612.

Greenlaw, David, James D. Hamilton, Ethan Harris, and Kenneth D. West. 2018. “A Skeptical View of the Impact of the Fed’s Balance Sheet.” NBER Working Papers 24687. National Bureau of Economic Research.

Greenwood, Robin, Samuel G. Hanson, Andrei Shleifer, and Jakob Ahm Sorensen. 2022. “Predictable financial crises.” *Journal of Finance* 77 (2): 863–921.

Grenville, Stephen. 1997. “The Evolution of Monetary Policy: From Money Targets to Inflation Targets.” In *Monetary Policy and Inflation Targeting. Proceedings of a Conference, 1997.* Edited by Philip Lowe, 125–59. Alken Press.

Guerrieri, Veronica, and Robert Shimer. 2014. “Dynamic adverse selection: A theory of illiquidity, fire sales, and flight to quality.” *American Economic Review* 104 (7): 1875–908.

Havrilesky, Thomas. 1995. “The Pressures on American Monetary Policy.”

Herald, Scotland. 2003. *King’s first outing as governor surprises market. Rate cut taken as sign that hawkish image is softening.*

Hibbs, Douglas A. 1977. “Political parties and macroeconomic policy.” *American Political Review* 71 (4): 1467–87.

Hill, B.W. 1971. “The Change of Government and the "Loss of the City", 1710-1711.” *Economic History Review* 24 (3): 395–413.

Honohan, Patrick, and Daniela Klingebiel. 2003. “The Fiscal Cost Implications of an Accommodating Approach to Banking Crises.” *Journal of Banking and Finance* 27 (8): 1539–60.

Humphrey, Thomas M. 1989. “Lender of Last Resort: the Concept in History.” *Federal Reserve Bank of Richmond Economic Review,* no. 1, 8–16.

Jeanne, Olivier, and Anton Korinek. 2020. "Macroprudential regulation versus mopping up after the crash." *Review of Economic Studies* 87 (3): 1470–97.

Johnston, Rob. 1985. "Prudential Supervision of Banks', address to the Victorian Division of the Securities Institute of Australia and the Institute of Chartered Accountants by Robert Johnston, Melbourne, 21 February 1985." *Reserve Bank of Australia Bulletin,* no. 1, 571–75.

Jorda, Oscar, Moritz Schularick, and Alan M. Taylor. 2016. "Macrofinancial history and the new business cycle facts." In *NBER Macroeconomics Annual Vol. 31,* edited by Martin Eichenbaum and Jonathan Parker, 213–63. University of Chicago Press.

Jorda, Oscar, Moritz Schularick, and Alan M. Taylor. 2017. "Macrofinancial History and the New Business Cycle Facts." In *NBER Macroeconomics Annual 2016, volume 31,* edited by Martin Eichenbaum and Jonathan A. Parker. Chicago: University of Chicago Press.

Joyce, Michael, Ana Lasaosa, Ibrahim Stevens, and Matthew Tong. 2011. "The Financial Market Impact of Quantitative Easing in the United Kingdom." *International Journal of Central Banking* 7 (3): 114–61.

King, Mervyn. 2007. "Turmoil in Financial Markets: What can Central Banks Do?" *Letter to the Treasury Select Committee, September 12, 2007.*

Kirti, Divya. 2020. "Lending standards and output growth." IMF Working Paper No. 18/23.

Kuttner, Kenneth D., and Adam S. Posen. 2010. "Do Markets Care Who Chairs the Central Bank?" *Journal of Money, Credit, and Banking* 42 (2-3): 347–71.

Kuusterae, Antti, and Juha Tarkka. 2011. *The Bank of Finland, 200 years. 2 Vols.* Otava.

Levy, Jack S. 1983. *War in the Modern Great Power System, 1495-1975.* University Press of Kentucky.

Lorca, Pedro Tedde de. 1999. *El Banco de San Fernando (1829-1856).* Alianza Editorial.

Malanima, Paolo. 2011. "The long decline of a leading economy: GDP in central and northern Italy, 1300-1913." *European Review of Economic History* 15 (2): 169–219.

Malmendier, Ulrike, and Jessica Wachter. 2022. "Memory of past experiences and economic decisions." *Oxford Handbook of Human Memory.*

Martin, Antoine. 2006. "Liquidity provision vs. deposit insurance: preventing bank panics without moral hazard." *Journal of Economic Theory,* no. 28, 197–211.

Martin, Antoine. 2009. "Reconciling Bagehot with the Fed's response to Sept. 11." *Journal of Money, Credit, and Banking* 41 (2-3): 397–415.

Martín-Aceña, Pablo. 2017. "The Banco de España, 1782-2017. The history of a central bank." *Banco de España: Estudios de Historia Económica* 73: 1–83.

Mehrling, Perry. 1997. *The Money Interest and the Public Interest: American Monetary Thought, 1920-1970.* Harvard University Press.

Meltzer, Allan H. 1997. "Monetarism. The Issues and the outcomes." *Carnegie Rochester Conference Proceedings,* 8–31.

Metrick, Andrew, and Paul Schmelzing. 2024. "Banking-Crisis Interventions Across Time and Space." NBER Working Paper No. 29281.

Meyer, Eugene. 1954. "From Laissez Faire with William Graham Sumner to the RFC." *Public Policy* V: 3–27.

Mishkin, Frederic S. 2000. "Moral Hazard and the Reform of the Government's Safety Net." In *Global Financial Crises. Lessons from Recent Events,* edited by Joseph R. Bisignano, William C. Hunter, and George G. Kaufman, 261–69. Springer.

Mishra, Prachi, and Ariell Reshef. 2019. "How do central bank governors matter? Regulation and the financial sector." *Journal of Money, Credit, and Banking* 51 (2-3): 369–402.

Molteni, Marco, and Dario Pellegrino. 2022. "The establishment of banking supervision in Italy: an assessment (1926–1936)." *Business History* forthcoming.

Monnet, Eric, and Damien Puy. 2020. "The educational and occupational background of central bankers and its effect on inflation: An empirical analysis." *Journal of International Economics* 127 (11): 103394.

Nakabayashi, Masaki. 2017. "Contained crisis and socialized risk. Unconventional monetary policy by the Bank of Japan in the 1890s." *Research in International Business and Finance* 40: 231–41.

Negro, Marco del, Gauti Eggertsson, Andrea Ferrero, and Nobuhiro Kiyotaki. 2017. "The Great Escape? A Quantitative Evaluation of the Fed's Liquidity Facilities." *American Economic Review,* 824–57.

Niebuhr, Marcus von. 1854. *Geschichte der Königlichen Bank in Berlin. Von der Gründung derselben (1765) bis zum Ende des Jahres 1845.* Verlag der Dederschen Geheimen Ober-Hofbuchdruckerei.

Ommeren, Emile van, and Guilia Piccillo. 2021. "The Central Bank Governor and Interest Rate Setting by Committee." *CESifo Economic Studies* 67 (2): 155–85.

Pfister, Ulrich. 2022. "Economic growth in Germany, 1500–1850." *Journal of Economic History* 82 (4): 1071–107.

Pozzo, Mario da, and Giuseppe Felloni. 1964. *La Borsa Valori di Genova nel Secolo XIX.* ILTE - Industria Libraria Tipografica Editrice.

Praet, Peter. 2016. Speech at the Committee on Capital Markets Regulation conference on the lender of last resort: An international perspective.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2009. *This Time is Different. Eight Centuries of Financial Folly.* Princeton University Press.

Richardson, Gary, and William Troost. 2009. "Monetary Intervention Mitigated Banking Panics during the Great Depression: Quasi Experimental Evidence from a Federal Reserve District Border, 1929-1933." *Journal of Political Economy* 117 (6): 1031–73.

Richter, Björn, Moritz Schularick, and Paul Wachtel. 2020. "When to lean against the wind." *Journal of Money, Credit and Banking* 53 (1): 5–39.

Ridolfi, Leonardo, and Nuvolari. 2021. "L'Histoire Immobile? A Reappraisal of French Economic Growth Using the Demand-Side Approach, 1280-1850." *European Review of Economic History* 25 (3): 405–28.

Rogoff, Kenneth S. 1985. "The optimal degree of commitment to an intermediate monetary target." *Quarterly Journal of Economics* 100 (4): 1169–89.

Romer, David, and Christina Romer. 2018. "Phillips Lecture – Why Some Times Are Different: Macroeconomic Policy and the Aftermath of Financial Crises." *Economica* 85: 1–40.

Sayers, R.S. 1956. "The Development of Central Banking after Bagehot." In *The Development of Central Banking after Bagehot,* edited by R.S. Sayers, 8–19. Oxford University Press.

Schneider, Sabine. 2021. "The politics of last resort lending and the Overend and Gurney crisis of 1866." *Economic History Review.*

Schularick, Moritz, and Alan M. Taylor. 2012. "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008." *American Economic Review* 102 (2): 1029–61.

Segreto, Luciano. 2019. "Stringher, Bonaldo." In *Dizionario Biografico degli Italiani, Vol.94.* Istituto della Enciclopedia Italiana.

Shafik, Minuche. 2016. "Small is beautiful but big is necessary." *Bank of England Speech, 28 September 2016,* 1–19.

Shizume, Masato. 2018. "Financial Crises and the Central Bank: Lessons from Japan During the 1920s." In *Coping with Financial Crises. Some lessons from Economic History,* edited by Hugh Rockoff and Isao Suto, 131–48. Springer.

Sieveking, Heinrich. 1934. "Die Hamburger Bank." In *History of the Principal Public Banks,* edited by J.G. Van Dillen, 125–60. Martinus Nijhoff.

Simmons, Beth A. 1996. "Rulers of the Game: Central Bank Independence During the Interwar Years." *International Organization* 50 (3): 407–43.

Simonsson, K. 1931. *Sveriges Riksbank 1668–1918/1924. Bankens tillkomst och verksamhet, V Vols.* Norstedt.

Sims, Eric, and Cynthia Wu. 2020. "Evaluating central banks' tool kit: Past, present, and future." *Journal of Monetary Economics* 118: 135–60.

Smets, Frank, and Simon M. Potter. 2019. "Unconventional Monetary Policy Tools: A Cross-Country Analysis." *CGFS Papers,* no. 63, 1–85.

Smits, Jan-Pieter, Edwin Horlings, and Jan Luiten van Zanden. 2000. "Dutch GDP and its Components 1800-1913." *Groningen Monograph Series* 5: 1–259.

Stella, Peter. 2009. "The Federal Reserve System Balance Sheet: What Happened and Why it Matters." IMF Staff Working Paper No. 09-120.

Strachan, Hew. 2004. *Financing the First World War.* Oxford University Press.

Sulkunen, Pekka. 2015. "What is Neo-Liberalism? Justifications of deregulating financial markets in Norway and Finland." SIFO - National Institute for Consumer Research Working Paper No. 6.

Svendsen, Knud, Svend Hansen, Erling Olsen, and Erik Hoffmeyer. 1968. *Dansk Penghistorie, Bind 1, 1700-1914.* Andelsbogtrykkeriet i Odense.

Thornton, Henry. 1802. *An Enquiry into the Nature and Effects of the Paper Credit of Great Britain.* London: George Allen & Unwin Ltd, 1939.

Timberlake, Richard H. 1993. *Monetary Policy in the United States. An Intellectual and Institutional History.* University of Chicago Press.

Times, Financial. 2003. *Trichet Gets Green Light for Ecb.* Via Gale, June 19, 2003.

Times, The Sunday. 1990. *Turmoil in Tokyo.* Via Proquest, April 8, 1990.

Trichet, Jean Claude. 2003a. "Asset Price Bubbles and Their Implications for Monetary Policy and Financial Stability," edited by William C. Hunter, George G. Kaufman, and Michael Pomerleano, 15–22. MIT Press.

Trichet, Jean Claude. 2003b. "Financial Stability." *BIS Review* 53: 1–6.

Tucci, Ugo. 1973. "Convertibilita e copertura metallica della moneta del Banco Giro Veneziano." *Studi Veneziani* 15: 349–448.

Tucker, Paul. 2014. "The lender of last resort and modern central banking: Principles and reconstruction." In *Re-thinking the Lender of Last Resport,* edited by Dietrich Domanski and Vladyslav Sushko. BIS Papers 79. Bank for International Settlement.

Vayanos, Dimitri, and Jean-Luc Vila. 2021. "A Preferred Habitat Model of the Term Structure of Interest Rates." *Econometrica* 89 (1): 77–112.

Volcker, Paul. 2004. "Foreword." In *Too Big to Fail. The Hazard of Bank Bailouts.* Brookings Institution Press.

Vuehrer, A. 1886. *Histoire de la Dette Publique en France.* Berger-Levrault et Cie.

Vuletin, Guillermo, and Ling Zhu. 2011. "Replacing 'disobedient' central bank governors with a 'docile' one: A novel measure of central bank independence and its effect on inflation." *Journal of Money, Credit and Banking* 43 (6): 1185–215.

Webb, Stephen B. 1985. "Government Debt and Inflationary Expectations as Determinants of the Money Supply in Germany, 1919-23." *Journal of Money, Credit, and Banking* 17 (4): 479–92.

White, Lawrence H. 2008. "Did Hayek and Robbins Deepen the Great Depression?" *Journal of Money Credit and Banking* 40 (4): 751–68.

White, Lawrence H. 2012. *The Clash of Economic Ideas: The Great Policy Debates and Experiments of the Last Hundred Years.* Cambridge University Press.

Zanden, Jan Luiten van, and Bas van Leeuwen. 2012. "Persistent but not Consistent: the growth of national income in Holland, 1347-1807." *Explorations in Economic History* 49 (2): 119–30.

Appendix 3.A Governor classification

In this section, we detail our sources and methodology to determine the “policy bias” of all governors in charge of central banks during a banking panic, across our 17 advanced economies for the period of 1870-2020. Seminal articles, including Hibbs (1977), have previously associated political-ideological leanings of (legislative) policymakers with relative macroeconomic preference rankings. Generally, such work has associated a higher preference for full employment and for economic expansion – as opposed to price, balance of payments and FX stability - to left and center-left leaning policymakers, and a higher preference for price and FX stability to center-right policymakers. Distinct in our framework is the assessment of "moral hazard" concerns, a specific preference among monetary policymakers. To our knowledge, no previous work has specifically assessed preference rankings for central bank governors – who are distinct from elected political executives by not having to face "popular votes", and not being directly involved in legislative processes. Recent work by Bordo and Istrefi (2023) for the U.S. during 1960-2018, and more recently Ommeren and Piccillo (2021), does not provide such generalized attitude "rankings", with the latter inferring governor leanings directly from the ideology of the nominating government. Deducing a governors’ leaning directly from the nominating government may be appropriate for particular historical instances – such as the appointment of fully dependent central bank executives in the autocratic contexts of Nazi Germany, Imperial Japan, or Fascist Italy. Generally, however, this approach seems to rely on the ambitious assumption that the de facto independent policy room for the governor – once appointed – is highly limited on a *general* level, cannot intellectually evolve, and simply follows political executive directives. It is also inappropriate in practice, as recognized in reference literature: the governor of the Federal Reserve Board in the U.S., of course, has to be confirmed by a Senate majority - which often differs ideologically from the representing party in the White House: hence, Presidential appointment proposals have fallen through repeatedly, and have to take into account "opposition" preferences.[71] All this supports the notion of investigating each governor case individually, and to present evidence supporting such constraints, which we confirm in various cases, and reject in others.

Meanwhile, focusing on a governor’s educational and academic backdrop to characterize leaning, for instance by falling back onto labels such as “freshwater” or “saltwater” ideologues as suggested by Bordo and Istrefi (2023) could be adopted to some degree to other countries – but the approach gets more difficult for earlier historical periods — not least because a majority of central bank governors did not hold advanced economics degrees then (the most common profession represented, in fact, is the legal one). Instead, a large number of pre-1945 central bank officials have records of long political careers as members of an ideologically-positioned

71. Most recently, recall the rejection of President Obama’s nominee Larry Diamond by the oppositional Republican Party in the U.S. Senate in 2010, or in fact President Donald Trump’s failure to rally his own party behind multiple Board appointment proposals. Further historical evidence abounds from virtually all countries: over time, legislative chambers retain a veto power over an executive branch central bank governor nominee in [14] of the 17 advanced economies we cover, according to our evidence.

party and often cabinet positions: while not ignoring the possibility that these individuals could be deviating from majority positions, or from stances by the prime minister in charge, we tend to view such evidence as often being a clear first hint of de facto convictions and leanings of a policymaker.[72]

We count 143 "panic" instances as defined by the Baron, Verner, and Xiong (2021) chronology, in addition to 48 annual "crises without panics". For 20 crisis country-years, no central bank had been established yet, or central bank asset data is missing, or a central bank operated without a governor (e.g. "PT-1956"), and hence we operate with a sample of 171 crisis country-years for which information on the respective governors in charge exist.

Figure 3.A.1 now illustrates the first practical step we undertake to source ex ante governor statements prior to a financial crisis. In particular, we extensively rely on digitized newspaper archives – which provide linguistic and chronological filters – which are available for *all* of our 17 advanced economies. The Figure displays the respective databases for France (*Gallica BNF*, hosted via the Bibliotheque Nationale), and for Denmark (*Statsbiblioteken*, hosted via the Danish State Library).

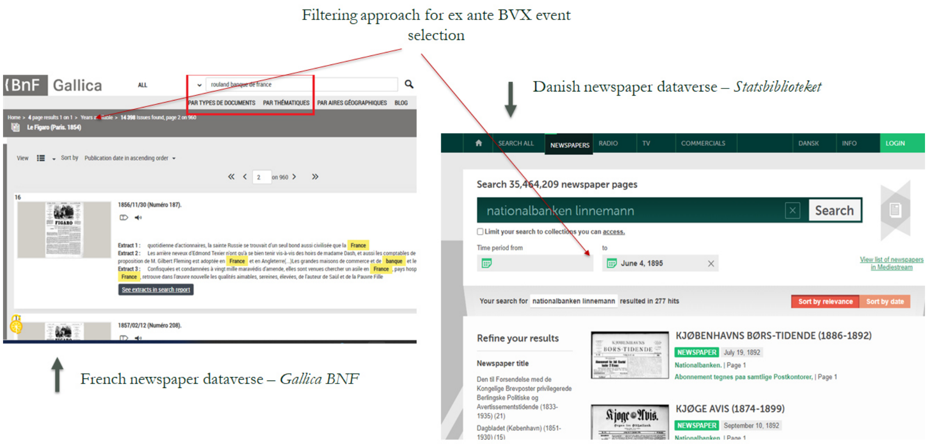


Figure 3.A.1. STEP 1: selected newspaper archives, chronological filtering approach for ex ante governor results, Danish (*Statsbiblioteket*) and French (*Gallica BNF*) cases.

As detailed above, we classify a governor as a "*hawk*", or "*dove/pragmatist*" if at least three news or research items – of which at least one must be an ex ante source – indicate a particular policy leaning in any direction prior to the BVX crisis start date. The national biographical encyclopedias (ex post sources) –- existing for virtually all advanced economies in question – constitute a key resource type for the ex post material, commenting on a policymaker's fundamental stance, intellectual development and key convictions. If the gathered material reveals

72. Again, we recognize that ideologies within the political spectrum have shifted over time: at the same time, we do see plenty of evidence that justifies a distinction into socialist party or cabinet membership being indicative of dovish leanings, and conservative/center-right party or cabinet membership being indicative of hawkish leanings. We flag cases where such a distinction is too simplistic (i.e. in the case of a "Catholic socialist" such as Bank of Spain governor Eduardo Sanz y Escartin).

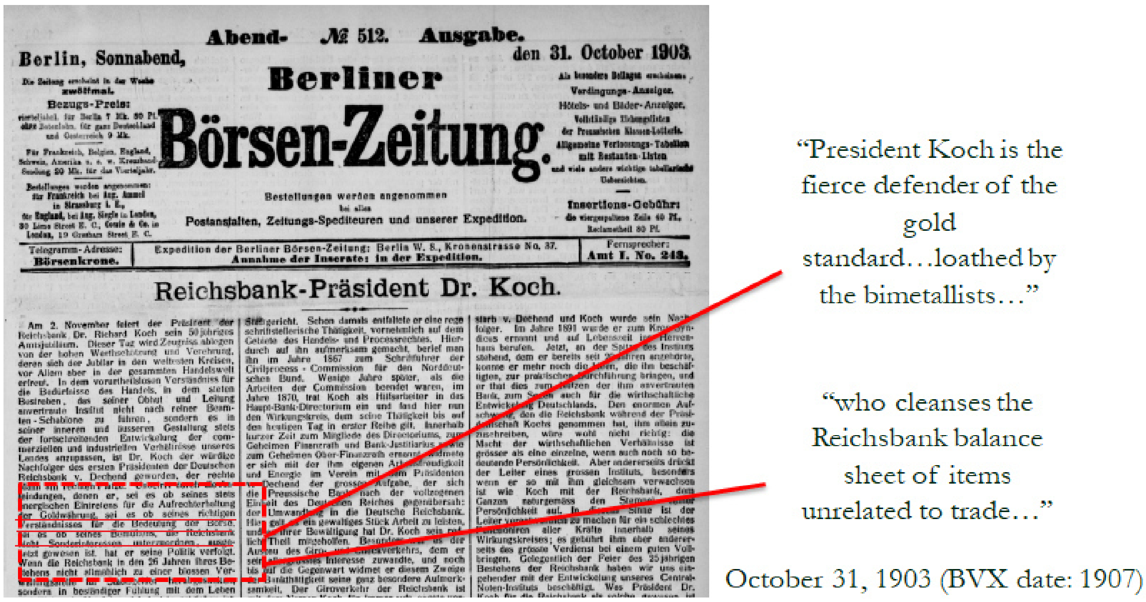


Figure 3.A.2. STEP 2: Identifying policy stances based on pre-crisis public statements and assessments: example for Richard Koch, October 31, 1903.

Notes: Ex ante primary source commenting on policy stances of Reichsbank President Richard Koch, via *Berliner Boersen-Zeitung*, October 31, 1903.

inconsistencies between ex ante and ex post sources, we flag such cases ([B] for a "borderline policy orientation", and [N-I] for cases where evidence exists on constraints to central bank governor independence), and test for the alternative classification (see Figure 3.L.11). Typically, unambiguous and repeated pro-austerity, anti-inflationary leanings and comments are common indications for us to classify a governor as a *hawk*. Importantly, hawks frequently voice moral hazard concerns or warn about the build-up of asset price bubble – a rationale they then invoke to refuse liquidity support on a scale acceptable to doves/pragmatists during crises. In addition, in the earlier half of the sample, expressions of support for the real bills doctrine are common; on the other hand, governors who are ready to grant liquidity requests relatively liberally, prioritize exchange rate flexibility and devaluations over price stability and fixed exchange rates and revaluations, are regular indications that lead us to classify a policymaker as *"dove/pragmatist"*.

Figure 3.A.2 illustrates the second step: systematically parsing the statements outputted by our database search, filtering for statements (in the respective languages) related to keywords and parses now summarized via 3.A.1.

Besides obituaries, academic sources and contemporary media commentary, wherever possible we also take into account the market reaction upon the appointment of the particular governor to assess the leaning of the policymaker, partly falling back on work by Kuttner and Posen (2010) who assessed market reactions for 15 advanced economies since 1980. If the latter report an exchange rate depreciation and/or a bond yield appreciation, we take this as an indication

Table 3.A.1. Policy preferences of central bank governor types

	Dove	Pragmatist	Hawk
Decreasing order	Full employment		Price stability
	Economic expansion	Price stability	Moral hazard
	Income equality	Economic expansion	FX stability
		Full employment	
	Price stability	FX stability	Economic expansion
	FX stability	Income equality	Full employment

Notes: Ranking of central bank governor policy preferences regarding key macroeconomic goals. Adopted from Hibbs (1977, 1471).

that market participants assessed the new governor to have dovish, expansionary leanings; in the case of an exchange rate appreciation and/or bond yield contraction, we see such a reaction as an indication of a hawkish assessment of future policy by market participants.

Table 3.A.2. Further Governor attributes, by ideology

	Hawks	Doves/Pragmatists
Crisis observations	29	47
Age at crisis	58	61.0
Treasury experience (share)	27.6%	40.4%
Political party membership (share)	17.2%	36.2%
Financial sector experience (share)	51.7%	31.9%
Pre-appointment crises	2.22	1.57

Notes: Additional central bank governor attributes prior to appointment or banking crisis. "Party Political Experience" counts either official political offices held prior to appointment (e.g. Senator), or position within a national political party (e.g. press secretary) - but not passive party memberships. "No. of lifetime systemic crises" counts panics on the BVX basis between the birth year and the appointment year for the respective governor. "Average inflation experience" measures the average of the annual change in the CPI index from the respective governor's birth year to the final year prior to the banking crisis outbreak.

Figures 3.A.2 and 3.A.3 display typical newspaper sources we utilize, the first representing a detailed profile of Reichsbank governor Richard Koch, written on the occasion of his 50th anniversary as head of the (de facto) central bank, in October 1903 – thus four years prior to our observation of the 1907 German banking crisis in "BVX". The paper, the *Berliner Börsen-Zeitung* was a widely-circulating medium for financial industry professionals, businessmen, and economic policymakers, comparable to the British *Financial Times*. The opinion of the paper thus provides key context of the prevailing attitude among these groups towards the Reichsbank at that date, and the assessment of its governor. The praise lavished onto the governor as a "fierce defender the gold standard..loathed by the bimetallists" can be contextualized well in the literature on the bimetallic debates prominent in the final years of the gold standard era – with conservative "deflationary" policymakers typically being outspoken against the proponents advancing the case for silver (Green, 1988). The assessment by the paper is echoed in other sources, for instance the rival *Berliner Handels- und Tageblatt*, which equally praises Governor Koch for "cleansing" the Reichsbank balance sheet of "bills unrelated to trade" - a clear confirmation of Koch's real bills convictions – well associated with the overarching aim of preventing "inflationary overissue" (Humphrey, 1982).

Not separately displayed is an interview with then-Banque de France governor Jean-Claude Trichet with the leading French daily *Le Monde*, in June 1997. In the interview, Trichet expresses highly critical views of the public debt management situation, repeatedly criticizing the efforts of the Chirac government. In sharp terms, the governor thus expresses a preference of price stability goals over economic growth and employment goals, the respective preferences of the Chirac government. The interview was conducted well before the identified "BVX" crisis in 2008, when Trichet had risen to the position of ECB governor, and thus confirms other contemporary evidence that identified Tichet with "hawkish" preferences: already upon his appointment in 1993, financial markets reacted to the news with a "hawkish pattern" as analyzed in Kuttner and Posen (2010) - with a clear appreciation of the French Franc, and a sharp decline in French bond yields. In subsequent years, however, Trichet's attitudes markedly softened, and the Frenchman was positioned by a block of Southern, more deficit-prone Eurozone countries to succeed the "German-style hardliner" on currency and inflation issues, Wim Duisenberg, half-way through his regular tenure (e.g.Telegraph (1998, 14)); by mid-2003, shortly before his official ECB appointment, markets had shifted their expectations in favor of a "pragmatic and flexible policy stance" from the governor, contrasting with his predecessor (F. Times, 2003, 1). This backdrop serves to illustrate our dynamic classification approach, which takes into account shifts in the governor's policy attitude over time, and seeks to capture as precisely the expectations associated with him as closely as possible at the time of the banking crisis outbreak: in this case, it is more relevant what Mr. Trichet's public policy beliefs were in 2003, rather than during the 1990s: and in contrast to classification schemes such as Bordo and Istrefi (2023), we sharply discount information on the governor's earlier biographic attributes (for instance his educational background) if such attitudes have evidently shifted.

Jean-Claude Trichet juge « impensable » la non-réduction des déficits

Dans un entretien accordé au « Monde », le gouverneur de la Banque de France, insiste, dans le but de lutter contre le chômage, sur la nécessaire modération des salaires, sur la poursuite de la réduction des déficits publics et sur le besoin de réforme de l'économie

JEAN-CLAUDE TRICHET

« Quelles sont les grandes recommandations que fait le Conseil de la politique monétaire au président de la République et au Parlement ?

– Lorsqu'il transmet son sentiment dans le rapport annuel, le Conseil de la politique monétaire n'entend naturellement pas se substituer au gouvernement, au Parlement, aux syndicats, au patronat, etc. Il soumet simplement son diagnostic et ses réflexions à la discussion démocratique, comme le lui demande la loi. Les cinq principales recommandations de cette année correspondent à notre position constante. Elles sont, comme les années précédentes, inspirées par le souci de préserver la stabilité, la confiance dans la monnaie et de consolider l'une des conditions nécessaires de la croissance et de la lutte contre le chômage.

» En premier lieu, la modération dans les évolutions des revenus nous paraît essentielle non seulement pour maintenir un bas niveau des prix mais encore pour lutter contre le chômage. En second lieu, réduire les déficits publics, conformément aux orientations du traité de Maastricht, est nécessaire pour consolider la confiance et pour

monde entier que le franc d'aujourd'hui est essentiel. Il y a dans nos taux à dix ans, au moment où je parle, huit ans et demi d'euro ! Que deviendraient nos taux d'intérêt à long terme – et donc notre croissance – si l'Euro était peu solide et inspirait peu confiance ?

– A quoi attribuez-vous la baisse des taux en 1996 ? – La baisse des taux de marché, qui nous a conduit au troisième plus bas niveau du monde, a été le fruit d'un accroissement considérable de la confiance. C'est le fruit d'une stratégie continue poursuivie depuis de longues années.

» De notre point de vue, la décision prise par le gouvernement et le Parlement de donner l'indépendance à la Banque de France en

publics en 1997 comme celui en 1998 et au-delà. C'est indispensable pour l'Europe. Mais, et c'est ceci qui enracine encore plus ma propre confiance, c'est indispensable pour la croissance et la création d'emplois en France. Car s'il apparaissait que nous ne pouvons pas ou ne voulons pas respecter le critère, nous perdrions en termes de création d'emplois beaucoup plus du fait de la perte de confiance nationale et internationale et de la hausse de nos taux d'intérêt de marché que ce que nous penserions gagner grâce au déficit supplémentaire. Si nous avons aujourd'hui les troisièmes plus bas taux d'intérêt du monde, cela signifie que les épargnants français et étrangers ont déjà complètement intégré le fait que le gouvernement français était et est prêt à prendre les mesures nécessaires.

» Quant au niveau européen, nous savons, depuis Amsterdam, que nous aurons un bon pacte de stabilité et de croissance, ce qui est essentiel pour la crédibilité de l'euro. C'est indispensable mais ce n'est pas suffisant. En outre, nous avons un renforcement de la coordination des politiques écono-

doxe français. Vu de l'étranger, nous inspirons confiance puisque nous avons les troisièmes plus bas taux d'intérêt du monde. Aussi parce que nous avons le niveau de vie le plus élevé d'Europe avec l'Allemagne. *The Economist* vient, dans sa dernière édition, de nous classer comme numéro deux mondial pour la qualité de vie. Et, dans le même temps, nous avons un très mauvais moral à cause du chômage, en particulier du chômage des jeunes, dont nous sommes malheureusement nous-mêmes, dans une très large mesure, les auteurs puisque l'OCDE dit que notre

« Le gouvernement a maintenu l'engagement européen de la France et je suis donc convaincu qu'il fera ce qui est nécessaire. Je le répète : en infléchissant cette stratégie, la lutte contre le chômage serait moins efficace »

chômage est structurel à 80 %. Et ce mauvais moral lui-même crée

bonne politique budgétaire sont des conditions nécessaires mais pas suffisantes à elles seules. Au-delà, il faut, croyons-nous, des réformes structurelles pour enrichir notre croissance en emplois. C'est ce que disent les communiqués d'Amsterdam et de Denver.

– Le gouvernement Jospin veut accélérer la croissance en engageant un tournant keynésien de la politique économique par une relance de la consommation et par une consolidation du rôle de l'Etat. Qu'en pensez-vous ?

– C'est votre interprétation. La

consommation privée ne présente pas d'anomalie marquée, ce qui est

3 % ou moins de déficit cette année. Il en reste quatre. La Grèce est dans une situation spéciale. Et, à part la Grèce, trois pays, l'Italie, l'Allemagne et la France feraient spontanément un peu plus de 3 %. Naturellement, ces trois pays vont prendre des mesures correctrices. Ne pas prendre des mesures correctrices est impensable. Et, s'agissant de nous, qui peut croire que c'est en étant le pays le plus déficitaire d'Europe que l'on peut le mieux combattre le chômage ?

– Si, néanmoins, le déficit français atteint 3,5 % du PIB %, alors que le traité de Maastricht fixe une limite à 3 %, pourra-t-on faire l'euro ?

– Ce chiffre donnerait probablement à la France la plus mauvaise performance de l'Union européenne, la Grèce mise à part ! Ce n'est ni notre tradition, ni notre vocation, ni notre intérêt pour combattre le chômage. Je le répète, j'ai confiance dans la volonté de notre gouvernement de respecter le traité.

– Un report est-il envisageable ?

– Reporter la monnaie unique, cela veut dire amender le traité puisque la date du 1er janvier 1999

Figure 3.A.3. Editorial on Banque de France governor Trichet, *Le Monde*, June 25, 1998.

To illustrate our approach further, we proceed with several examples within our governor sample, spanning several relevant cases from both categories.

- **Bonaldo Stringher, Banca d'Italia (1900 to 1930) – Dove/Pragmatist**. Bonaldo Stringher – the longest-serving governor in our entire sample – took helm at the Italian central bank at the turn of the 19th century as a 45 year-old public servant, gaining previous experience at the Italian Statistical Office, the Italian Treasury, and as a finance lecturer at the University of Rome. His biographical details are comparatively well-documented, in both Italian and English sources, including entries in the Italian biographical dictionary ("Dizionario Biografico degli Italiani", via Segreto (2019)). From these sources, we learn the following details about Stringher's pre-appointment convictions: Stringher supported the establishment of popular banks, and described himself as a "devoted disciple" of his mentor Luigi Luzzatti, the progressive 20th Prime Minister of Italy and dedicated advocate for worker's rights during the last quarter of the 19th century (ibid.). Luzzatti himself remains clearly associated with the unionist, co-operative economic ideas spearheaded by the German Hermann Schulze-Delitzsch that sought, not least, to establish a widespread national network of "people's banks" promoting low interest rates and high levels of permanent liquidity (Pecorari and Ballini, 2006). In the immediate years prior to the outbreak of the 1907 crisis, Stringher, generally favoring classical gold standard arrangements for Italy, is recorded to pursue "cordial" relationships with the Treasury, helping in various advantageous public debt conversion operations and etatist industrial and infrastructure projects – a level of collaboration not necessarily standard across other DM central banks at the time, and thus further indication to us of a clear personal prioritization of growth and unemployment goals above those of FX and price stability. With no evidence that Stringher's fundamental stances changed decisively in between our four banking crisis dates ("IT-1907", "IT-1914", "IT-1921", and "IT-1930"), our classification for the governor remains uniform across these events.

- **E.C. Y Roffignac, Banco d'Espana (1911 to 1913) – Dove/Pragmatist**. Eduardo Roffignac served a brief term at the Spanish central bank, having obtained a law degree and previous experience in multiple parliamentary deputy and senatorial roles. Roffignac is representative of many of his pre-1945 peers in his legal and technocratic professional background, and only peripheral acquaintance with academic economics. Our source basis, particularly for governors serving short-term appointments, or not discussed in detail in English, is typical: we consulted the Spanish national dictionary ("Diccionario Biográfico electrónico") [73] established by the Spanish Historical Academy, where learn that Roffignac "from his first parliamentary interventions...focused his economic ideology on achieving budgetary balance, in accordance with the prevailing thinking among economists and politicians of the time" Arroyo (2018). In other words, our governor displayed clear preferences for FX and inflation stability, over growth and unemployment goals – however, consensus sentiment in Spain after the exceptionally costly Spanish-American War was leaning towards fiscal austerity across partisan lines: such a fact discounts an otherwise clear data point suggesting a "hawkish" leaning. Together with the fact that he appears to have abandoned his political conservatism after the death of his "mentor" Fernandez Villaverde in 1905 Arroyo (2018), we designate Roffignac as a "dove/pragmatist".
- **Victor Moll, Sverige's Riksbank (1912 to 1928) – Hawk**. Victor Moll's economic and political beliefs underwent several transformations over the course of his professional career. Historians are in agreement that Moll began his career as a progressive in the circle of the politician Karl Staaff, helping him to draft unionist, anti-monarchical speeches and financial policy proposals. A member of the Swedish Parliament for the Liberal Party prior to his tenure at the central bank, Moll initiated legislative proposals to restrict stock market speculation. Gradually, however, Moll shifted his ideological convictions towards more traditional foundations, becoming a committed defender of the pre-war gold standard arrangements, opposing more flexible currency arrangements - and turning to "combative opposition" to some progressive and liberal Swedish economists, including Knut Wicksell Grafvert (1985, 662). In 1917, Moll penned a detailed refutation of Gustav Cassel's proposals for a more flexible re-arrangement of pre-war gold standard arrangements that took account of international PPP dynamics (Moll (1917)). Moll's case is typical of a number of governors that underwent ideological shifts over their lifetimes: the relevant datapoint for our purposes is the identification of the governor stance as closely as possible prior to the banking crisis year in the BVX chronology we are utilizing: in this case "SWE-1919". As Moll's outspoken opposition to stock market speculation and (comparatively) flexible FX arrangements precede the year 1919, but evidently occurs subsequent to the accounts of his early center-left leanings in his dealings with Staaff, we read the evidence as confirming that Moll's intellectual shift towards more traditional monetary thinking – as well as moral hazard concerns regarding financial market trends - clearly preceded the banking crisis. On this basis, we reach the verdict to classify Governor Moll as a "hawk".

73. Available via dbe.rah.es.

- **Ben Bernanke, Federal Reserve (2006 to 2013) - Dove/Pragmatist**. Ben Bernanke hailed from an academic professional background when appointed chairman at the Federal Reserve in 2006, having previously served on the Board. Kuttner and Posen (2010, 358) document an exchange rate depreciation of the US Dollar, and a (slight) rise in U.S. bond yields upon the announcement of Bernanke as new Fed chair in 2006 – a reaction in line with more dovish market expectations. While a lifelong registered Republican, Bernanke is exemplary of our approach not to prioritize such formal party affiliations, or the political leaning of the nominating government. Just prior to his appointment confirmation, in-depth profiles of Bernanke in U.S. news outlets were universally stressing the governor's "unclear" political stance – with some academic colleagues commenting on his de facto "Democratic" stance McGinn and Wolffe (2005) and Uchitelle and Porter (2005, C1). In such instances, we would prioritize evidence of "de facto" pre-existing policy leanings, and emphasize as well the documented market reactions: in result, Ben Bernanke is classified as a "dove/pragmatist" in our framework.

Table 3.A.3. Central Bank Governor Classification

Governor	Term	Classification	Sources
		Australia	
E. Riddle	1927 to 1937	**Hawk**	*Two ex-ante, two ex-post source:* Promotes low interest rate policy early in Great Depression, supports work schemes, the expansionist "Premier's Plan" of 1931, and public deficits, see Financial Times (1935, 12f. – E.A.); Giblin (1951, 35ff. – E.P.): Riddle "not much interested in central banking", "the whole responsibility for the formulation of central bank policy [fell] on the Chairman ... Sir Robert Gibson". Gibson, in turn, strongly hawkish on inflation and supportive of the anti-expansionary policies by Scullion/Theodore ministries of 1920s ("principal bulwark of orthodoxy [in economic policy]"), via T. Magazine (September 11, 1930, 13 – E.A.) and Hart (1969, 38ff. – E.P.).
R.A. Johnston	1983 to 1989	**Dove**	*Two ex-ante, two ex-post sources:* Johnston mainly "worried" about inflation in public eye, but no radical counter-measures, see Australia (1989, 3 – E.A.), and AFR (2017, 17 – E.P.) announcement; regarding interventions, publicly embraces "light and flexible" commitment to liquidity and solvency support from RBA during banking crises pre-1989 crisis Johnston (1983, E.A.); "non-radical adherence to monetarism" under early years in term, then phasing out of monetary targets Grenville (1997, 129ff. – E.P.);
		Belgium	
E. Previnaire	1870 to 1877	**Dove**	*Three ex-post sources:* Long-term liberal party member and senator, on the one hand influenced by Frere-Orban policies – which are interventionist, mildly socialist/progressive, see in particular Parliamentary debates Hymans (1880, 7f., 12f. – E.P.); "Follower of the principles of Smith and Malthus", free market beliefs, Kauch (1954b, 9 – E.P.); Politically free-market liberal and pro-business, but highly restrictive policies during Franco-German War of 1870-1, see also generally Buyst and Maes (2008, E.P.);

A. Jamar	1882 to 1888	**Dove**	*Three ex-post sources:* Heading a "bureaucratic, inward-looking institution with little interest in new responsibilities" or intervening in wider economy, see Buyst and Maes (2008, 170f. – E.P.); interventionist and pro-employment and growth attitudes as minister of public works in Frere-Orban government: passing pro-labour legislation, advocating nationalization of key railway operators in mid-1870; opposes rail tariffs for adverse impact on workers, supports Caisse d'Epargne given favorable impact on workers, see Kauch (1954a, 9ff. – E.P.), Hentenryck (1984, E.P.);
T. De Lantsheere	1905 to 1918	**Dove**	*Four ex-post sources:* Career bureaucrat and Catholic pragmatist, with long political career preceding bank role - squarely located in moderate wing of party, but flexible ("Zijn persoonlijke opvattingen lieten zich niet opsluiten in een keurslijf van partijtucht", Janssens (1997, 66 – E.P.)) – especially in context of death penalty, universal suffrage debates Monballyu (2014, 187ff. – E.P.); from 1912, Lantsheere firmly supports gold standard, as opposed to bimetallic Latin Currency Union standard, citing price and financial stability reasons - but at the same time builds "secret" low-denomination cash fund of five-franc notes in 1912 for emergency use Janssens (1997, 68f., 71 – E.P.); Kauch (1957, 3ff. – E.P.);
L. Franck	1926 to 1937	**Hawk**	*Four ex-post sources:* Bank with deflationary bias going into Great Depression, gradually becoming more interventionist and pro-inflationary Wee (2012, 142f. – E.P.); Shennan (1992); Buyst (2012, 4f. – E.P.) – generally, clear rejection of Keynesianism prevails, majority of executives committed to stabilization anti-inflation policies; Franck, who holds "idees conservatrices et liberales" in regular conflict with Socialist government, including Finance Minister Henri de Man over interventionism Buyst, Maes, and Pluym (2005, 137 – E.P.);

G. Janssen	1938 to 1941	**Dove**	*Three ex-post sources:* Lawyer by training, generally "followed the instructions of cabinet members, especially the minister of finance" (Taber, 2014, 229 – E.P.), "interventionist conceptions ... follower of the ideas of [Etatist/Socialist] Henri de Man" as head of Banking Commission, conflicts with more conservative predecessor Louis Franck Buyst, Maes, and Pluym (2005, 137, 139 – E.P.); later highly concerned about inflationary impact of RKKS issuance during German occupation Klemann and Kudryashov (2012, 195 – E.P.);
J.-C. Trichet	2004 to 2011	**Dove**	*Four ex-ante, two ex-post sources:* Clear hawkish reaction upon announcement as BdF governor in 1993, see Kuttner and Posen (2010, E.P.); repeated clashes with Jacques Chirac over budget deficits, which T. criticizes publicly as too high Monde (1997, 18 – E.A.); consistently dismissive or skeptical about LLR function of CBs pre-2008, e.g. "apart from their operational tasks -– such as the management of money market liquidity and the monitoring of large value payment systems – central banks must endeavour unremittingly to create the conditions for the international economy to minimize misalignments in asset prices, excessive volatility, purely speculative phenomena and dangerous herding behaviour. This is the underlying message in central banks' repeated calls for prudence and caution", (Trichet, 2003, E.A.); subscribes to primacy of price stability mandate...but rejects bailouts given moral hazard threats, as "not all boom or bubble episodes are threatening financial stability. Policy makers should not fall into the fallacy of attempting to eliminate all risk from the financial system. Either they would be unsuccessful (moral hazard) or they are likely to hamper the appropriate functioning of a market economy where risk taking is of the essence." (Trichet, 2005, E.A.); but moderation of policy positions in years leading up to 2008, with market consensus expecting "pragmatic and flexible policy stance" by April 2003, F. Times (2003, 1 – E.A.); more ambiguity by 2004, "The overall assessment will determine whether remedial action is needed", (Trichet, 2004, E.A.); Tobback, Nardelli, and Martens (2017, E.P.).

M. Draghi	2012 to 2019	**Dove**	*Two ex-ante, one ex-post source:* Generally seen as Keynesian: F. Times (2011, E.A.) – early studies under Keynesian Federico Caffè; Fiorella Kostoris: "would describe him as a Keynesian 'in the MIT sense'"; in agreement also: Tamburello (2011, E.A.); Tobback, Nardelli, and Martens (2017, E.P.).
		Canada	
G. Bouey	1973 to 1986	**Hawk**	*Two ex-ante, two ex-post sources:* Bouey as convinced monetarist, praised by Milton Friedman; follows U.S. in staunch anti-inflation policies during 1980s, "dramatically Friedmanesque" public agenda by 1975, see: WSJ (1980, 6 – E.A.); Drainville (1995, E.P.); by 1977, publicly seen as Bouey's Bank of Canada, starting with "watershed" speech in 1975, "embraced the monetary doctrine known as monetarism", seen as decisive in implementation of wage and price controls; under Bouey, "The Bank of Canada's insist[s] on fighting inflation as the first priority in the face of mounting unemployment", via Chodos (1977, 41ff. – E.A.); ex post fully in agreement in Crow (2009, E.P.).
		Denmark	
M. Levy	1861 to 1891	**Dove**	*Three ex-post sources:* Levy models bank policy on Bank of England – for the first time moving to liberal general discount policy, but "not a man with great visions … had long employed caution, which provides means to help business in 1885 crisis", see Gejl and Vestberg (1981, 24f. – E.P.); main aim from 1861 is to increase discount policy flexibility, introducing rate rage among other steps, as lesson of overly hawkish 1857 crisis response, see Svendsen et al. (1968a, 296-298 – E.P.); Positive assessments from both Social-Democratic and Conservative analysts, Levy frequently participates in public debate, pushing Scandinavian monetary union, gold currency basis, and presents himself as patriotic "banker of the people", see Soerensen (2015, 331ff. – E.P.);
S. Linnemann	1891 to 1896	**Dove**	*One ex-post source:* Trained lawyer with pragmatic and unideological bureaucratic career, generally see Vestberg (1981, 82 – E.P.).

J.P. Winther	1907 to 1924	**Hawk**	*Two ex-post sources:* Hansen (1991, 38ff.); Hansen (1996, 312) – Winther states that he does "not hold principle" that central banks should not generally be ready to help banks with liquidity; other sources emphasize outsized roles of director Marcus Rubin as well as Carl Th. Ussing – both as vocal supporters of full employment policies –, see Svendsen et al. (1968a, 358ff., E.P.).
C. V. Bramsnaes	1933 to 1949	**Dove**	*Three ex-post sources:* Long activism in labor/social democratic grassroot organizations, campaigning for worker rights and publishing on social problems. Implements austerity measures during early Great Depression, but reallocates expenditures to lower incomes. Resists Krone devaluation and key Leftist FX policy demands in 1933, vowing to preserve currency stability. See Dybdahl (1979, 445ff. – E.P.); in agreement: Thomsen (2019, E.P.). As early as summer 1931, isolated across Social Democratic and center-left circles with advocacy of deflationary macro policies Svendsen et al. (1968b, 162ff. – E.P.).
E. Hoffmeyer	1965 to 1994	**Hawk**	*One ex-ante, two ex-post source:* "Hoffmeyer is known for his ... conservative monetary philosophy" (Europe 1991); "Hoffmeyer preaches an old-time religion: ... austerity" (WSJ 1992, A10 – E.A.); H. decisive for spread of monetarist ideas in Denmark, see Marcussen and Zoelner (n.d., 106f. – E.P.); Soerensen (2015, 341ff. – E.P.); Jyllands Posten (2016 – E.P.);
B. N. Andersen	1995 to 2005	**Hawk**	*One ex-ante, one ex-post source:* Initially seen as "continuity candidate" – "there has been no change in the bank's policies. Continuity is the watchword" (FT March 29, 1995 – E.A.); supports adoption of Maastricht criteria, opposes inflation target, steers against more FX flexibility; Ommeren and Piccillo (2021, 30 – E.P.) tag as centrist/center-left;
N. Bernstein	2005 to 2013	**Hawk**	*Two ex-ante, one ex-post source:* Engrained fiscally hawkish views - public criticism of right-wing government for not being austere enough in 2007, see FT (2007, 2 – E.A.); EIU (2008 – E.A.); Ommeren and Piccillo (2021, E.P.).
		Finland	

T. Wegelius	1898 to 1906	**Dove**	*Three ex-post sources:* Pragmatic attitude to FX policies when on executive board 1880s, i.e. flexible adjustments to threats of rising unemployment, see Pipping (1969, 157 – E.P.); further: Schybergson (1913, 318 – E.P.); Kuusterae and Tarkka (2011, I, 366 – E.P.).
O. Stenroth	1918 to 1923	**Dove**	*Three ex-post sources:* Member of Young Finnish nationalist party, pro-business and background in banking; during 1920s supportive of abolishing FX controls, but favors balanced budgets, later pro-Allied forces during WWII and supporting flexible exchange rates, see also Kuussterae (1997, 294 – E.P.), Kuusterae and Tarkka (2011, I, 454ff. – E.P.); more generally, Tudeer (1940, E.P.);
R. Ryti	1924 to 1940	**Dove**	*One ex-ante, two ex-post sources:* Early etatist and pro-labor convictions, with Ryti later rejecting deflationary policies for adverse social consequences. But even by 1936, supportive of gold standard version with flexible bands: "first duty [of the central bank] is that it should maintain internal purchasing power of the currency" Ryti (1936, E.A.); Tudeer (1940, E.P.); Kivimaeki (1943, E.P.).
R. Ryti	1944 to 1945	**Dove**	See above.
R. Kullberg	1983 to 1992	**Hawk**	*Two ex-ante, two ex-post sources:* Anti-inflation and austerity attitude from early 1970s: "especially under Mr. Kullberg, the bank has become increasingly monetarist in its approach" FT (1984, 33 – E.A.); Kullberg (1984 – E.A.): "monetary policy should never be easy. It should always be hard in order to keep the banks in your hands all the time ... we have found that it is best always to fight inflation. Employment policy is up to the government"; strongly held fixed FX conviction (ECU peg), tenders resignation upon FIM float in 1991, see further Jonung, Kiander, and Vartia (2009, E.P.) and Kuusterae and Tarkka (2011, II, 466ff. – E.P.);
		France	

G. Rouland	1865 to 1878	**Dove**	*Three ex-post sources:* Career politician with no background in financial matters: "Rouland's position in the bank seems to have been to defend loyally but not strenuously the government's point of view in the Conseil General, accepting the decisions of the latter, independently of whether they were in favor or against the government's will" Einaudi (2001, 137 – E.P.); see also Bouvier (1988, E.P.). Plessis (1985, 328ff. – E.P.) is more nuanced: Rouland a "neophyte who develops no original ideas on money or banking" ("Mais ce neophyte n'exprime point d'idee originale sur la monnaie et la banque"), but from at least 1867 leans more and more towards the Regents rather than the government: de facto opposes Minister Rouher over Credit Mobilier emergency aid in September 1867;
P. Magnin	1882 to 1897	**Dove**	*One ex-ante, two ex-post sources:* pre-BdF voting record in French Senate is center-left, including support for Adolphe Thiers, against monarchists, but moderate fiscal policies in Ministry of Finance, accused of "favoritism" towards capitalists in context of rentes issuance, see Robert, Bourloton, and Cougny (1891, 222 – E.A.); Close connections to leftist Union Republicaine, later entry into C. de Freycinet cabinet, see further Ortiz-Serrano (2018, 349 – E.P.); Biographical volume in Delabrousse (1916, esp. 54ff. – E.P.), confirms his strong conceptual support for Bank's stabilizing role as early as 1865 in Senate proceedings, advocating great capital increase ("qu'en 1865, Magnin avait prononcé sur la Banque de France un des discourles plus documentés qui figuraient dans les annales parlementaires, ajoutant que c'était à lui qu'était réservé l'honneur de réaliser la mesure qu'il réclamait dès 1865, en faveur de l'industrie et du commerce français").
G. Pallain	1898 to 1920	**Dove**	*One ex-ante, three ex-post sources:* Asserts before U.S. Congress in 1908 that he would "help" Credit Lyonnais and other banks in times of crisis, supports role of BdF as de facto "bank of banks", Aldrich (1908, 3, 10, 25 – E.A.); further: Blancheton (2014).

C. Moret	1931 to 1934	**Hawk**	*Three ex-post sources:* Appointed by Poincare's center-left government, but strong hawkish/sterilizing views prevail at BdF in interwar period, see Moure (1991, 141 – E.P.) and Eichengreen (1992 – E.P.); Moret draws sharp criticism from commercial banks for pushing competitive policy during crisis, but defends independent bank outlook in private responses – ("far from a bank of banks"), see Gonjo (1996, 312f. – E.P.);
E. Labeyrie	1936 to 1937	**Dove**	*One ex-ante, three ex-post sources:* Labeyrie appointment as part of "leftist" Leon Blum nationalization of Banque, and ousting of old elites, see CSM (1936 – E.A.); Margairaz (1991, 285ff. – E.P.); Labeyrie "attuned to Popular Front desires for low interest rates … was clearly following Popular Front cheap money", "pliant" and less devaluationist choice over Pierre Quesnay, Moure (1988, 499 – E.P.); Le Journal (March 13, 1937 – E.P.);
J.-C. Trichet	2004 to 2011	**Dove**	See above.
M. Draghi	2012 to 2019	**Dove**	See above.
		Germany	
R. Koch	1890 to 1907	**Hawk**	*Two ex-ante, three ex-post sources:* Divergent views: "fierce defender of the gold standard…often loathed by the bimetallists…refuses to let the Reichsbank be a cheap source of long-term liquidity" Börsen-Zeitung (1903, 1f. – E.A.); in agreement: Arendt (1895, E.A.); implements de facto real bill policies "cleansing [Reichsbank] portfolio of bills unrelated to trade" Berliner-Handels-und-Tageblatt (1908, 11 – E.A.); ex post sharply criticized for too liberal credit policies in 1890s, see Plenge (1913, 22ff. – E.P.), also Bopp (1954, 180 – E.P.); vis-a-vis liberal credit growth internationally pre-1907, still on balance hawkish, criticized for hands-off approach during 1907 crisis, see Eschweiler (1993, 50f. – E.P.);

R. Havenstein	1908 to 1923	**Dove**	*One ex-ante, three ex-post sources:* Upon appointment in 1908, observers sense continuation of Koch's hawkish leanings and praise his alignment with de facto real bills doctrine: "by and large following Koch's policies, namely regarding discount policies…and the cleansing of bill portfolios [of the Reichsbank] of bills unrelated to trade" Berliner-Handels-und-Tageblatt (1908, 11 – E.A.); Humphrey (1982, 12 – E.P.) also notes underlying real bills convictions leading to money expansion. Post-war dovish shift, by 1920 "fully rejects FX stabilizations … his fiscal policy amounted to nothing but a tolerance of the inflation machinery" (Berliner Tageblatt 1923); Havenstein fully "abandons opposition to the Reich's inflationary fiscal policy", "partial adoption of balance of payments theories", "shifts towards quantity theory", (Holtfrerich (1986, 166ff. – E.P.), Holtfrerich (1988, E.P.)).
H. Luther	1930 to 1932	**Hawk**	*One ex-ante, two ex-post sources:* NYHT (1930 – E.A.); Close confidante of Bruening – supports deflation policy and Mark stabilization, but pragmatic attitude during banking crisis; Luther supports comparatively hawkish policies during hyperinflation as Cabinet minister, but during 1926 recession turns into advocate of deficit spending Clingan (2010, 41ff., 77ff. – E.P.); on economic and monetary matters, intellectually influenced by Gustav Schmoller and Hans Preuss, pushes hawkish credit policies and deflationary fiscal consolidation as finance minister together with Schacht from October 1923, and is strong advocate of Bruening's deflation policies from 1929, see Born (1987, 545ff. – E.P.).
J.-C. Trichet	2004 to 2011	**Dove**	See above.
		Italy	

C. Bombrini	1870-1882	**Dove**	*One ex-ante, one ex-post source:* Between 1861-1882 director of Banca Nazionale: supports controversial state financing via fiat money during first war of independence, against many opponents, and despite inflationary dangers Calzaverini (1969, E.P.). Sponsors bill for abolition of "forced currency exchange" to better aid liquidity and bank groups ("Consorzio") as early as 1881, see Bombrini (1881, E.A.).
G. Grillo	1882 to 1894	**Dove**	*Three ex-post sources:* Between 1882-1893 director of Banca Nazionale (de facto CB), Bocci (2002, E.P.) – at first supportive of highly expansionary fiscal policies of Agostino Magliani, and general acceleration of public note issuance – concerned about unification of Italian note supply; later opposes Crispi government and Treasury in their attempt to enact monetary easing and threaten independence of BdI, see Barone (1997, 70 – E.P.); contemporaries criticize too liberal lending bias at Banca Nazionale, supporting struggling banks (inc. Banca Romana) as early as October 1885, see Colajanni (1893, 359ff. – E.P.).
B. Stringher	1900 to 1930	**Dove**	*Three ex-post sources:* Supports progressive social legislation during 1880s, including rights to strike, influenced strongly by "mentor" Luigi Luzzatti who abolishes bank clearing system and founds popular (credit expansionary) banks, see Segreto (2019, E.P.); later repeatedly opposes demands from Treasury for more deflationary action, supports Lira devaluation and freely meeting private credit demand – however, supports more banking regulation and hestitant on BdI interventions during 1907, see Bonelli (1982, E.P.); Stringher (1993, E.P.);

C.A. Ciampi	1980 to 1992	**Dove**	*Three ex-post sources:* Considered politically center-left, generally pro-expansionary attitudes, though he leads bank "divorce" from Treasury and previous purchase obligations; amid global inflation of 1980s, focus on price/monetary stability, but less aggressive than committed monetarists Signorini (2018, 7f. – E.P.); Savona (2016, E.P.) argues that Ciampi departs from Keynesianism initially, espousing more monetarist views, only to later oppose deflationary impulses; Kuttner and Posen (2010, 357 – E.P.) measure dovish market reaction (FX depreciates upon announcement, bond yields tighten upon departure).
J.-C. Trichet	2004 to 2011	**Dove**	See above.
M. Draghi	2012 to 2019	**Dove**	See above.
		Japan	
Y. Shigetoshi	1882 to 1887	**Hawk**	*Three ex-post sources:* De facto policy is made by Treasury under Matsukata – who pursues deflationary policy, with Shigetoshi intellectually in agreement – hands-off LLR approach in initial BoJ period, but focus on general market liquidity provision, see Sims (2001, 57ff. – E.P.); Shizume (2017, 9ff. – E.P.) Ericson (2020, 88 – E.P.).
K. Koichiro	1890 to 1896	**Dove**	*Three ex-post sources:* Long career in Mitsubishi conglomerate - "the personification of feudal morality" prior to BoJ appointment, but favorable treatment of business concerns and zaibatsu cooperation throughout tenure, initiates cross-stock holdings from BoJ and personally, see Wray (1984, 26, 240, 487 – E.P.), Shizume (2017, 9ff. – E.P.), Ericson (2019, 100 – E.P.).
T. Yamamoto	1899 to 1903	**Hawk**	*One ex-ante, one ex-post source:* Prolonged resistance of BoJ against higher fiscal deficits, until Yamamoto removed – Yamamoto speaks out repeatedly against government debt policies, opposing raising of foreign loans, and supporting fiscal consolidation (i.e. speech on November 18, 1902, via Yamamoto (1902, 417f. – E.A.); background in Mitsubishi bank conglomerate; Sims (2001, 101 – E.P.): "much too orthodox for Seiyukai party ... determined to take even tougher measures to restore financial soundness than the previous cabinet".

S. Matsuo	1904 to 1910	**Hawk**	*One ex-ante, two ex-post sources:* Matsuo as traditional Imperialist, supporting Emperor during Restoration struggles. Refuses to stimulate markets during 1903-4 recession, "reserved" and "cautious" attitude in view of observers, "[BoJ] could not but conform to situation...general tendency was in the direction of decrease [of advances to money market]" Chronicle (1904, 222 – E.A.). Energetic (fiscally restrictive) reforms in Treasury, incl. debt consolidation, establishments of reserve funds, balanced budgets, see Matsuo (1911, 20f. – E.P.); B. Magazine (1911, 642ff. – E.P.).
J. Inoue	1919 to 1923	**Hawk**	*Five ex-post sources:* NYHT (1932 – E.P.); Member of liberal Minseito party, member of liberal-moderate Hamaguchi cabinet; warnings from early 1920s about moral hazard and need for banking restraint in the face of emerging asset price bubble, see speech of January 27, 1920, via Shizume (2018, 134 – E.P.); clear advocate for high interest rates to fight inflation during 1920s, and advocate for classical gold standard return, repeatedly opposing expansionary Treasury, see Hanawa and Ogawa (1985, 35ff. – E.P.) and Shizume (2002, 83 – E.P.); further confirmation via Eichengreen (1992, 308 – E.P.) and End (2019, 250);
J. Inoue	1927 to 1928	**Hawk**	See above.
Y. Mieno	1989 to 1994	**Hawk**	*Two ex-ante, two ex-post sources:* Aggressive tightening policy from beginning of term ("Mieno shock", early 1990), public rows with Finance minister over hawkish interest rate turn from February 1990, with public view to deflate asset bubbles, defend currency, limit inflation, see T. S. Times (1990, D3 – E.A.), FT (1990, 8 – E.A.); But initially FX depreciation upon announcement in Kuttner and Posen (2010, E.P.); Ommeren and Piccillo (2021, E.P.).
Y. Matsushita	1995 to 1998	**Dove**	*Two ex-post sources:* Werner (2003, 143ff. – E.P.) claims that Matsushita was not de facto in charge – left in the dark about credit creation policies by BoJ staff – though he consents to features of easy money strategies. Repeatedly full public prioritization of "price stability" over growth or employment goals, but against context of deflationary tendencies, see also Friedman (2002, 10 – E.P.).

M. Hayami	1998 to 2002	**Hawk**	*One ex-ante, two ex-post sources:* Markets at first react dovishly to announcement, see Kuttner and Posen (2010, 357 – E.P.); but increasingly defensive policy in light of deflation, publicly doubtful on QE, see Heckel (2014, 272ff. – E.P.); by late 1999, repeated public warnings about "moral hazard" resulting from BoJ liquidity provisions WSJ (1999, 6 – E.A.);
		Netherlands	
N. van den Berg	1891 to 1912	**Hawk**	*Two ex-post sources:* Berg as skeptic of silver standard arrangements, devotes extensive publications to Dutch colonial finance, and as head of Java Bank at times he argues for low interest rates as preferable to high dividends. Steady rise in gold dominance in Netherlands economy during his tenure, following German model. See Jong (1967, 427ff. – E.P.) and Imhülsen (1989, E.P.);
G. Vissering	1913 to 1931	**Dove**	*One ex-ante, three ex-post sources:* As head of "Zuiderzee Society" and "Vissering Commission" pushes Etatist/interventionist reclamation projects, despite formal liberal political affiliations; heads interest group during 1920s to call for "deflation of the world's balance sheet", fiscal restraint, see Vissering (1915, E.A.); in 1925, warnings against threat of deflation and "inopportune" return to gold standard arrangements (which he implements), see Vries (1989, E.P.); Feldman (1997, 315f. – E.P.); Grift (2013, 613f. – E.P.);
J.-C. Trichet	2004 to 2011	**Dove**	See above.
		Norway	
K.G. Bomhoff	1893 to 1920	**Dove**	*Three ex-post sources:* Member of economically progressive Liberal Party in 1880s: chosen over Evald Rygh because Bomhoff closer to progressive Venstre party ideology, see Lie (2020, 97f. – E.P.); though resists political influence over Norges Bank in early years gradually more lax, inflationary policies pushed by Knudsen government – Norges Bank as willing executor, see Gjedrem (2010, E.P.); further: Gram (2020, E.P.).

N. Rygg	1921 to 1946	**Hawk**	*Four ex-post sources:* Background in statistical offices, convinced of deflationary policies to return to pre-War FX parities, later criticized for "too deflationary" policies, see Jahn (1954, 51 – E.P.); pushes votes of no confidence against socialist politicians; "main executor of deflation policies", see Kutsen (1991, 57 – E.P.); further: Sjersted (1973, E.P.); Notermans (2000, 68 – E.P.);
H. Skanland	1986 to 1993	**Dove**	*Two ex-post sources:* Pragmatic anti-inflationist, supports fixed exchange rate framework Gjedrem (2010, 8f. – E.P.); however, Skanland during 1970s leads Keynesian commission advocating wage fine-tuning, widespread interventionism, Qvigstad (2010, 2f. – E.P.);
S. Gjedrem	1999 to 2010	**Dove**	*Three ex-post sources:* Expresses repeated doubts on fixed exchange rate regimes to combat financial crises – favors tighter regulation on banks and short-term capital flows, plus tight macro-pru policies regarding fin. sector, see Gjedrem (1999, E.P.); market reactions in Kuttner and Posen (2010, 358 – E.P.); Ommeren and Piccillo (2021, E.P.).
		Portugal	
A. A. Pereira de Miranda	1887 to 1891	**Dove**	*Three ex-post sources:* Repeatedly initiates pro-business legislation as member of the liberal-progressive party in Parliament, moderate-liberal views, see Silva (2010, E.P.). However, banking community still accuses him of "selfish" protection of Banco de Portugal interests Lisboa (1893, 2 – E.P.). Voices concerns about income inequality and consistently close to progressive causes: Diplomatique (1905, 1 – E.P.).
I. Camacho	1911 to 1936	**Dove**	*One ex-post source:* Clear socialist, anti-monarchist (Republican) leanings, together with wider family, position in Republican Party directory; later shift to social conservatism, liberal-conservatism, see Meneses and Sharp (2011, 29ff. – E.P.);
J.-C. Trichet	2004 to 2011	**Dove**	See above.
M. Draghi	2012 to 2019	**Dove**	See above.
		Spain	

A. R. Ortiz	1881 to 1883	**Dove**	*One ex-post source:* Liberal journalistic and literary background and engaged in anti-monarchical, anti-clerical, progressive politics and economic policies pre-1868 (incl. universal suffrage), various concurrent bureaucratic appointments pre-BdE tenure, Campo (2018, E.P.).
S. A. y Albert	1885 to 1890	**Dove**	*Two ex-post sources:* "Old moderate", loyal to Monarchy during 1868 Revolution, but progressive social policies in Cuba (incl. support to abolish slavery). Economically "free trader" spearheading liberal trade agreement with France, against much criticism from fellow conservative party members, close collaborator of liberal economic agenda developed under MinFin Camacho prior to BdE tenure. See Anon. (1890, 3 – E.P.), Montaud (2018, E.P.).
E. C. y Roffignac	1911 to 1913	**Hawk**	*Two ex-post sources:* Strongly influenced by classical economic liberalism of Smith, Say, Sismondi, Mill, and especially Leroy-Beaulieu, including non-interventionism see Pan-Montojo (2000, 174 – E.P.); supports "sanctity of balanced budgets" ["santo temor al deficit"], see Arroyo (2018, E.P.).
L. Pascual	1913 to 1916	**Hawk**	*Two ex-post sources:* PLC Conservative Party member, agrarian background, "cautious and serene" minister worried as MinFin about BoP deficits - which he tries to adjust via sharp import contractions and widespread tax hikes, irrespective of growth and unemployment effects, Jose Manuel Cuenca Toribio (2005, E.P.) and José Manuel Cuenca Toribio (2018, E.P.).
E.S. Escartin	1920 to 1920	**Dove**	*Two ex-post sources:* Intellectually indebted to "eclectic" fusion of organicism and evolutionism, as well as Italian Catholic socialists: includes supports for some state interventionism and the need for the organization of workers; on the economic side, influenced by Piernas Y Hurtado, Le Play, and Krausismo, see Sanchez (2011, E.P.); Gallego and Trincado (2020, 28 – E.P.).
C.V. Cailleaux	1924 to 1929	**Dove**	*One ex-post source:* Career bureaucrat in Finance ministry under Primo de Rivera, engaged in unsuccessful attempts to stabilize Peseta: no strong intellectual convictions, or economic ideology recorded by any biographers. General reluctance at BdE to assume LLR or other financial stability mandates, see Pastor (2018a, E.P.).

L.C. de Palma	1971 to 1976	**Dove**	*Four ex-post sources:* Mainly recognized prior to appointment as "new generation technocrat" pushing pro-business, pro-growth liberalization agenda in Spain as part of the "neoliberal clique" around Enrique Fuentes Quintana and Fabian Estape; key supporter of 1959- Stabilization Plan(s) together with Mariano Navarro Rubio, which seek to push growth but rein in on inflation, abolish budget deficits; see Lorca (1982, 69ff. – E.P.); Sanz (2006, E.P.); Atares (2008, E.P.); Pastor (2018b, E.P.).
L. De Letona	1976 to 1978	**Dove**	*Three ex-post sources:* Franco regime appointment, pro-business stance, with corporate/industrial background; hailing from same intellectual circles as predecessor Palma, supports 1959 Stabilization Plan, pushes growth program and productive efficiency improvement - repeated clear prioritization of economic expansion agenda above other variables; see Lorca (1982, 69ff. – E.P.); Sanz (2006, E.P.); Calzas (2018, E.P.).
J.-C. Trichet	2004 to 2011	**Dove**	See above.
		Sweden	
C. Lewenhaupt	1872 to 1889	**Hawk**	*One ex-post source:* Tolerant of some emergency aid, but generally strict stance against banking community, including Wallenberg/Ensklida, see Brisman (1931, 155ff. – E.P.).
K. Langenskioeld	1901 to 1911	**Dove**	*Two ex-post sources:* Models general bank organization and policy on Bank of England, Riksbank as "bank's bank"; though on the right within Riksdag, "dogmatically liberal" on various issues, deviating from party line, see Franzen (1977, E.P.); Some (mildly) interventionist banking sector convictions during 1890s, including tighter regulation of deposit rates, see Pipping (1969, 158f. – E.P.);

V. Moll	1912 to 1928	**Hawk**	*Three ex-post sources:* Early in career close to left-wing liberals around Karl Staaff, for which he drafts (progressive, unionist, anti-monarchical) financial policy; later good relations with Wicksell, and D. Davidson – but "combative" opposition to conservative economists around Gustav Cassel, see Grafvert (1985, 662 – E.P.); Riksbank pursues particularly deflationary and credit-restrictive policies, Riksbank intent to restore gold parities despite costs; see Peteri (1984, E.P.); Rongved (2017, E.P.).
I. Rooth	1929 to 1948	**Hawk**	*Three ex-post sources:* Hires some Keynesians during term for policy views, including Dag Hammarskjöld, but resists both Riksbank LLR demands (Krueger affair – only bows after severe gvt. Pressure) – and later repeated conflicts with Social Democratic government over debt financing/low interest rate policies, see Grafvert and Elgemyr (1998, 300 – E.P.); further: Straumann and Woitek (2009, E.P.); Riksbank (2010, 283ff. – E.P.).
B. Dennis	1982 to 1993	**Dove**	*One ex-ante, three ex-post sources:* Pragmatic attitude during banking crisis: lets Krona float, but introduces inflation targeting mandate; slightly dovish market reaction upon appointment, see Kuttner and Posen (2010, 358 – E.P.); see WSJ (1988 – E.A.); Canova (1994, E.P.); Ommeren and Piccillo (2021, E.P.).
S. Ingves	since 2006	**Hawk**	*One ex-ante, two ex-post sources:* Hawkish market reaction upon appointment via Kuttner and Posen (2010, 358 – E.P.); Eijffinger, Mahieu, and Raes (2013, E.P.); however, during 1990s, Ingves gives strong public support to large-scale government assistance for banking sector, including controversial aid for Nordbanken and Gota, FT (1994, 32 – E.A.).
		Switzerland	
H. Kundert	1907 to 1915	**Hawk**	*Three ex-post sources:* Long service in Cantonal banks pre-appointment; supports Real Bills doctrine, clear focus on price stability: inaugural speech in 1907 scorns build-up of "non-trade-related discount portfolio" at public banks, promises "relentless cleansing" to focus on trade bills only, via Bachmann, Wartensee, and Weber (1932, 74f. – E.P.); Baltensperger and Kugler (2017, 48 – E.P.); NZZ (1924, 1 – E.P.);

A. Burckhardt	1916 to 1924	**Hawk**	*Two ex-post sources:* Burckhardt, as protégé of Kundert, closely shares convictions, including Real Bills Doctrine, see Bachmann, Wartensee, and Weber (1932, 449f. – E.P.); "pursues hard anti-inflationist course", Gerber (1934, E.P.);
G. Bachmann	1926 to 1938	**Hawk**	*Two ex-ante, two ex-post sources:* Intellectually influenced in 1910s and 1920s by Conrad Cramer-Frey, liberal but etatist economist and politician, see NZZ (1947, 5 – E.P.); Consistently opposed to CHF devaluation after British gold standard exit, with FX stability as primary mandate; repeated public interventions opposing Franc devaluation see Bachmann (1934, E.A.); Katona (1934, 6 – E.A.); Bordo, Helbling, and James (2006, 14 – E.P.).
M. Lusser	1988 to 1995	**Hawk**	*One ex-ante, three ex-post sources:* Widely considered a monetarist – closely advised by monetarist Karl Brunner, see Furstenberg and Ulan (1998, 135ff. – E.P.); Rich (2007, E.P.); in 1988, Lusser prevails against Switzerland joining EMS for fears of losing FX autonomy, threats to price stability primacy, embodying consensus on conservative and tight money principles FT (1988, 14 – E.A.); Kuttner and Posen (2010, 358 – E.P.) measure slightly dovish market reaction, incl. FX depreciation;
J.-P. Roth	2001 to 2009	**Dove**	*Two ex-ante, two ex-post sources:* In early 2000s, Roth's policy actions largely can be rationalized in standard macro reaction functions given business cycle, see Ohyama and Tanigawa (2006, E.P.); in January 2007, at Davos meeting, Roth warns of "speculative bubbles" in financial markets, will steer against exuberance NZZ (2007, 35 – E.A.); Aggressive policy easing in response to crisis, some (undue) concern about inflation 2009ff.; FT (2004 – E.A.); mixed market reaction upon inauguration documented in Kuttner and Posen (2010, 358 – E.P.).
		United Kingdom	
E. H. Palmer	1878 to 1879	**Dove**	*Two ex-post sources:* Very scarce evidence on Palmer himself in Clapham (1958, E.P.) or Kynaston (2017, 201ff. – E.P.), but BoE de facto engaging in supportive policies during 1878 crisis ("Bagehot would have approved", see Kynaston (2017, 211f. – E.P.);

W. Lidderdale	1889 to 1892	**Hawk**	*One ex-ante, two ex-post sources:* Praised across the bench for pragmatic stance during Barings crisis Clapham (1958, 328ff. – E.P.); FT (January 1, 1891 – E.A.): "a more retiring man never held the governorship" and "a public speech is his abomination"; career background in commerce and merchant banking (Rathbone Bros & Co.); but intellectually opposes Bagehot, see Kynaston (2017, 207 – E.P.);
W. Cunliffe	1913 to 1918	**Dove**	*One ex-ante, two ex-post sources:* Close co-operation with Treasury from early states of war, assists in freezing "enemy banks", backs supporting businesses in "temporary insolvency" Bankers-Magazine (1917, E.A.); . Often in agreement with Keynes, but generally in 1914 "he had neither the sort of experience nor the intellectual power which would have helped him to judge what really was happening...all measures were marked by practical sense" Economic-Journal (1920, 130 – E.P.). Increasingly submits to Treasury under Bonar Law as War progresses, see Sayers (1976, I, 79ff. – E.P.).
G. Richardson	1973 to 1982	**Dove**	*Two ex-ante, one ex-post sources:* 'Pragmatic' monetarist, who supports adaptable targets, flexibility, see Richardson (1978, E.A.) and Bareau (1978, 46f. – E.A.), but not "undiluted, pure, monetarism"; mildly pro-inflationary; Independent (2010): "flirting with monetarism", but ultimately rejecting policies as "too tight", "pragmatist"; see further Loehnis (2010 – E.P.).

R. Leigh-Pemberton	1983 to 1993	**Dove**	*One ex-ante, three ex-post sources:* Strongly dovish market reaction upon appointment, see Kuttner and Posen (2010, 358 – E.P.); Generally approves of central bank liquidity interventions during crises, explicitly in 1989, "It has been recognized since at least the nineteenth century that the macroeconomic goals of price and exchange rate stability can be undermined if the financial system is unstable. For this reason, all central banks have developed ways of channelling liquidity to the banking system in periods of pressure and the arrangements for the prudential supervision of individual firms have been progressively strengthened. I imagine most of us could agree, at least in broad terms, on these goals", via Leigh-Pemberton (1989, E.A.); Conservative party member, but pragmatist supporting EMU accession for Britain, see: Guardian (2013 – E.P.), further Ommeren and Piccillo (2021, E.P.).
M. King	2003 to 2013	**Hawk**	*One ex-ante, three ex-post sources:* Tends to be seen as pro-Conservative; The Standard (2010 – E.P.) – "hawkish pre-crisis, dovish since the crisis"; hawkish market reaction upon appointment, see Kuttner and Posen (2010, 358 – E.P.); equally, Ommeren and Piccillo (2021, E.P.). Generally approves of government interventions during crises, including Asian LLR responses during 1990s crises, "From time to time, there may well be financial crises when it would be appropriate for the international community to provide temporary financial assistance to mitigate the costs of sharp adjustment in trade flows and output. But such a role should not be the principal focus of international monetary co-operation", King (2006, E.A.).
		United States	

E. Meyer	1930 to 1933	**Hawk**	*Three ex-post sources:* Nuanced context in Meltzer (2005, E.P.) – Meyer subscribes to Riefler-Burgess doctrine and real bills framework – sides with hawkish real bills majority within committee including McDougal, Norris, Young: Ben Strong and over-expansionary policies in late 1920s – "the New York bank had built up its power entirely out of proportion with the intent of the [Federal Reserve] Act" (ibid., 409); Eichengreen (1992, 297f. – E.P.) confirms hawkish leaning; however, Butkiewicz (2013, E.P.) suggests intellectual influence of Adolph Wagner and German state interventionism;
P. Volcker	1979 to 1987	**Hawk**	*Two ex-post sources:* Kuttner and Posen (2010, 358 – E.P.) record clear hawkish market reaction upon announcement; by early 1979 (pre-appointment), Volcker fundamentally at odds with Miller Fed, pushing for more aggressive action on inflation, rejects notions that policy is "tight" already, see Goodfriend and King (2005, 994f. – E.P.).
A. Greenspan	1988 to 2005	**Dove**	*Three ex-ante, two ex-post sources:* Pro-business/deregulation, but usually associated with dovish or neutral leanings, see Bordo and Istrefi (2023, E.P.); Clear USD depreciation upon announcement, coupled with sizable yield widening (27bps), see Kuttner and Posen (2010, 358 – E.P.); however, various hawkish statements with regards to LLR and bailout policies, including Greenspan (1999, E.A.) and Greenspan (2002, E.A.) – "Alan Greenspan, chairman of the Federal Reserve, warned nervous markets that they shouldn't count on a Fed bailout if recent financial turbulence intensifies. "We must be careful not to foster an expectation that policy makers will ultimately solve all serious potential problems and disruptions," Mr. Greenspan said in a speech at a Chicago banking conference" (WSJ, May 5, 2000).

B. Bernanke	2006 to 2013	**Dove**	*One ex-ante, two ex-post sources:* Kaletsky (2014, via Reuters – E.P.) – "Bernanke, despite his radicalism during the financial crisis, was philosophically an orthodox monetarist, who followed his mentor Milton Friedman in believing that the main job of a central bank is to stabilize inflation"; Anna Schwartz, via Sorman (2009, E.A.), disputes that Bernanke policy is "monetarist"; 2004 "Bernanke doctrine" warns of deflation; though not consistent pre-2008, on balance seen as dovish, see (Bordo and Istrefi, 2023); slightly dovish market reaction via Kuttner and Posen (2010, 358 – E.P.);

Appendix Governor References

Aldrich, Nelson W. 1908. *Interviews on the banking and currency systems of England, France, Germany, Switzerland and Italy, National Monetary Commission.* GPO.

Anon. 1890. “D. Salvador Albacete.” *El Liberal* 12 (4067): 3.

Arendt, Otto. 1895. *Herr Reichsbankpraesident Dr. Koch und die Waehrungsfrage. Eine Antwort auf die Herrenhausrede des Herren Dr. Koch vom 16. Mai 1895.* Hermann Walther.

Arroyo, Fausto Dopico Gutierrez del. 2018. “Eduardo Cobian y Raffignac.” In *Diccionario Biografico Electronico - DBE.* Real Academia de la Historia.

Atares, M.L. 2008. “50 Aniversario 1958-2008. Cincuenta Grandes Nombres. 14. 1971 Luis Coronel de Palma / Jose R. Álvarez Rendueles. Gobernadores del Banco de España.” *Actualidad Economica.*

Australia, The Age. 1989. *Bank failed to redress inflation, head claims.* The Age Google News Archive, July 17, 1989, p.3.

Bachmann, Gottlieb. 1934. “Why Switzerland Must and Will remain on the gold standard.” *Amerikanisch-Schweizerische Zeitung.*

Bachmann, Gottlied, Charles Schnyder von Wartensee, and Ernst Weber. 1932. *Die Schweizerische Nationalbank, 1907-1932.* Berichthaus Zuerich.

Baltensperger, Ernst, and Peter Kugler. 2017. *Swiss Monetary History since the early 19th Century.* Cambridge University Press.

Bankers-Magazine. 1917. “Lord Cunliffe of Headley, Governor of the Bank of England.” 95 (4): 456–60.

Bareau, Paul. 1978. “The Governor on ’Practical Monetarism’.” *Journal of the Institute of Bankers* 99: 46–47.

Barone, Giuseppe. 1997. “La nascita della Banca d’Italia.” *Meridiana* 29: 55–72.

Berliner-Handels-und-Tageblatt. 1908. *Geldmarkt und Banken: Excellenz Havenstein.* Deutsches Zeitungsportal Digitalisat, August 26, 1908, p.11.

Blancheton, Bertrand. 2014. “L’autonomie de la Banque de France de la Grande Guerre a la loi du 4 aout 1993.” *Revue d’economie financiere* 113 (1): 157–78.

Bocci, Marco. 2002. “Grillo, Giacomo.” In *Dizionario Biografico degli Italiani.* Istituto della Enciclopedia Italiana.

Bonelli, Franco. 1982. “The 1907 Financial Crisis in Italy: a peculiar case of the Lender of Last Resort in Action.” In *Financial Crises - theory, history, and policy,* edited by Charles P. Kindleberger and Jean-Pierre Laffargue, 51–66. Cambridge University Press.

Bopp, Karl R. 1954. “Die Tätigkeit der Reichsbank von 1876-1914. II/II.” *Weltwirtschaftliches Archiv* 72: 179–224.

Bordo, Michael D., Thomas Helbling, and Harold James. 2006. “Swiss exchange rate policy in the 1930s. Was the delay in devaluation too high a price to pay for conservatism?” *NBER Working Paper,* no. 24650, 1–37.

Börsen-Zeitung, Berliner. 1903. Deutsches Zeitungsportal Digitalisat, October 31, 1903, Abend Ausgabe, p.1.

Bouvier, Jean. 1988. “The Banque de France and the State from 1850 to the present day.” In *Central Banks’ Independence in Historical Perspective,* edited by Fausto Vicarelli, Richard Sylla, Alec Cairncross, Jean Bouvier, Carl-Ludwig Holtfrerich, Giangiacomo Nardozzi, and Gianni Toniolo. De Gruyter.

Brisman, Sven. 1931. *Sverige’s Riksbank 1668-1918. Vol. IV: Den stora reformperiode, 1860-1904.* Norstedt.

Butkiewicz, James L. 2013. “Eugene Meyer and the German Influence on the Origin of U.S. Financial Rescues.” *University of Delaware Economics Working Paper,* no. 9, 1–40.

Buyst, Erik. 2012. “Why was Belgium so late in adopting Keynesian ideas and devising regional development policies?” *Leuven Vives Working Paper,* no. 27, 1–18.

Buyst, Erik, and Ivo Maes. 2008. “Central banking in nineteenth-century Belgium: was the NBB a lender of last resort?” *Financial History Review* 15 (2): 153–73.

Buyst, Erik, Ivo Maes, and Walter Pluym. 2005. *The Bank, the Franc and the Euro. A history of the National Bank of Belgium.* Tielt Lannoo.

Calzas, Roi Velasco. 2018. “José María López de Letona Núñez del Pino.” In *Diccionario Biografico Electronico - DBE.* Real Academia de la Historia.

Calzaverini, Mirella. 1969. “Bombrini, Carlo.” In *Dizionario Biografico degli Italiani, Vol.11.* Instituto della Enciclopedia Italiana.

Campo, José Priego Fernández del. 2018. “Antonio Romero-Ortiz García.” In *Diccionario Biografico Electronico - DBE.* Real Academia de la Historia.

Canova, Timothy A. 1994. “The Swedish Model Betrayed.” *Challenge* 37 (3): 36–40.

Chodos, Robert. 1977. “The silent revolution at the Bank of Canada. How Gerald Bouey-you’ll find his name on the dollar bill-achieved quietly what James Coyne failed to do noisily.” *Canadian Business* 50 (11): 41–44, 84–92.

Chronicle, Japan. 1904. *Trade and Commerce, February 25, 1904.* Via Gale, February 25, 1904.

Clapham, John. 1958. *The Bank of England - A History. Vol. II: 1797-1914.* Cambridge University Press.

Clingan, Edmund. 2010. *The Lives of Hans Luther, 1879 - 1962: German Chancellor, Reichsbank President, and Hitler’s Ambassador.* Lexington.

Crow, John. 2009. “Canada’s Difficult Experience in Reducing Inflation: a cautionary tale.” *C.D. Howe Institute Commentary,* no. 299, 1–14.

Diplomatique, Revue. 1905. *Son Exc. M. Le Conseiller Antonio A. Pereira de Miranda Ministre de L’intérieur du Portugal.* Via Gale, March 12, 1905.

Drainville, Andre C. 1995. “Monetarism in Canada and the World Economy.” 46 (1): 7–42.

Dybdahl, Vagn. 1979. “Bramsnaes, Carl Valdemar.” In *Dansk Biografisk Leksikon: Bering-Bruel,* 445–47. Gyldendalske Boghandel, Nordisk Forlag.

Economic-Journal. 1920. “Obituary: Lord Cunliffe.” *Economic Journal* XXX (117): 128–31.

Eichengreen, Barry. 1992. *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939.* Oxford University Press.

Eijffinger, Sylvester, Ronald Mahieu, and Louis Raes. 2013. “Estimating the Preferences of Central Bankers: An Analysis of Four Voting Records.” *CEPR Working Paper,* no. DP9602.

Einaudi, Luca. 2001. *Money and Politics: European Monetary Unification and the International Gold Standard.* Oxford University Press.

End, Nicolas. 2019. “Japan during the interwar period: from monetary restraint to fiscal abandon.” In *Debt and Entanglements between the Wars,* edited by Era Dabla-Norris. IMF Publications.

Ericson, Steven J. 2019. *Financial Stabilization in Meiji Japan.* Cornell University Press.

Ericson, Steven J. 2020. *Financial Stabilization in Meiji Japan: The Impact of the Matsukata Reform.* Cornell University Press.

Eschweiler, Bernhard. 1993. *Rules and central bank independence in German monetary history.* Rutgers University Dissertation.

Feldman, Gerald D. 1997. *The Great Disorder: Politics, Economics, and Society in the German Inflation, 1914-1924.* Oxford University Press.

Financial Times. 1935. … Financial Times Historical Archive.

Franzen, Olle. 1977. “B Carl (Karl) J Langenskioeld.” In *Svenskt biografiskt lexikon (SBL), Vol. 22,* 251. Riksarkivets.

Friedman, Benjamin M. 2002. “The Use and Meaning of Words in Central Banking: Inflation Targeting, Credibility, and Transparency.” *NBER Working Paper,* no. 8972.

FT. 1984. *Independent Institution.* Via Gale, May 22, 1984, p.33.

FT. 1988. *The Fundamentals Are Sound.* Via Gale, December 19, 1988.

FT. 1990. *The Curtain Falls on the Era of the Triple Merits.* Via Proquest, February 24, 1990.

FT. 1994. *Being Punished for Prudence.* Via Gale, March 17, 1994, p.32.

FT. 2007. *Bank chief blasts Danish policy.* Via Gale, August 30, 2007, p.2.

Furstenberg, George M., and Michael K. Ulan. 1998. "Switzerland's Lusser: price stability to bank on." In *Learning from the world's best central bankers,* edited by George M. Furstenberg and Michael K. Ulan. Springer.

Gallego, Elena, and Estrella Trincado. 2020. "Debates on development in the Spanish economy, 1848-1960." In *Ideas in the History of Economic Development: the case of peripheral countries,* edited by Estrella Trincado, Andres Lazzarini, and Denis Melnik, 22–40. Routledge.

Gejl, Ib, and Jens Vestberg. 1981. "Levy, Moritz." In *Dansk Biografisk Leksikon, Vol.9,* 24–25. Gyldendalske Boghandel.

Gerber, Therese Steffen. 1934. "Burckhardt, August." In *Historisches Lexikon der Schweiz.*

Giblin, Lyndhurst F. 1951. *The growth of a central bank; the development of the Commonwealth Bank of Australia, 1924-1945.* Melbourne University Press.

Gjedrem, Svejn. 1999. "Politikk eg marked i del internasjonale finansieile systemet – Sentraibanksjef Svein Gjedrems foredrag pa Johan Throne Holst-konferansen pa Bl 3. juni 1999." *Internasional Politikk* 57 (4): 551–61.

Gjedrem, Svejn. 2010. "Making use of a central bank." *BIS Review* 154: 1–17.

Gonjo, Yasuo. 1996. "La modernisation de la Banque de France (1930-1946)." *Etudes et Documents* 8: 281–356.

Goodfriend, Marvin, and Richard King. 2005. "The incredible Volcker disinflation." *Journal of Monetary Economics* 52: 981–1015.

Grafvert, Bjoern. 1985. "Victor L Moll." In *Svenskt biografiskt lexikon (SBL), Vol. 25,* 662. Riksarkivets.

Grafvert, Bjoern, and Goeran Elgemyr. 1998. "Ivar Rooth." In *Svenskt biografiskt lexikon (SBL), Vol. 30,* 368. Riksarkivets.

Gram, Trond. 2020. "Karl Gerther Bomhoff." In *Store Norske Leksikon.* Online Version, snl.no/karl_gerther_bomhoff accessed June 2, 2021.

Grenville, Stephen. 1997. "The Evolution of Monetary Policy: From Money Targets to Inflation Targets." In *Monetary Policy and Inflation Targeting. Proceedings of a Conference, 1997.* Edited by Philip Lowe, 125–59. Alken Press.

Grift, Liesbeth van de. 2013. "On New Land a New Society: Internal Colonization in the Netherlands, 1918-1940." *Contemporary European History* 22 (4): 609–26.

Hanawa, Toshiya, and Eiji Ogawa. 1985. "Taisho era controversies over currency and banking principles." 20: 21–47.

Hart, Peter. 1969. "Lyons: Labor Minister: Leader of the U.A.P." *Labor History* 17: 37–51.

Heckel, Markus. 2014. *The Bank of Japan – Institutional Issues of Delegation, Central Bank Independence and Monetary Policy.* 1–532. Dissertation, University of Duisburg-Essen.

Hentenryck, Ginette Kurgan-van. 1984. "Rail, finance et politique en Hainaut au 19e siècle." *Les cahiers de Mariemont* 15: 29–36.

Holtfrerich, Carl-Ludwig. 1986. *The German inflation 1914-1923: causes and effects in international perspective.* De Gruyter.

Holtfrerich, Carl-Ludwig. 1988. "Relations between Monetary Authorities and Governmental Institutions: The Case of Germany from the 19th Century to the Present." In *Central banks' independence in historical perspective,* edited by Gianni Toniolo. De Gruyter.

Humphrey, Thomas. 1982. "The Real Bills Doctrine." *Federal Reserve Bank of Richmond Quarterly Review* 68 (5): 3–13.

Hymans, Louis. 1880. *Histoire Parlementaire de la Belgique de 1831 a 1880.* Bruylant Christophere & Co.

Jahn, Gunnar. 1954. "Rygg, Nicolai Theodorius Nilssen." In *Norsk Biografisk Leksikon, Vol.12,* edited by Einar Jansen and Paulus Svendsen, 47–54. H. Aschehoug & Co.

Janssens, Valery. 1997. "Theophile de Lantsheere (1905-1918)." In *De Beheerders van ons Geld,* 65–78. Lannoo.

Jong, Adriaan M. De. 1967. *Geschiedenis van De Nederlandsche Bank, III.* J. Enschede.

Jonung, Lars, Jaakko Kiander, and Pentti Vartia. 2009. "The great financial crisis in Finland and Sweden: the dynamics of boom, bust and recovery 1985-2000." In *The Great Financial Crisis in Finland and Sweden: The Nordic Experience of Financial Liberalization,* edited by Lars Jonung, Jaakko Kiander, and Pentti Vartia, 19–70. Edward Elgar.

Katona, George M. 1934. "Swiss Franc in Danger? Internal Considerations versus Adherence to the Gold Block." In *May 7, 1934,* 6. Barron's.

Kauch, Pierre. 1954a. "Alexandre Jamar: quatrieme gouvernor de la Banque Nationale de Belgique, 1821-1888." *Revue du personnel de la Banque Nationale de Belgique* 10 (11): 3–14.

Kauch, Pierre. 1954b. "Eugene Previnaire. Deuxieme governeur de la Banque de Belgique." *Revue du personnel de la Banque Nationale de Belgique* 10 (4): 3–15.

Kauch, Pierre. 1957. "Théophile de Lantsheere: septième gouverneur de la Banque Nationale de Belgique (1833-1918)." *Revue du personnel de la Banque Nationale de Belgique* 13 (2): 3–14.

King, Mervyn. 2006. "Speech by Mr Mervyn King, Governor of the Bank of England, at the Indian Council for Research on International Economic Relations (ICRIER), New Delhi, 20 February 2006."

Kivimaeki, T.M. 1943. "Risto Ryti." *Zeitschrift für Politik* 33 (4-5): 273–78.

Klemann, Hein, and Sergei Kudryashov. 2012. *Occupied Economies. An Economic History of Nazi-occupied Europe, 1939-1945.* Berg Verlag.

Kuttner, Kenneth D., and Adam S. Posen. 2010. "Do Markets Care Who Chairs the Central Bank?" *Journal of Money, Credit, and Banking* 42 (2-3): 347–71.

Kuusterae, Antti, and Juha Tarkka. 2011. *The Bank of Finland, 200 years. 2 Vols.* Otava.

Kynaston, David. 2017. *Till Time's Last Sand. A history of the Bank of England.* Bloomsbury.

Leigh-Pemberton, Robin. 1989. "Europe 1992: Some Monetary Policy Issues. Speech at Jackson Hole, August 30, 1989."

Lie, Einar. 2020. *Norges Bank, 1816-2016.* Oxford University Press.

Lisboa, A Semana de. 1893. *Antonio Augusto Pereira de Miranda.* October 29, 1893.

Lorca, Pedro Tedde de. 1982. "El Banco de España desde 1892 a 1982." In *El Banco de España : dos siglos de historia, 1782-1982,* edited by Jose Maria Vinuela, 17–74.

Magazine, Banker's. 1911. "Asiatic: The Governor of the Bank of Japan." *Banker's Magazine* 83 (5): 642–45.

Marcussen, Martin, and Mette Zoelner. n.d. "Monetarism and the masses: Denmark and economic integration in Europe." *Cooperation and Conflict* 38 (2): 101–23.

Margairaz, Michel. 1991. *L'État, les finances et l'économie. Histoire d'une conversion 1932-1952. Volume I.* Institut de la gestion publique et du développement économique.

Matsuo, Shigeyoshi. 1911. "The Banking Year 1910 in Japan." *Market World and Chronicle* 13 (1): 20–21.

McGinn, Daniel, and Richard Wolffe. 2005. "A New Money Man. Ben Bernanke has a tough act to follow as Fed Chairman." *Newsweek* 169 (19): 54–55.

Meneses, Filipe Ribeiro de, and Alan Sharp. 2011. *Alfonso Costa: Portugal.* Haus Publishing.

Moll, Victor. 1917. "Riksbanken och dyrtiden." *Ekonomisk Tidskrift* 19 (7): 269–79.

Monballyu, Jos. 2014. *Six Centuries of Criminal Law. History of Criminal Law in the Southern Netherlands and Belgium (1400-2000.* Brill.

Monde, Le. 1997. *Jean-Claude Trichet juge « impensable » la non-réduction des déficits…* Via Proquest, June 25, 1997, p.18.

Montaud, Inés Roldán de. 2018. "Salvador de Albacete y Albert." In *Diccionario Biografico Electronico - DBE.* Real Academia de la Historia.

Moure, Kenneth. 1988. ""Une Eventualité Absolument Exclue": French Reluctance to Devalue, 1933-1936." *French Historical Studies* 15 (3): 479–505.

Moure, Kenneth. 1991. *Managing the Franc Poincare: Economic Understanding and Political Constraint in French Monetary Policy, 1928-1936.* Cambridge University Press.

Notermans, Ton. 2000. *Money, Markets, and the State: Social Democratic Policies since 1918.* Cambridge University Press.

NZZ. 1924. *Heinrich Kundert.* Via ENA, February 19, 1924, p.1.

NZZ. 1947. *Zur Erinnerung an Prof. Gottlieb Bachmann.* Via ENA, December 13, 1947, p.5.

NZZ. 2007. *SNB-Präsident Roth warnt vor Börsen-Übertreibungen.* Via NexisUni, January 27, 2007, p.35.

Ohyama, Shinsuke, and Junko Tanigawa. 2006. "Monetary policy conduct of the Swiss National Bank: the experience from 2001 to 2004." *Bank of Japan Working Paper Series,* no. 06E09.

Ommeren, Emile van, and Guilia Piccillo. 2021. "The Central Bank Governor and Interest Rate Setting by Committee." *CESifo Economic Studies* 67 (2): 155–85.

Ortiz-Serrano, Miguel Angel. 2018. "Political connections and stock returns: evidence from the Boulangist campaign, 1888–1889." *Financial History Review* 25 (3): 323–56.

Pan-Montojo, Juan Luis. 2000. "Eduardo Cobian Y Raffignac: la transaccion como politica." In *La Hacienda desde sus ministros del 98 a la guerra civil,* 163–220. Prensas Universitarias.

Pastor, Paloma Gomez. 2018a. "Carlos Vergara Cailleaux." In *Diccionario Biografico Electronico - DBE.* Real Academia de la Historia.

Pastor, Paloma Gomez. 2018b. "Luis Coronel de Palma." In *Diccionario Biografico Electronico - DBE.* Real Academia de la Historia.

Pecorari, Paolo, and Pierluigi Ballini. 2006. "Luzzatti, Luigi." In *Dizionario Biografico degli Italiani, Vol.66.* Istituto della Enciclopedia Italiana.

Peteri, Gyoergi. 1984. "The inflation-proof gold standard. The foreign policy of Riksbankchefen. Victor Moll and the origin of the Swedish Bank on gold imports in 1924." *Journal of European Economic History* 3: 635–64.

Pipping, Hugo E. 1969. *I Guldmyntfotens hang. Finlands Bank 1878 – 1914.* Helsingfors.

Plenge, Johann. 1913. *Von der Diskontpolitik zur Herrschaft über den Geldmarkt.* Springer.

Plessis, Alain. 1985. *Régents et gouverneurs de la Banque de France sous le Second Empire.* Librairie Droz Geneve.

Qvigstad, Jan F. 2010. "On Transparency." In *On Transparency,* edited by Oyvind Eitrheim and Bjarne Gulbrandsen, 1–14. Bank of Norway Occasional Paper Series.

Rich, Georg. 2007. "Swiss Monetary Targeting 1974–1996: The Role of Internal Policy Analysis." *Schweizerische Zeitschrift für Volkswirtschaft und Statistik* 143 (3): 283–329.

Richardson, Gordon. 1978. *Reflections on the conduct of monetary policy.* Mais Lecture at City University London, February 9, 1978.

Robert, Adolphe, Edgar Bourloton, and Gaston Cougny. 1891. *Dictionnaire des parlementaires français, Tome 4: LAV-PLA.* Bourloton.

Rongved, Gjermund Forfang. 2017. "The Gold War: the dissolution of the Scandinavian Currency Union during the First World War." *Scandinavian Economic History Review* 65 (3): 243–62.

Ryti, Risto. 1936. "The Bank of Finland. Characteristics and Aims of Its Activities. Address delivered on the occasion of the Bank's 125th Anniversary." *Bank of Finland Monthly Bulletin* 16 (12): 22–25.

Sanchez, Carlos Campo. 2011. "Eduardo Sanz Y Escartin: El reformismo de un Catolico conservador." *Miscelanea Comillas. Revista de Ciencias Humanas y Sociales* 69 (134).

Sanz, Jose M. Serrano. 2006. "La internacionalización financiera española: de la peseta al euro, 1962-2005." In *150 años del Banco de España,* edited by Pablo Martin-Acena, 165–72. Banco de Espana Publications.

Savona, Paolo. 2016. "Il modello economico di riferimento implicito nell'azione di Carlo Azeglio Ciampi da Governatore della Banca d'Italia e da Ministro del Tesoro." *Annali Fondazione Ugo La Malfa* 31: 30–42.

Sayers, R.S. 1976. *The Bank of England, 1891-1944.* Cambridge University Press.

Schybergson, Emil. 1913. *Finlands Bank, 1811-1911.* Frenckellsche Druckerei-Aktiengesellschaft.

Segreto, Luciano. 2019. "Stringher, Bonaldo." In *Dizionario Biografico degli Italiani, Vol.94.* Istituto della Enciclopedia Italiana.

Shizume, Masato. 2002. “Economic Developments and Monetary Policy Responses in Interwar Japan: Evaluation Based on the Taylor Rule.” *Bank of Japan Monetary and Economic Studies,* no. 4, 77–116.

Shizume, Masato. 2017. “A History of the Bank of Japan, 1882-2016.” *WINPEC Working Paper Series,* 1–31.

Shizume, Masato. 2018. “Financial Crises and the Central Bank: Lessons from Japan During the 1920s.” In *Coping with Financial Crises. Some lessons from Economic History,* edited by Hugh Rockoff and Isao Suto, 131–48. Springer.

Signorini, Luigi Federico. 2018. “Carlo Azeglio Signorini. Writings in the Nuova Antologia.” *Banca d’Italia Speech, 12 March 2018,* 1–13.

Sjersted, F. 1973. *Ideal, teori og virkelighet. Nicolai Rygg og pengepolitikken i 1920-arene.* Cappelen.

Soerensen, Anders Ryan. 2015. “Banking on the Nation: How Four Danish Central Bank Governors Used and Reproduced the Logics of National Identity.” *International Journal of Politics, Culture, and Society,* no. 28, 325–47.

Sorman, Guy. 2009. “Monetarism defiant: Legendary economist Anna Schwartz says the feds have misjudged the financial crisis.” *City Journal* 1.

Straumann, Tobias, and Ulrich Woitek. 2009. “A pioneer of a new monetary policy? Sweden’s price-level targeting of the 1930s revisited.” *European Review of Economic History* 13 (2): 251–82.

Stringher, Bonaldo. 1993. *Memorie riguardanti la circolazione e il mercato monetario. With an introduction of Franco Bonelli.* Edizioni di Banche e Banchieri.

Taber, George. 2014. *Chasing Gold.* Simon & Schuster.

Tamburello, Stefania. 2011. *Mario Draghi, il governatore : dalla Banca d’Italia al vertice della BCE.* Rizzoli ETAS.

Thomsen, Jens. 2019. “Carl Valdemar Bramsnæs. Fra hyrdedreng til minister og nationalbankdirektor.” In *Med hånden på statskassen: Økonomer i regering,* edited by Jørgen Hansen, Niels Kærgård, and Jens Thomsen, 105–26. Djoef Forlag.

Times, Financial. 2003. *Trichet Gets Green Light for Ecb.* Via Gale, June 19, 2003.

Times, Financial. 2011. *Man in the News: Mario Draghi. April 29, 2011.*

Times, The Sunday. 1990. *Turmoil in Tokyo.* Via Proquest, April 8, 1990.

Tobback, Ellen, Stefano Nardelli, and David Martens. 2017. “Between Hawks and Doves: Measuring Central Bank Communication.” *ECB Working Paper Series,* no. 2085.

Toribio, José Manuel Cuenca. 2018. “Lorenzo Domínguez y Pascual.” In *Diccionario Biografico Electronico - DBE.* Real Academia de la Historia.

Toribio, Jose Manuel Cuenca. 2005. *Historia general de Andalucía.* Editorial Almuzara.

Tudeer, A.E. 1940. *The Bank of Finland, 1912-1936.* Helsinki - GPO.

Uchitelle, Louis, and Eduardo Porter. 2005. “A Washington Gamble Pays Off for a Professor; Ben Shalom Bernanke.” *New York Times* October 25: C1.

Vestberg, Jens. 1981. “Linnemann, Stephan.” In *Dansk Biografisk Leksikon: Levi-Moltesen,* 82. Gyldendalske Boghandel, Nordisk Forlag.

Vissering, Gerard. 1915. “The Netherlands Bank and the War.” *Grotius Annuaire International* 1: 1–54.

Vries, Jan de. 1989. “Vissing, Gerard (1865-1937).” In *Biografisch Woordenboek van Nederland, Vol. 3,* 628–30. Nijhoff.

Wee, Herman van der. 2012. “Belgian Monetary Policy under the Gold Standard during the Interwar Period.” In *The Gold Standard Peripheries,* edited by Anders Ögren and Lars Fredrik Øksendal, 130–44. Springer.

Werner, Richard. 2003. *Princes of the Yen: Japan’s central bankers and the transformation of the economy.* M.E. Sharpe.

Wray, William D. 1984. *Mitsubishi and the N.Y.K., 1870-1914: Business Strategy in the Japanese Shipping Industry.* Harvard University Press.

WSJ. 1980. *Bank of Canada Governor Bouey Holds Nation to a Course of Monetary Restraint.* Via [Proquest, December 30, 1980, p.6.

WSJ. 1999. *Listening to Mr. Hayami.* Via Proquest, October 8, 1999, p.6.
Yamamoto, Tatsuo. 1902. "Address delivered before Osaka's Banking Club, November 18, 1902." *Banker's Magazine* 64 (3): 417–18.

Appendix 3.B Early central banks – a filtering approach

Table 3.B.1. Early central banks: excluded banking institutions, and details

	Country, est. date	Max. known assets (year)	Comments	Literature
Barcelona Taula di Canvi	Spain, 1403	358,053 ll (1433)	Usher (1943) reports various aggregate balance sheet data points (including for January 1433) – however, the data is far too sparse to construct an annual series.	Usher (1943).
Milan Banco Ambrogio	Italy, 1593	L 43.81M (1658)	The Banco acts as a de facto central bank, but while Cova (1972, 178ff.) provides a total of 19 annual balance sheets for the Bank over the period 1624-1800, it is not possible to built a continuous series on this basis.	Cova (1972).
Roman Banco di Santo Spirito	Italy, 1605	Scudi 2.8M (1858)	Ponti (1951) reports bank activities over 1605-1870, but precise balance sheet data is only given sporadically. The Bank acts as a direct agent for the Papacy, with a de facto monopoly in the state.	Ponti (1951).
Venice Banco Giro	Italy, 1619	Ducati correnti 6.083M (1762)	The Banco acts as a de facto central bank, but while individual asset items are covered on an annual basis (deposit volumes, the "metallic fund"), Tucci (1973) does not provide total asset volume data – these figures therefore remain unknown.	Tucci (1973).

Table 3.B.2. cont.: Early central banks: excluded banking institutions, and details

Nuremberg Banco Publico	Germany, 1621	Rfl 219,482 (1706)	The Banco acts as a de facto central bank, but while Denzel (2012) provides deposit volumes and turnover figures for the Bank on a continuous annual basis, total asset volumes are unknown.	Denzel (2012).
Caisse d'Escompte	France, 1777	LT 503.3M (1789)	While the Caisse can be regarded as a de facto central bank, Courtois (1881, Annexe E) only provides turnover and escompte volumes over 1777-93, but not total asset volumes.	Courtois (1881).
Royal Prussian Banco Franconia	Germany, 1780	Rfl 5.5M (1800)	While the Royal Prussian Banco can be regarded as a de facto central bank, both Poschinger (1876) and Steffan and Diehm (1955) only provide intermittent aggregate balance sheet data, insufficient for a continuous series.	Poschinger (1876), Steffan and Diehm (1955).

Note: The table reports existing de facto and de jure central bank institutions, as surveyed by existing literature – and our rationale for including or excluding the institution in our data set. The "max. known assets (year) column reports the volume and year for which the maximum total asset volume can be identified, on the basis of the existing sources – this volume is not necessarily the actual peak volume of assets, nor does it necessarily include all actual bank assets.

Appendix 3.C Additional evidence on the historical evolution of central bank balance sheets

This section presents country-specific long-run series as well as estimates of year fixed effects controlling for country fixed effects. This allows to test for potential sample composition effects in th aggregate patterns shown and discussed in Section 3.1.2.

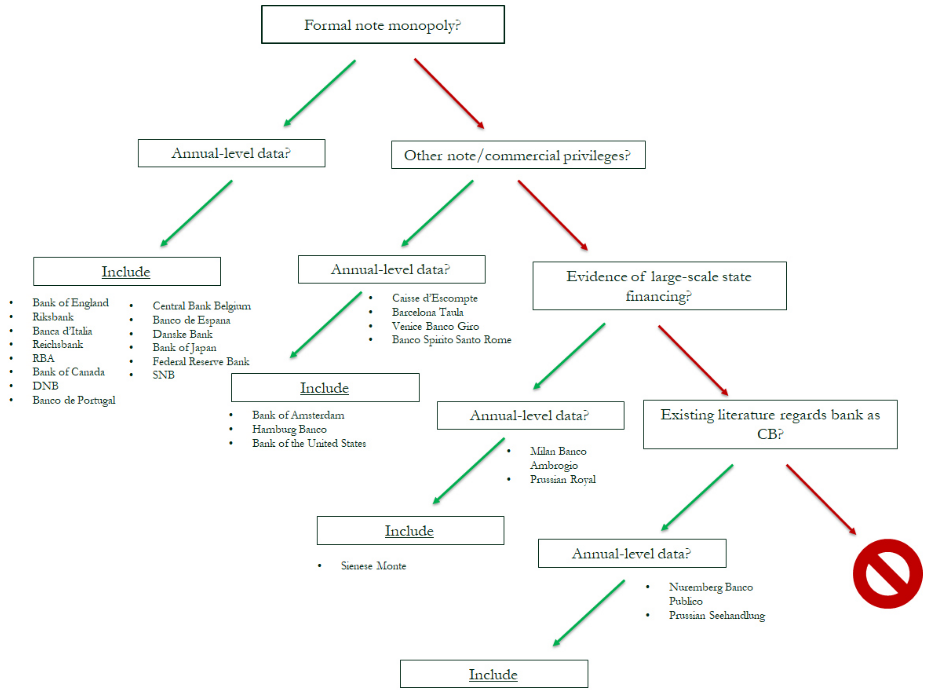


Figure 3.B.1. Filtering approach to early modern central banks (CBs) – a decision tree.

Notes: Modern and early modern bank inclusion decision tree. For sources and further definitions see table 3.B.1, table 3.B.2 and discussion in section 2.1.

3.C.1 Country-specific series

Country-specific series for central bank assets relative to GDP are shown in Figure 3.C.1, central bank assets relative to private lending in Figure 3.C.2, central bank holding of government debt relative to total government debt outstanding in Figure 3.C.3 and central bank government debt as a share of total central bank assets in Figure 3.C.4.

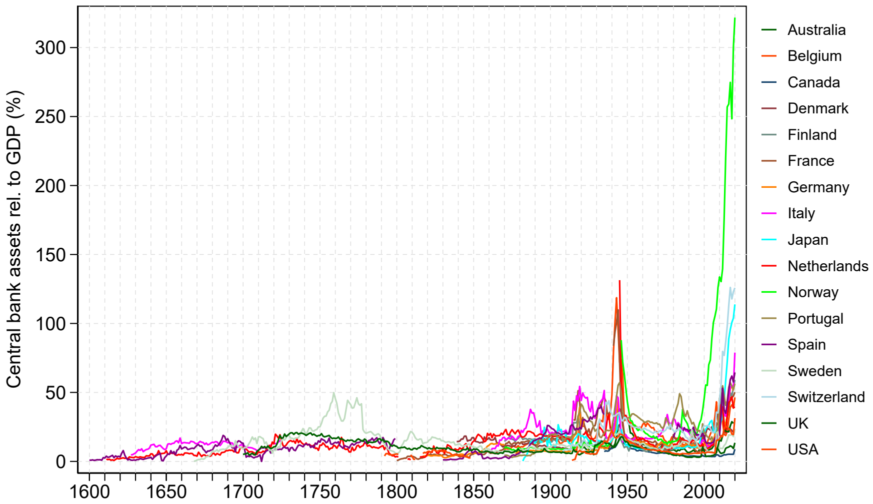


Figure 3.C.1. Central bank assets relative to GDP, by country

Notes: The figure shows country-specific series of central bank assets relative to GDP.

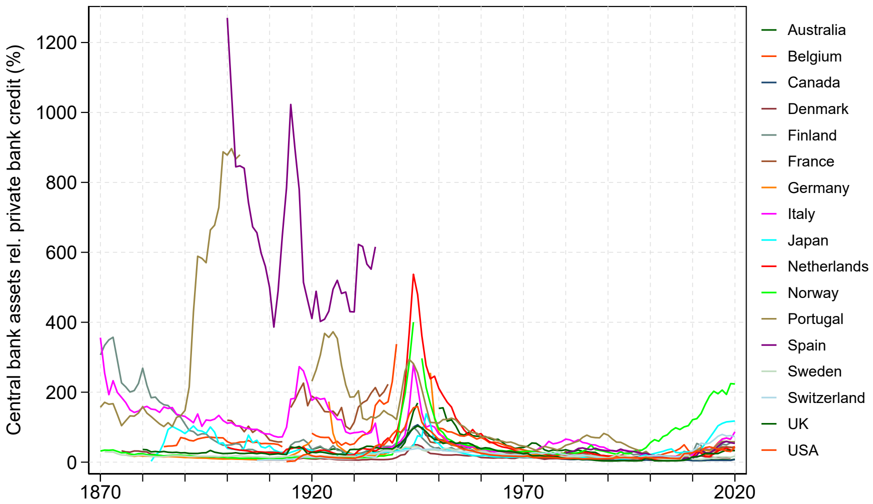


Figure 3.C.2. Central bank assets relative to private lending, by country

Notes: The figure shows country-specific series of central bank assets relative to bank loans to the nonfinancial sector.

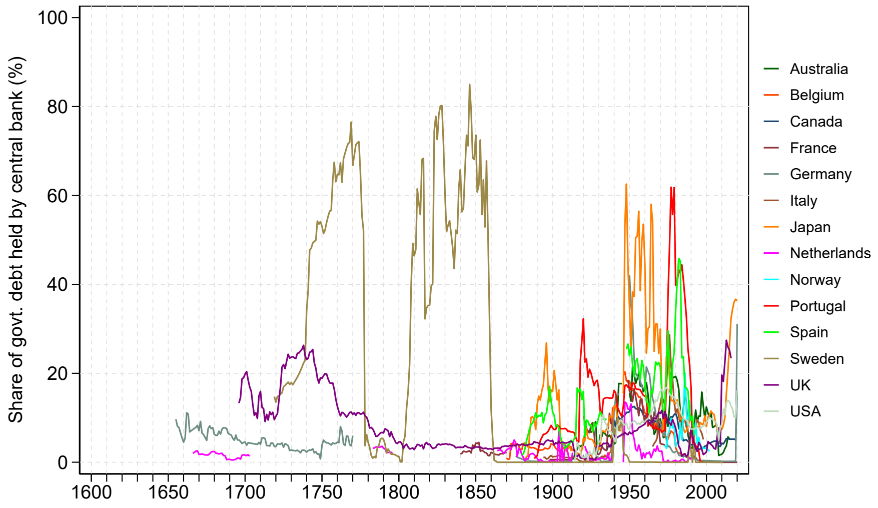


Figure 3.C.3. Share of outstanding public debt held by central bank, by country

Notes: The figure shows country-specific series of share of outstanding public debt held by central bank.

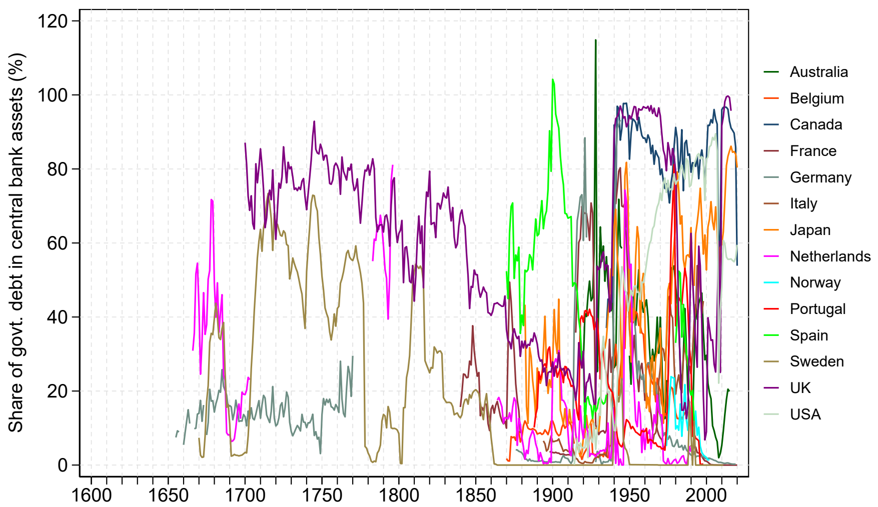


Figure 3.C.4. Share of government debt in central bank assets, by country

Notes: The figure shows country-specific series of the share of government debt in central bank assets.

3.C.2 Estimated time effects

This section tests whether main features discussed in Section 3.1.2 are driven by sample composition. Specifically, we estimate year fixed effects controlling for country fixed effects for each variable to filter the time effect net of sample composition. Figure 3.C.5 plots the year effect with 95% confidence intervals for central bank assets relative to GDP. Figure 3.C.6 shows estimates for central bank asset relative to private lending, Figure 3.C.7 examines central bank government debt relative to total government debt outstanding and Figure 3.C.8 shows the estimates for central bank government debt as a share of total central bank assets. In each case, aggregate patterns are very similar to the raw data moments presented in the main text.

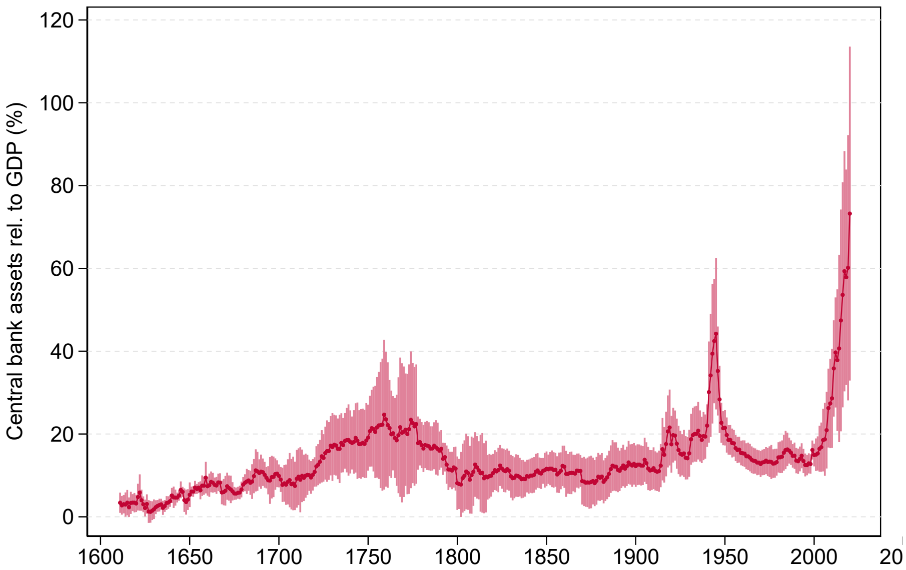


Figure 3.C.5. Estimated time effects in central bank assets relative to GDP

Notes: The figure shows estimates of year fixed effects from a panel regression of central bank assets relative to GDP, controlling for country fixed effects. Whiskers mark the 95% confidence intervals.

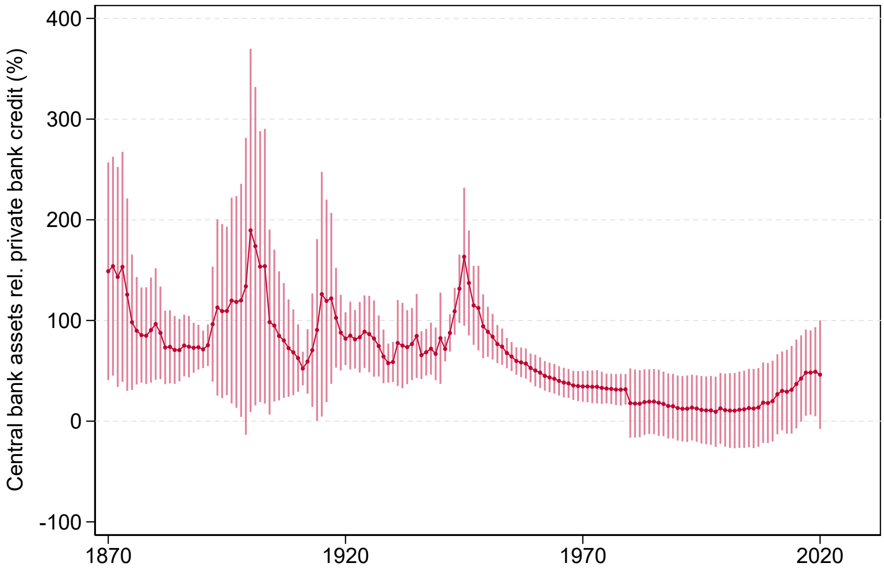


Figure 3.C.6. Estimated time effect in central bank assets relative to private lending

Notes: The figure shows estimates of year fixed effects from a panel regression of central bank assets relative to bank loans to the private nonfinancial sector, controlling for country fixed effects. Whiskers mark the 95% confidence intervals.

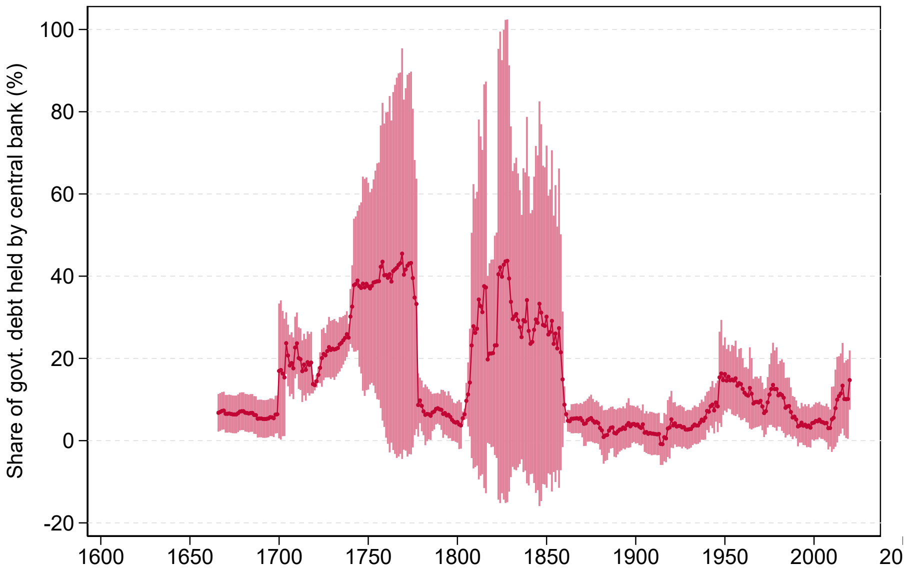


Figure 3.C.7. Estimated time effects in share of public debt held by central bank

Notes: The figure shows estimates of year fixed effects from a panel regression of central bank government debt assets relative to total government debt outstanding, controlling for country fixed effects. Whiskers mark the 95% confidence intervals.

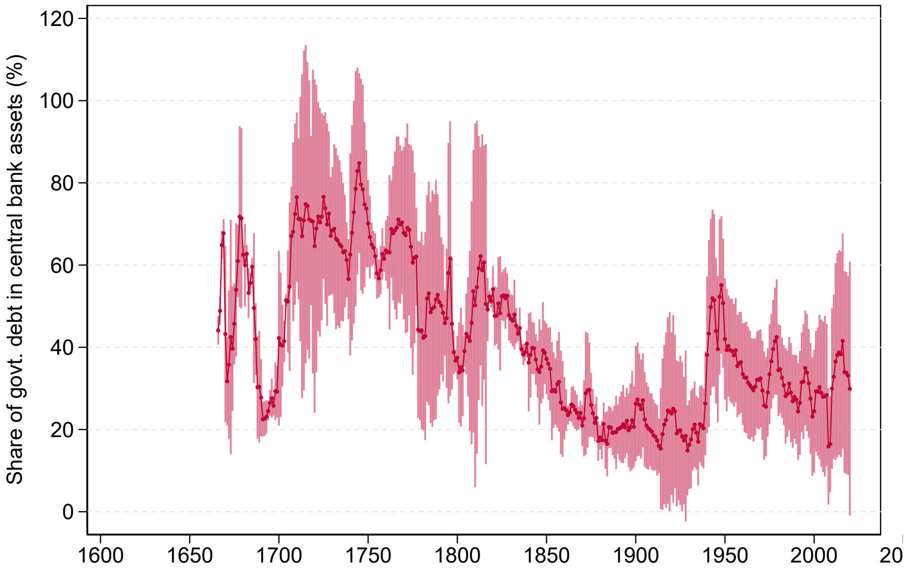


Figure 3.C.8. Estimated time effects in central bank assets share of public debt

Notes: The figure shows estimates of year fixed effects from a panel regression of the share of government debt in total central bank assets, controlling for country fixed effects. Whiskers mark the 95% confidence intervals.

Appendix 3.D Details on individual major expansion events

In this appendix section, we present details of around the "top 25" nominal year-on-year central bank balance sheet expansion events, in chronological order, to illuminate the particular types of expansion drivers, and rationalize our classifications. Expansion figures always refer to year-on-year nominal year-average growth, unless otherwise noted.

Neapolitan public banks, 1609. +197% expansion: Stefano (1940) or Balletta, Balletta, and Costabile (2018) do not record a specific tail event during 1609; the backdrop is in this case a sharp increase in banking activity and the swift establishment of multiple new banking houses in the Kingdom of Naples since 1580 –– a boom that ends in the severe banking crisis of 1622, when aggregate balance sheets contract substantially.

Bank of Amsterdam, 1618. +235% expansion: the Bank of Amsterdam, as the de facto central bank of the (emerging) Dutch Republic grew rapidly after its foundation in 1609; from its inception, financial markets in Amsterdam were under the influence of the major geopolitical events of the time, including the ongoing Eighty-Years War, during which the Dutch states fought for independence from Spain, and the religious tensions in the Holy Roman Empire. In 1618, matters saw a sharp escalation with the “defenestration” in Prague –– the event that is commonly associated with the beginning of the Thirty Years War. Despite important domestic factors, we interpret the expansion event as a function of an exogenous, pan-European capital flight, into the early modern “safe havens” (Van Dillen 1934, 84ff.). We would therefore characterize the expansion as ‘war or revolution” driven in our typology, but one demonstrably driven by gold and foreign asset growth.

Bank of Hamburg, 1675. +68% expansion: the history of Hamburg — with its famed merchant and financial communities -– during the last quarter of the 17th century is closely tied to the geopolitical events brought about by France’s belligerent regent, Louis XIV. The largest nominal aggregate asset expansion at the Bank of Hamburg takes place just after the French declaration of war against the Dutch Republic, and the invasion of French forces into the German Rhineland in 1674. We view the underlying drivers of the Hamburg expansion as clearly motivated by capital flight from the Dutch and German financial hubs, and would classify the 1675 balance sheet expansion as a typical “war or revolution” event, though it did not involve modern-type war financing activities on behalf of the Hamburg municipal authorities themselves -– there was no bank-led emergency lending to public authorities. As Israel (1989, 293) notes, the Dutch commercial hubs immediately felt the pain after the French declaration of war in April 1672: “there was a massive run on the banks. Millions of guilders were transferred abroad”. Apart from Hamburg, Italian cities were a key beneficiary for funds hastily withdrawn Barbour (1963, 57ff.).

Riksbank, 1726. +66% expansion: in the aftermath of the South Sea Bubble, Sweden saw significant capital inflows and one of the largest pre-1870 annual expansions of the central bank’s balance sheet; in the absence of clear geopolitical drivers, we designate the event a financial crisis expansion, despite no evidence of domestic volatility in Stockholm’s financial community at the time (Fregert, 2014).

Japan, 1883. +728.1% expansion: this country-year records the second-highest y-o-y growth on record across our sample; we have classified the event in the “revaluation” category at present. The Bank of Japan is founded in 1882, and begins operations in October of that year. The sharp rise in 1883 on a year-on-year basis is thus explained by technical factors, and the increase in operation from a very low asset base in the inception year. There are no exceptional crisis or exogenous events in 1883 otherwise, though a still-elevated inflation level persisted as a legacy from the Seinan Civil War of 1877 (Shizume, 2020).

Japan, 1905. +113.6% expansion: Japan is most prominently represented in our “top 25” expansion sample (with four listings on the aggregate asset expansion basis); 1905 marks the Russo-Japanese War, which Tokyo successfully completed by September 1905. Japanese war expenditures were met partly by raising substantial foreign loans in London and New York, but also aided by significant BoJ accommodation including direct purchases of Treasury bills; public debt/GNP more than doubles within a span of less than five years over 1902-1907 BoJ (1906, 4).

USA, 1917. +161.3% expansion: this country-year records the sixth-highest y-o-y growth on record across our sample, and is currently classified as a “war or revolution” expansion. While war finance — specifically the issuance of Liberty Loans during 1917-1919 — exercised the strongest influence over Federal Reserve balance sheet dynamics in the early years of the Fed’s inception, some of the increase in the central bank's total assets are related to the technical consolidation of the member bank system enacted in 1917: legislation enacted in June of the year, for instance, required member banks to deposit a much higher share of required reserve at Federal Reserve banks — a move increasing total excess reserves in the Fed system by US$ 300m Meltzer (2005, 79ff.).

Belgium, 1918. +151.2% expansion: this country-year marks the ninth-highest growth on record, and is classified in the "revaluation" category. Following the occupation of Belgium during World War One, and the subsequent armistice, the National Bank of Belgium (NBB) was instructed by the political authorities to swap the substantial amount of outstanding German mark money volumes — made legal tender by the Germans during 1916-1918 – into newly-issued Belgian currency. Such operations, in addition to the financing of post-war reconstruction efforts, significantly expanded the NBB's balance sheet Wee (2012, 130f.).

Germany, 1922. +1186% year-on-year total asset expansion: the German hyperinflation years mark the largest central bank balance sheet events across our entire sample over 150 years. Against the wider macroeconomic backdrop, and the complete collapse of one of the leading advanced economies of the time, this status is perhaps unsurprising. The expansion itself during 1922 is mainly driven by sharply rising commercial bill discounting activity. Webb (1985) argues the Reichsbank behaves passively through this phase, de facto letting the market decide its balance sheet size. We have designated the event in the "revaluation" category, since market actors' borrowing activity is overwhelmingly motivated by attempts to counter the rapid price surge and match revalued liabilities (ibid.).

Switzerland, 1931. +91.1% expansion: this country-year records the 19th-highest y-o-y growth on record across our sample, and represents the largest balance sheet expansion in the "FX attack or accumulation" group. The German emergency laws of July 1931 -— amid the collapse of Danat Bank and heavy capital outflows -— froze substantial volumes of Swiss creditor funds. In the aftermath, and the escalation of European-wide uncertainty, Switzerland experienced substantial capital inflows, despite reductions in discount rates -— not least representing inflows facilitated by foreign central banks. The momentum substantially accelerated after the British departure from gold in September, with the SNB increasingly resorting to direct substantial gold purchases to stem the currency appreciation: gold assets on the SNB balance sheet rose from CHF 953M in May 1931, to CHF 2.4BN by the end of December Bachmann, Wartensee, and Weber (1932, 302ff.).

Belgium, 1942. +38.7% expansion. The expansion is related to sharp growth in NBB assets related to the establishment of the Banque d'Emission de Bruxelles; the exact breakdown of underlying assets is not reported in printed accounts to our knowledge -— but it is likely that a mix of international, and domestic public and private assets are ultimately involved Wee and Verbreyt (2009, 109ff.). We treat the event as a "mixed" domestic asset expansion event.

Germany, 1939-1945. Expansions driven by “Reichskreditkassenscheine” (“RKKS”) during Nazi Germany’s occupation. Reichskreditkassenscheine (“RKKS”) were created by Nazi occupation authorities to replace the domestic money supply in various countries after 1939, to enable a direct underwriting of armament and occupation costs — leaving significant traces on central bank balance sheets at the time, though the overall recourse varied across occupied territories; Klemann and Kudryashov (2012, 194-201) provide a general discussion about the phenomenon and technical details. RKKSs enabled both individual soldiers to transact on an everyday basis in occupied territories, as well as the Wehrmacht armaments offices and other associated public agencies to purchase equipment and related needs; in this sense RKKS transactions reflect a combination of public and private economic activity and we designate central bank balance sheet expansions as a “mixed” domestic asset expansion in country-years where these items assume a dominant influence. The following expansions are demonstrably dominated by RKKS liability growth:

Norway, 1940-1944. The country’s +147.4% expansion in 1940 features in the “top ten” all-time expansion events, and is closely related to Nazi Germany’s invasion of the country in the first half of the year. Though it managed to transfer its entire gold reserves to the U.K. in an emergency operation in April 1940, from later this month the Norges Bank was de facto required to accept German RKKS as official legal tender. The Norges Bank accepted to swap domestic currency for RKKS, and in practice financed both the ongoing Wehrmacht campaigns against British forces, as well as the regular occupation costs, via domestic money expansion. Later, all RKKS transactions were booked via a special “occupation account” on Norges Bank balance sheet, with amounts until 1945 in this account recaching NOK 11.3BN (Espeli, 2014). We have accordingly designated the country-year as a “war or revolution” type. Also see figure breakdowns in Hvidsten (2013).

Netherlands, 1940-1945. As in France, the German occupants took control over the monetary institutional architecture and decisively upset balance sheet dynamics at the Dutch National Bank — but one that did not trigger domestic asset expansion events under our benchmark definitions; for details on the Dutch situation, see Barendregt (1993).

Belgium, 1942-1944. See in particular Wee and Verbreyt (2009) for the Belgian experience with RKSS issuance driving the NBB balance sheet dynamics during the German occupation.

France, 1941-1942. See Baubeau (2018), with French RKKSs in the balance sheet of the Banque de France peaking in December 1941, at FRF 64.6M, or 18% of total liabilities. RKKSs account for just over 43% of the total Banque de France balance sheet growth over the course of 1941-42. Note that these years still fall short of our domestic asset expansion threshold.

Denmark, 1941, 1943, 1944. See Abildgren (2017), with RKKSs being recorded under “deposits and other net liabilities”, which grow from 10.3% of Danish GDP in 1940, to no less than 45.1% by 1945.

Italy, 1941. +123.6% expansion: this country-year marks the eleventh-highest growth on record, as we have classified it in the "war or revolution" category. Fratianni and Spinelli (1997, 162ff.) associate the initial war years with failed attempts to finance the spiraling government deficits via a "capital circuit" strategy -- de facto forced private sector purchases of government securities. With the growing realization that this chancel was unable to sufficiently address financing needs, currency creation was increasingly resorted to.

Japan, 1945. +217.1% expansion: the final World War Two year in Japan ranks among the "top 5" all-time central bank balance sheet expansion years. Despite the obvious association with "war finance" dynamics as the country struggles to prevail against the odds in the Pacific War theatre, the balance sheet expansion has multiple origins. As Nakamura (2003, 75ff.) and others document, Japanese M2 surges year-on-year by almost JPY 80BN, but the increase is fueled not least by capital flight from formerly occupied territories, and rampant inflation from August 1945 (ibid., 90), which leads to a surge in the value of the BoJ's outstanding "notes" components. The fiscal deficit rises relatively "modestly" in 1945, by JPY 12BN y-o-y, and newly-issued Japanese government bond volumes actually fall y-o-y. A sharp rise is instead recorded in public subsidies to the industrial sector. Given the underlying price and capital flow dynamics, a reasonable case could be made to treat this country-year as a "revaluation" event. On the margin, we still opted to see it as a "war or revolution" event, however, given the overwhelming influence of these factors on the general economy.

Japan, 1947. +121.5% expansion: this country-year features in the "top 20" all-time central bank balance sheet expansion events, and is closely associated with the immediate post-war political and financial efforts to reconstruct Japan's economy. Key for the Bank of Japan's balance sheet expansion is the authorities' establishment of the Reconstruction Finance Bank ("Fukko Kinyu Koko") during the year, which saw its bond issuance fully subscribed to by the Bank of Japan (Nakamura 2003, 91f.).

Italy, 1976. +151.5% expansion: this country-year records the seventh-highest y-o-y growth on record across our sample; we have classified this event in the "revaluation" category at present. Italy during the 1970s experienced deep-seated structural problems related to lacklustre productivity growth, high inflation, and rising fiscal deficits. Lubitz (1978, 14f.) notes that "the rapid expansion of the monetary aggregates is in turn due to the increase in the monetary base and the major source of monetary base creation has been the central bank's financing of the Treasury deficit. The Bank of Italy has itself maintained that it has been required to finance the Treasury deficit and has therefore lost control of the monetary base and money supply".

U.K., 1999. +212% expansion: this country-year marks the fifth-largest expansion on record over the past 150 years across advanced economy central banks. In its 1999 annual report, the Bank of England comments on its balance sheet increase as follows: "The Bank is providing EUR 3 billion as a float of liquidity for the UK financial sector's use of TARGET. This float comprises securities and deposits denominated in euro and is included on the Bank's balance sheet. together with the corresponding funding. The Bank started to acquire the assets for the float in

December 1998 purchasing securities and placing deposits, initially in currencies that would on I January 1999 convert to the euro. These assets were then redenominated into the euro. This portfolio was financed by swaps and an increase in the deposits for the Issue Department. The TARGET system involves the creation of bilateral positions between central banks in the member countries. These balances reflect the net flows between the individual countries through the central banks. Although the net position is what matters for most operational purposes, the individual balances are with different legal entities and must therefore be shown gross under UK accounting rules. The existence of these balances has resulted in a significant increase of around EUR 12BN (GBP 8BN) in the Bank's balance sheet footings at the balance sheet date" BoE (1999, 51). Hence, this country-year is part of the general increase in Eurosystem TARGET claims that generate key "expansion" events for most Eurosystem central banks in 1999 (see our separate note on 1999 as a European technical expansion event below). The Bank of England aggregate balances in 2000 -– as is the case in most other affected Eurosystem member banks — record a substantial decrease in total assets almost exactly canceling out the previous expansion. We have designated the country-year as a "revaluation" event, reflecting the purely technical background to this "major expansion".

Norway, 2000, 2001, 2005. The Norges Bank asset expansion over the two years of 2000, 2001 and for 2005 are notable in size, but are overwhelmingly driven by changes in assets related to the "Government Petroleum Fund", which for accounting purposes appears in the central bank balance sheet. The Norges Bank (NorgesBank (2001, 59), NorgesBank (2006, 26)) does provide details about the asset allocation of the Petroleum Fund for these years, which reveals that its assets are overwhelmingly invested in foreign equity and foreign fixed income assets for all three years -– the two categories responsible for the overwhelming share of the y-o-y growth. While such asset growth is not technically consolidated under the headline "international reserves" category, we treat the three country-years as "foreign asset"-driven, and as such they do not appear in our domestic expansion event sample.[74]

Sweden, 2008. +230.4% expansion: this country-year records the third-highest y-o-y growth on record across our sample, and is classified in the "financial crisis" category. The increase in the Riksbank balance sheet was primarily related to a substantial provision of liquidity assistance to the banking sector during the second half of the year, with total loans reaching more than SEK 450BN over that timeframe Elmer et al. (2012, 2ff.).

USA, 2008. +151.3% expansion: the U.S. response – together with the Swedish case – marks the most aggressive financial crisis monetary policy interventions on record over the past 150 years; initially, the Fed's actions in 2008 concentrated upon liquidity provision to the banking

74. For instance, the 2005 year-on-year change in Government Petroleum Fund assets are given as + NOK 387BN, of which + NOK 169 are related to "foreign equities" changes, and + NOK 50.7BN to "foreign fixed income" changes -– the aggregate Norges Bank asset change for the year is reported as + NOK 457BN NorgesBank (2006, 18, 26).

sector and money markets, with programs such as TAF, MMIFF, and CPFF being mainly responsible for the balance sheet expansion in the early phase of the crisis – only later did Treasury purchases assume a more decisive role (Calomiris and Kahn, 2015).

Portugal, 2010. +82.5% expansion: this country-year is recorded in the context of the early stages of the European debt crisis, with sharply rising Portuguese bond spreads over 2H-10 and the ECB announcing its SMP program and new LTROs in May 2010; the Banco de Portugal de facto replaced international financing of the Portuguese economy, via recourse to unconventional policy instruments, and supplied substantial liquidity to the banking sector: the average balance of open market operations and net liquidity provision increased by +EUR 24.5BN y-o-y, concentrated on MROs and LTROs, in addition to EUR 3.5BN in monetary security purchases BdP (2011, 303ff., 362). We designate the country-year as a "financial crisis" type given the overall context of events.

Finland, 2011. +113.1% expansion: this country-year features among the top 25 long-run expansions. The unfolding European sovereign debt crisis – with a particular focus on Greece, Portugal, and Ireland – dominated financial market and Euro Area monetary policy action during the second half of 2011. During the year, an expansion of the SMP program was decided by the ECB, as well as substantial liquidity support measures for the common currency area's banking sector (including a 36-month LTRO program in December 2011). More important for the overall expansion of the balance sheet, however, was the surge in net TARGET 2 claims: the Bank of Finland records an increase of EUR 46.32BN of TARGET 2 claims for the year 2011, while by year-end, the increase in LTRO assets only reached EUR 2.5BN BoF (2012, 92). Almost the entire balance sheet expansion of EUR 42.15BN can thus be related to TARGET 2: we therefore decided to regard this country-year as a "residual" type, rather than a "financial crisis" type, even though we acknowledge the fact that such TARGET claims may well to some extent reflect underlying intra-European capital flight dynamics.

Netherlands, 2011. +97.7% expansion: this country-year records the 17th-highest y-o-y nominal expansion across modern developed economies. Similar to the reasoning in the Finnish case (s.a.), we have designated this event as a "residual" type. According to DNB (2012, 122) figures, net 'other' claims within the Eurosystem rose between 2010-2011 from EUR 40.2BN, to no less than 152.8BN. This latter figure constituted no less than 57% of total 2011 DNB balance sheet assets, and the underlying reporting reveals that TARGET 2 claims are responsible for the asset dynamics.

The Bank of Amsterdam, together with the Bank of England, is the first institution in our sample whose balance sheet expansions can be characterized as having an "active" nature. Even though legally it was prohibited – like other institutions – from creating explicit overdraft accounts, it did lend increasingly large sums to the Dutch VOC, the municipal government and channeled lending via the Leeningen Office to the merchant community, for instance in 1763 (Van Dillen ibid., 96ff.). After the Bank of Naples, the Bank of Amsterdam had the highest frequency of "major expansion events", 33 in total. Most of these events reflected asset fluctuations of a technical or business cycle nature, but there are various notable exceptions: the year 1617-8, for instance, would qualify as a major expansion event according to our definitions, being driven by gold inflows into the Dutch states – the two years saw growth in assets of 235%, amid the surge in geopolitical volatility in Bohemia (typically associated with the outbreak of the Thirty Years' War). We note additional episodes of particularly sharp asset growth in 1626, in 1645, during and after the South Sea Bubble in 1719-1723, and again during 1763-4, perhaps the first instance of a clear emergency lending operation.[75]

During the Napoleonic occupation of Amsterdam (and its subsequent confiscation of wealth, followed by liquidation), the banks' assets sharply declined. We also display the Bank's total asset/GDP ratio, with current Holland GDP data (interpolated decadal averages, in guilders) based on Zanden and Leeuwen (2012). On this basis, the long-run asset/GDP ratio until the Bank's demise stands at 7.8%, a figure well within the ranges of modern, post-1945 advanced economy central bank balance sheets.

Appendix 3.E Additional evidence on central bank balance sheet sensitivity

The secular increase in the sensitivity of central bank balance sheets to financial crises post WWII documented in the main text Figure 3.6 does actually not extend to recession events, see Figure 3.E.1. It suggests that balance sheet expansions are inherently related to financial stabilisation operations, rather than conventional monetary policy intended to stabilise the business cycle.

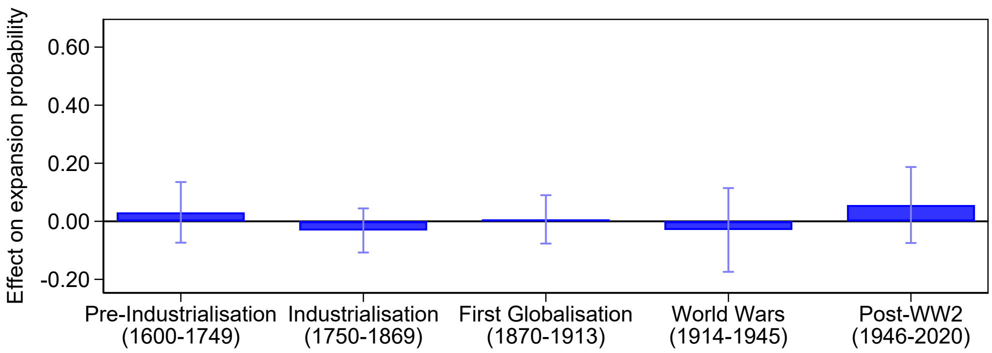


Figure 3.E.1. Central bank balance sheet sensitivity to recessions

Notes: Average effects on the probability of a central bank balance sheet expansion of +15% or more during the current or the next year. Estimates from probit model with episode-specific coefficients for a war, a financial crisis or recession as well as country fixed effects. Whiskers mark the 95% confidence interval.

75. For details, see Ugolini (2017, 130).

To what extend do currency pegs constraint central bank rescue operations? Might the discrepancy in balance sheet sensitivity to financial crises found between pre and post-World War II be actually be due to Gold Standard constraints? The left panel of Figure 3.E.2 repeats the analysis for the years 1870-2020, differentiating by the presence of a Gold Standard or other currency peg. In fact, we find no statistical different, pointing to the flexibility of central bank convertability pledges afforded by ad-hoc coordination or institutionalised arrangements (Metrick and Schmelzing, 2024).

In addition, the right panel in Figure 3.E.2 investigates whether the currency pegs compelled central banks to sterilise their balance sheet interventions to not risk convertibility. It plots the change in public debt assets held by the central bank against the aggregate asset increase, both normalised by total assets, for all country-years in the first or the second year of a financial crisis (Baron, Verner, and Xiong, 2021). While sterilisation may of course occur also within the sub-aggregates of public and private assets, contrasting these broader categories is a natural and interesting first cut and recognises our data constraints. For all observations inside the cone demarcated by the dashed lines, the increase in public debt assets is smaller than that of total assets. By contrast, observations above the cone are characterised by increases in public debt assets *in excess* of the expansion of total assets. Mechanically, this implies sale of private assets, i.e., sterilised public asset purchases. Similarly, observations below the cone exhibit sales of public assets while aggregate assets increase, i.e., sterilised private asset purchases. Importantly, central banks did not differ significantly in their propensity to sterilise interventions across currency regimes, again corroborating the arguments in Metrick and Schmelzing (2024).

Appendix 3.F Major expansions by asset type

We zoom into the dominant drivers of expansion in Figure 3.F.1, distinguishing expansions primarily driven by public versus other asset types. "Government debt-led expansions" (red bars) are defined as balance sheet expansion events that are driven by at least 80% of the assets consisting of public assets (domestic government bills, notes, and bonds): all other assets, including gold and foreign exchange assets are classified as "other" assets. Historically, we observe that most expansions are facilitated by a mix of public and other asset purchases. Public asset expansions have constituted around one-fifth of all balance sheet expansions over the period 1870-2020. In particular, World War Two stands out as a tail event that experienced mostly government debt-led expansions – an observation that holds for both Allied and Axis economies over the period. It is not clear-cut, however, to associate a particular tail event type generally with a specific asset bias: we note that other geopolitical tail events (World War One) experienced mainly mixed or other asset type expansions. Meanwhile, financial crises events, such as the Great Depression years or 2008 following, experienced a dominance of government debt-led expansions in certain phases, but not in any statistically significant way.

Figure 3.F.2 displays the LP-IV effects for the subset of 51 balance sheet expansions that are classified as "other", non-government debt-led expansions in Figure 3.F.1: we observe that there does not seem to be any obvious distinction with regards to the effects on money supply,

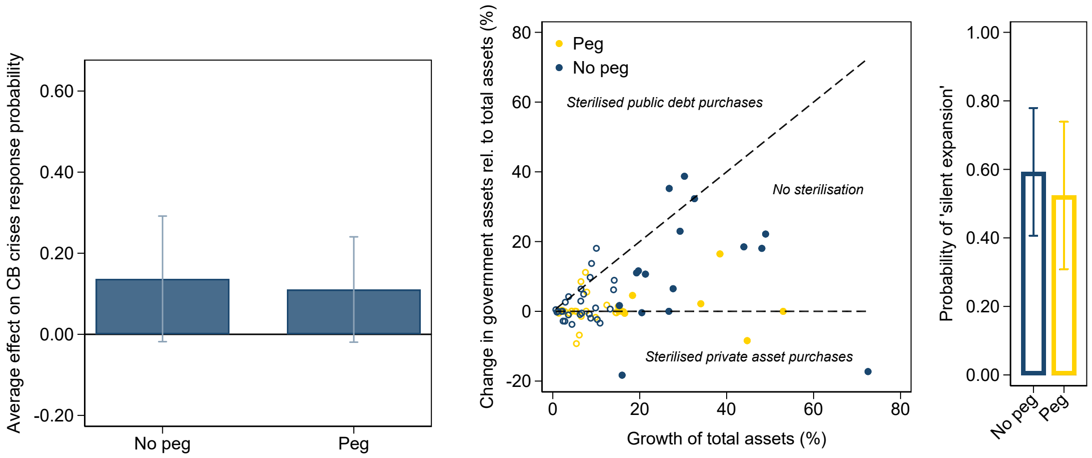


Figure 3.E.2. Central bank balance sheet sensitivity to financial crises, by currency peg

Notes: Left: Average effects on the probability of a central bank balance sheet expansion of +15% or more during the current or the next year. Estimates from probit model with currency-regime-specific coefficients for a financial crisis as well as country fixed effects. Whiskers mark the 95% confidence interval. Middle: Country-year observations of central bank balance sheet operations during first and second year of financial crises (Baron, Verner, Xiong, 2022). Hollow circles mark observations with aggregate balance sheet expansion below +15%. Observations outside cone imply increases in either private of public asset sub-aggregate in excess of the overall balance sheet expansion (sterilisation). Right: Share of operations below +15% aggregate expansion involving sterilisation, by currency regime.

real GDP growth, or CPI when such expansions are driven by "other assets". The three variables continue to display a robust effect over non-expansion events over the four-year horizon, in the same broad size compared to the full sample. Overall, therefore, the specific asset type-mix comprising a liquidity support intervention during banking crises appears not to have dramatically altered the macroeconomic response of such operations over time, at least when analyzed in such a broad public-private asset distinction.

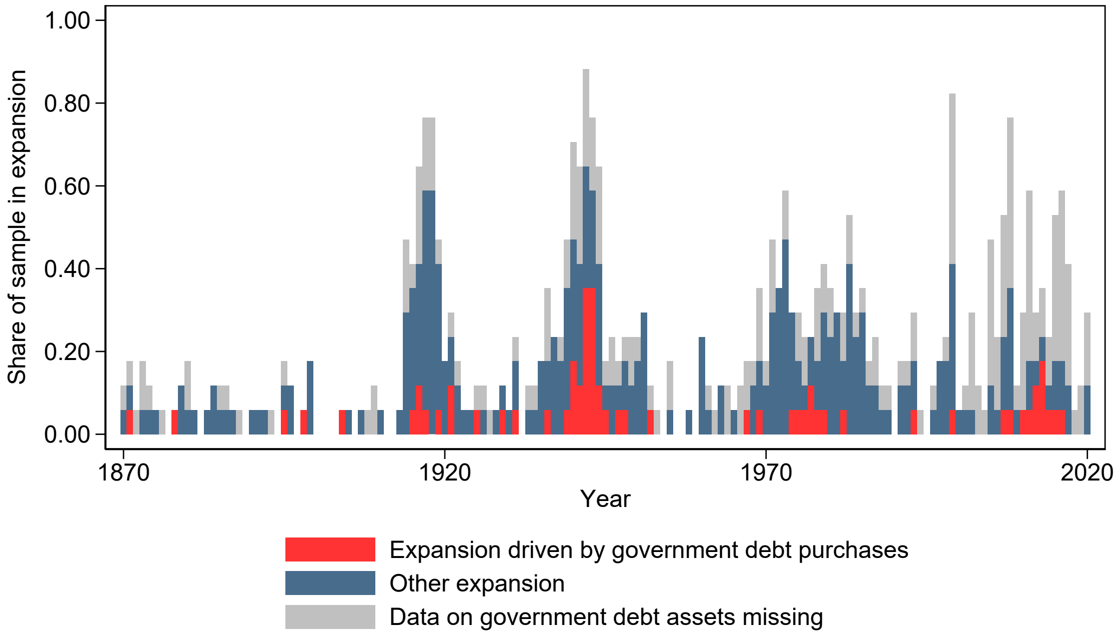


Figure 3.F.1. Central bank balance sheet expansions, by dominant asset type.

Notes: Central bank balance sheet expansion of at least +15% annually. Expansions marked in red are underpinned by domestic government debt purchases of 80% or more of the annual total (net) asset change.

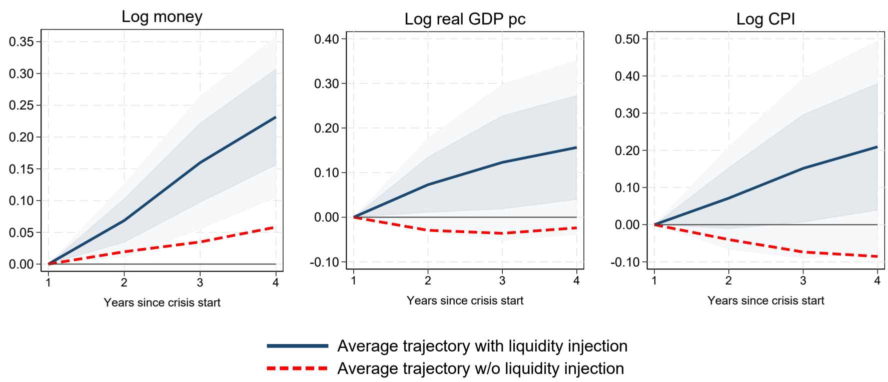


Figure 3.F.2. Expansions not driven by government debt assets

Notes: Omitting banking crises with expansions fuelled through the purchase of government debt. We define an expansion to be fuelled by government debt if the increase in central bank domestic government debt holdings amounts to at least 80% of the overall net balance sheet expansion in the respective expansion year. Lightly shaded areas mark 90% confidence intervals; ± one standard error in dark. Country fixed effects included, but excluding macro controls given the reduced number of observations ($N = 51$) standard errors clustered on counties.

Appendix 3.G Pre-crisis developments by governor type

3.G.1 Macroeconomic developments prior to crisis outbreak

We assume that the original shocks triggering crises are similar across governor types. To build confidence in this assumption, we investigate macroeconomic dynamics in the run-up to crises and compare those across governor types. For example, this addresses the concern that dovish governors are more likely to invite excessive credit expansions as financial firms take extra risk expecting leniency in the case of a crisis.

Specifically, we run regressions of the following form

$$y_{i,t-l} - y_{i,t} \;=\; \alpha_{l,i} + \beta_l \text{dove}_{i,t} + e_{i,t} \quad \text{for} \quad l \in [1,2,...,5] \tag{3.G.1}$$

for all country-years (i,t) with a financial crises as coded by Baron, Verner, and Xiong (2021). We run the regression for different dependent variables y including log real GDP, log CPI, the log narrow money aggregate, total bank loans relative to GDP, the log real stock price index and the log real house price index. The estimates are visualized in Figure 3.G.1. For none of the six variables can we detect significant differences in pre-crisis trajectories.

Overall, we do not reveal any striking differences. Macroeconomic pre-trends in real, monetary and financial variables have been generally comparable across crises when central banks were either led by hawkish or dovish governors. If anything, we find somewhat steeper growth for the hawkish set of crisis, where differences are significant at the 10% level at some horizons. However, other variables do not indicate that crisis with hawkish governors would be systematically preceded by stronger economic booms as trends in unemployment, lending, stock valuations and interest rates cannot be distinguished with any statistical assurance.

3.G.2 Banking sector regulation prior to crisis outbreak

Hawkish governors might push systematically for stricter bank regulation. This would arguably attenuate crisis outcomes and hence render our estimates conservative. Conversely, hawkish governors might get appointed *because* the regulatory framework is lenient to which political forces seek counterbalance. If such political economy factors dominate, our results could indeed be driven by differential banking sector regulation prior to crisis outbreak.

To test, we source data on legal reserve requirements from Federico, Vegh, and Vuletin (2014) and data on banking sector capitalization from Jordà et al. (2020). While actual banking sector capitalization is only an indirect measure of regulation stringency, this data covers our entire sample period starting in the 1870s. Reserve requirement data is available from the 1970s onward.[76]

Figure 3.G.2 compares the two measures during pre-crisis term segments of dovish and hawkish central bank governors. Figure 3.G.2a shows results for reserve requirements, Figure

76. We use fourth quarter values of the average legal reserve requirement measure of Federico, Vegh, and Vuletin (2014).

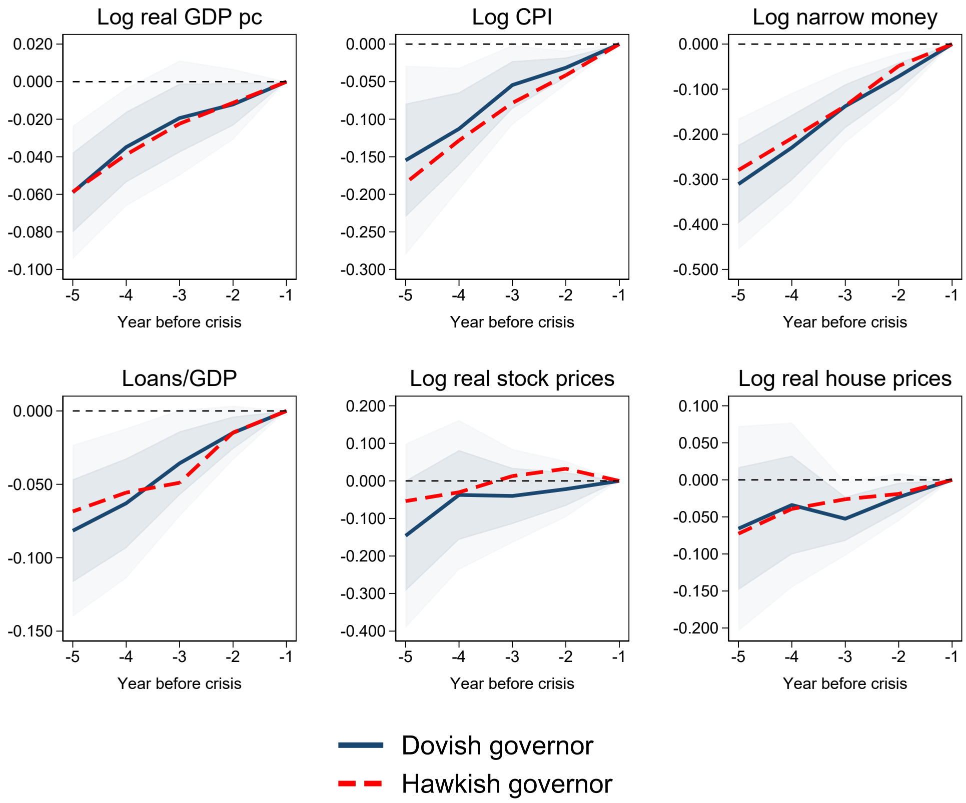


Figure 3.G.1. Macroeconomic trends in real and financial variables prior to crises, by governor type

Notes: The figure shows estimates from a sequence of regressions of the form $y_{i,t-l} - y_{i,t} = \alpha_{l,i} + \beta_l \text{dove}_{i,t} + e_{i,t}$ for $l \in [1, 2, ..., 5]$ and 88 country-years (i, t) with a financial crises coded by Baron, Verner, and Xiong (2021). The main regressor $\text{dove}_{i,t}$ is a binary variable indicating a dovish central bank governor during the crisis. For each dependent variable, the corresponding panel plots the average horizon-specific fixed effect $\bar{\alpha}_{l,i}$ as the dashed red line and its sum with the horizon-specific coefficient $\hat{\beta}_l$ as solid blue line. Shaded areas mark the 90% confidence interval for coefficients $\hat{\beta}_l$ and ±1 standard error. Standard errors are clustered at the country level. Due to data coverage, regressions for stock prices and house prices only cover 79 and 69 crises, respectively.

3.G.2b for banking sector capitalization. Irrespective of whether we consider average levels or average annual changes, we find no statistically significant difference between governor types in either measure. In terms of point estimates, banking sector capital buffers have been even larger in the run-up to crises when hawkish governors were in charge.

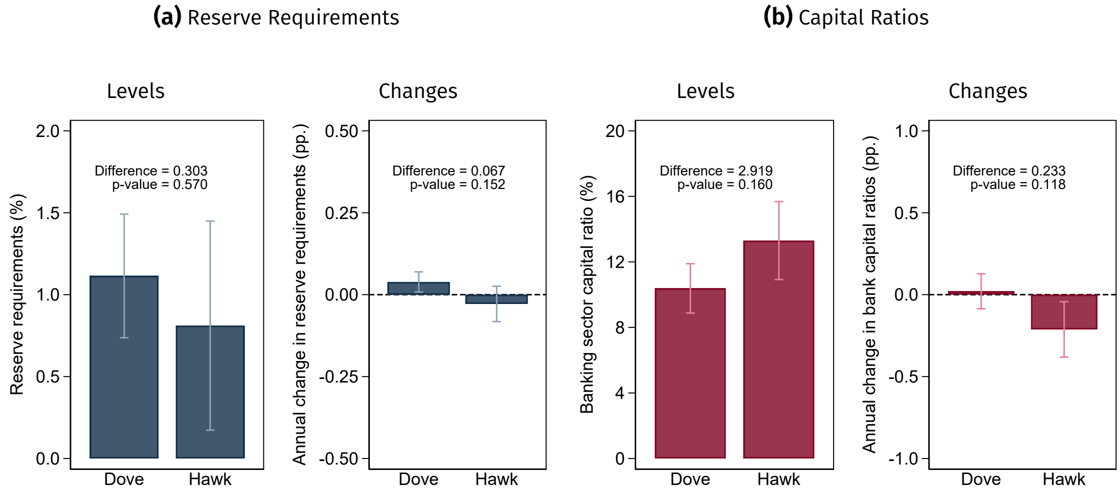


Figure 3.G.2. Pre-crisis banking regulation, by governor type

Notes: The figure plots estimates from the sample of country-years outside domestic wars during which a central bank governors holds office who will face a financial crises later during his term. We estimate regressions $y_{i,t} = \alpha_i + \beta \text{hawk}_{i,t} + e_{i,t}$ for four different dependent variables $y_{i,t}$: Legal reserve requirements, annual changes in legal reserve requirements, banking sector capitalization and annual changes in banking sector capitalization. For each regression, we plot the average value for dovish governors (measured by the average of the country fixed effects) and its sum with the *hawk* coefficient β next to it. Whiskers mark 95% confidence intervals. The printed *difference* is the absolute value of β, with its *p*-value below.

Appendix 3.H Lender of last resort and central bank balance sheet operations

Lender of last resort operations are commonly defined as provision of liquidity to financial institutions that have become illiquid, i.e., unable to obtain liquidity via market transactions under viable conditions, in the wake of widespread financial distress.[77] Enjoying the privilege to issue liabilities carrying legal tender status—the most liquid asset in the economy—the central bank is the natural and the typical institution to act as LLR. Specifically, central bank LLR implies growth in accounts held by targeted banks, which, ceteris paribus, translates into central bank balance sheet expansions. Therefore, our long-term central bank balance sheet data allows us to detect and measure central bank LLR operations around financial crises.

There are three main caveats to measuring the strength of LLR operations with the size of aggregate annual central bank balance sheet expansions:

(1) *Sterilisation:* Emergency liquidity injections might take place alongside maturing of other asset blocks or active asset sales. Especially when financial distress is in its roots and still concentrated among few institutions, such sterilisation does not even infringe with the effectiveness of LLR interventions.

77. Ideally, liquidity is extended only to solvent but illiquid institutions to contain moral hazard effects. Thus the art of such interventions is to separate the solvent illiquid from the insolvent illiquid institutions.

(2) *Swift interventions*: We work with end-of-year balance sheet data. Any swift in-and-out operations within the year thus fly under our radar. For example, the Bank of England back in the day usually discounted commercial bills with low remaining maturity, often two to three months and stuck to it during the crisis of 1763 among others (Bindseil, 2019).

(3) *Anticipation effects*: LLR often entails an announcement effect, which may calm financial markets irrespective of the ultimate injection volume. Timing is the important feature here: earlier announcements can be much more effective and may reduce the necessary balance sheet expansion.

For all these caveats but the third one, we can gauge the precision of our measurement approach. To the extent that we miss (specific) LLR operations, our results are to be interpreted as evidence on LLR operations involving *large and persistent balance sheet expansions*.

First, we compare changes in asset sub-aggregates to aggregate balance sheet movements to detect sterilisied interventions. Figure 3.H.1 plots the change in public debt assets held by the central bank against the aggregate asset increase, both normalised by total assets, for all country-years in the first or the second year of a financial crisis (Baron, Verner, and Xiong, 2021). While sterilisation may of course occur also within the sub-aggregates of public and private assets, contrasting these broader categories is a natural and interesting first cut and recognises our data constraints. For all observations inside the cone demarcated by the dashed lines, the increase in public debt assets is smaller than that of total assets. By contrast, observations above the cone are characterised by increases in public debt assets *in excess* of the expansion of total assets. Mechanically, this implies sale of private assets, i.e., sterilised public asset purchases. Similarly, observations below the cone exhibit sales of public assets while aggregate assets increase, i.e., sterilised private asset purchases. For some observations, the volume of sterilisation is considerable compared to the aggregate balance sheet expansion, e.g., -10% change in public assets alongside +6% increase in total assets implies a +16% annual increase in private assets. Notably, operations involving sterilisation in this sense are more prevalent when the aggregate expansion is below our threshold of +15%. Crucially for our identification strategy, however, governor types do not differ significantly in their propensity to engage in sterilisied balance sheet operations, as shown in the right panel of Figure 3.H.1.

Second, we can use weekly balance sheet data from the Bank of England to assess how many within-year expansion events go undetected with yearly reference dates for that particular institution. Figure 3.H.2 plots the year-on-year changes of the weekly consolidated aggregate balance sheet. Vertical lines mark dates of our annual data, which the Bank of England traditionally reported in late February. We mark the start of a within-year expansion event as the first time the weekly year-on-year growth exceeds +15% (marked by long-dashed line) after surpassing the long-term average growth rate (marked by short-dashed line). We can then assess how many of these within-year expansions did or did not correspond to a +15% increase for that year in the annual data.

The figure is split in four panels (partly to confine y-axis distortion from very large movements to corresponding sub periods). The first panel shows the data from 1844 up until World War I with nine within-year expansions of which the annual data detects four. The second panel

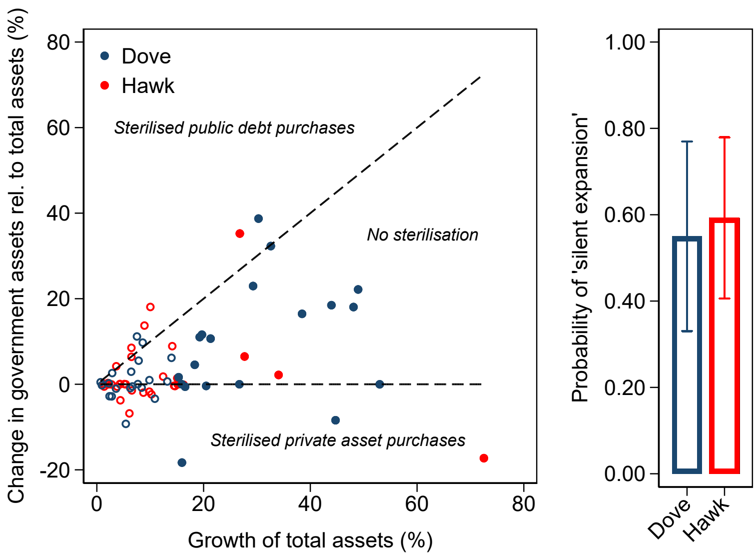


Figure 3.H.1. Sterilisation of central bank asset purchases

Notes: Left: Country-year observations of central bank balance sheet operations during first and second year of financial crises. Hollow circles mark observations with aggregate balance sheet expansion below +15%. Observations outside cone imply increases in either private of public asset sub-aggregate in excess of the overall balance sheet expansion (sterilisation). Right: Share of operations below +15% aggregate expansion involving sterilisation, by governor type.

depicts 1914 to 1945 including eight years with within-year expansions, six of which are detected by annual data. The third panel shows post-World War II data up until 1995, covering 17 years with within-year expansions, notably after the fall of Bretton Woods. Of those mostly exchange-rate-related balance sheet operations one can detect five in annual data. Finally, the fourth panel shows the weekly data until it stops in 2006, including seven years with within-year expansions of which five to undetected in annual data. According to this analysis, the number of expansions we cannot detect may be considerable, but overall the incidence of annual expansions consistently flags periods with intense balance sheet use.

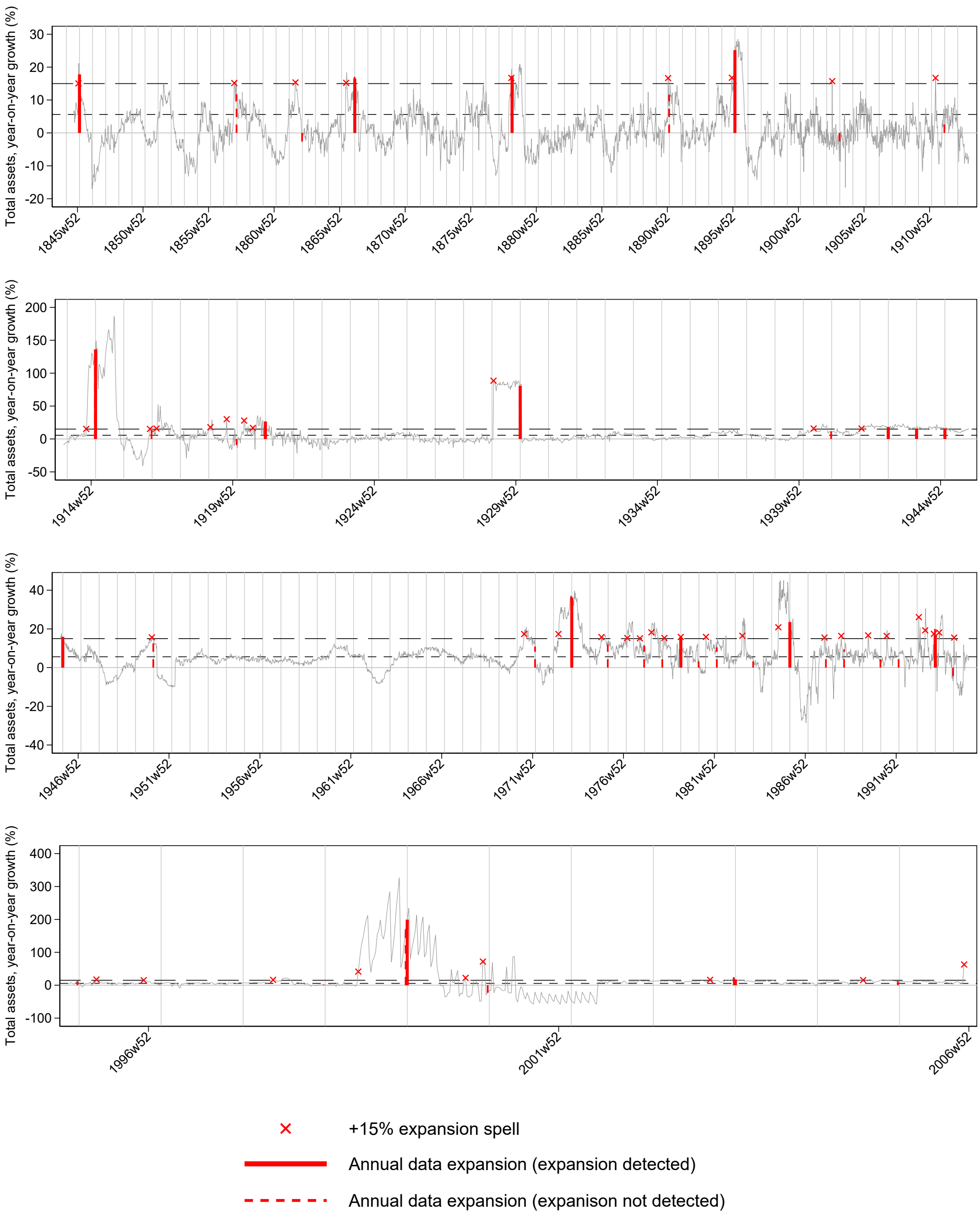


Figure 3.H.2. Within-year expansion events and annual data

Notes: Bank of England weekly aggregate consolidated balance sheet, year-on-year growth. Within-year expansion events defined as the first time exceeds +15% (marked by long-dashed line) after surpassing the long-term average growth rate (marked by short-dashed line) marked by red crosses. Vertical lines mark dates of annual balance sheet data.

Appendix 3.I First stage robustness

The first stage relationship between governor ideology and central bank liquidity injections during financial crises is robust to alternative controls, see Table 3.I.1 and 3.I.2.

Column (1) of Table 3.I.1 replicates the baseline specification presented in the main text for comparison with the remaining columns, which introduce additional controls for macro-institutional features.

Reassuringly, the relevance of governor ideology cannot be explained by the presence of a deposit insurance system (Demirgüç-Kunt and Detragiache, 2002), see column (2) and (3). Point estimates in column (3) suggest that the presence of a national deposit insurance scheme shrinks the probability of large central bank liquidity injections and mutes the relevance of governor ideology, but estimators are imprecise and insignificant.

Analogous conclusions hold when controlling for central bank independence, measured using an indicator assuming a value of 1 when Garriga (2016) assigns an index value below 0.5. The point estimate for the coefficient on governor beliefs increases slightly relative to the our baseline, see column (4) and (5) which introduce a level and interaction control. Column (5) corroborates the intuition that governor ideology should matter for for actual central bank policy outcomes only where the central bank enjoys a sufficient degree of independence: Adding the baseline and interaction effect gives a point estimate of about 0.09, much smaller than the baseline of 0.36. However, the interaction effects is subject to substantial statistical uncertainty.

Table 3.I.2 shows that our measure of governor beliefs is robust to the inclusion of, and statistically superior to, relevant biographical variables including the number of financial crises experienced pre-appointment and previous positions held. Notably, previous government affiliation has a statistically significant and quantitatively important positive effect on the propensity to expand inject central bank liquidity during financial crises.

Table 3.I.1. First stage with institutional controls

	(1)	(2)	(3)	(4)	(5)
Hawk ($g_{it+1} = 1$)	-0.363***	-0.349***	-0.560***	-0.441***	-0.466***
	(0.083)	(0.083)	(0.184)	(0.104)	(0.114)
Deposit insurance		0.069	-0.135		
		(0.139)	(0.252)		
Hawk × deposit insurance			0.472		
			(0.346)		
Central bank not independent				-0.278	-0.424
				(0.196)	(0.267)
Hawk × central bank not independent					0.376
					(0.308)
Macro controls	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
F	18.91	17.73	9.24	17.86	16.74
R^2	0.33	0.34	0.38	0.36	0.36
Crises	78	78	78	78	78

Notes: Macroeconomic controls as described in the main text. Country fixed effects absorbed by within-estimator. Standard errors clustered on countries in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Table 3.I.2. First stage with biographical controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hawk ($g_{it+1} = 1$)	-0.363***	-0.339***	-0.321***	-0.333***	-0.320***	-0.340***	-0.331***	-0.329***
	(0.083)	(0.081)	(0.086)	(0.082)	(0.087)	(0.088)	(0.079)	(0.097)
Crises		0.009						-0.011
		(0.020)						(0.019)
Inflation			0.012**					0.013
			(0.005)					(0.009)
Financial sector				-0.022				-0.029
				(0.135)				(0.147)
Treasury/cabinett					0.151**			0.153*
					(0.070)			(0.083)
Party member						-0.024		-0.103
						(0.141)		(0.158)
Age							0.002	-0.005
							(0.008)	(0.011)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F	18.91	17.68	14.07	16.56	13.69	15.00	17.77	11.45
R^2	0.33	0.39	0.41	0.39	0.41	0.39	0.39	0.42
Crises	78	77	77	77	77	77	77	77

Notes: Variables measure the pre-appointment biographies of governors: the number of crises experiences, life-time average annual inflation, whether his career included positions in the financial sector, in the treasury or the cabinet, whether the governor has been affiliated to a political party and his age. Macroeconomic controls as described in the main text. Country fixed effects absorbed by within-estimator. Standard errors clustered on countries in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Appendix 3.J Crises, liquidity injections and the banking sector

How do central bank liquidity injections affect a distressed banking system? To test, we use aggregate data on banking sector balance sheets collected by Jordà et al. (2020) and run local projection on a dummy indicating large-scale liquidity support during the first or second year of a financial crises, instrumented by the ideological belief set of the responsible central bank governor and controlling for two lags of the dependent variable.

Estimated impulse responses are shown in Figure 3.J.1a for real banking sector assets, capital and deposits and in Figure 3.J.1b for the non-core funding ratio, the capital ratio and the deposit ratio. Overall, estimates are characterized by substantial statistical uncertainty. However, we can assert that central bank interventions lead to a strong and significant recovery in banking sector capitalization. It seems that central bank support enables commercial banks to delever and shore up capital buffers to reassure depositors. Arguably, this reduces the likelihood bank runs and associated inefficient bank failures that destruct bank equity value. Accordingly, a governor belief-driven expansion of the central bank balance sheet beyond +15 percentage points in response to a crisis increases total banking sector capitalization over three years by +30 basis points and raises the capital ratio by +2 percentage points relative to the non-intervention counterfactual.

But are these effects indeed a virtue of liquidity injections—or rather the result of confounding capital injections into the banking sector orchestrated by the fiscal authority? Earlier research has pointed out that central bank liquidity support and fiscally financed bank capital injections often went hand-in-hand in the past (Metrick and Schmelzing, 2024). We investigate this caveat by re-running our LP-IV regressions with controls for capital injection events during the year of the onset of the crisis, the subsequent year and the preceding year—and conclusions remain unchanged.[78]

78. The quantitative effect shrink to +20 basis points.

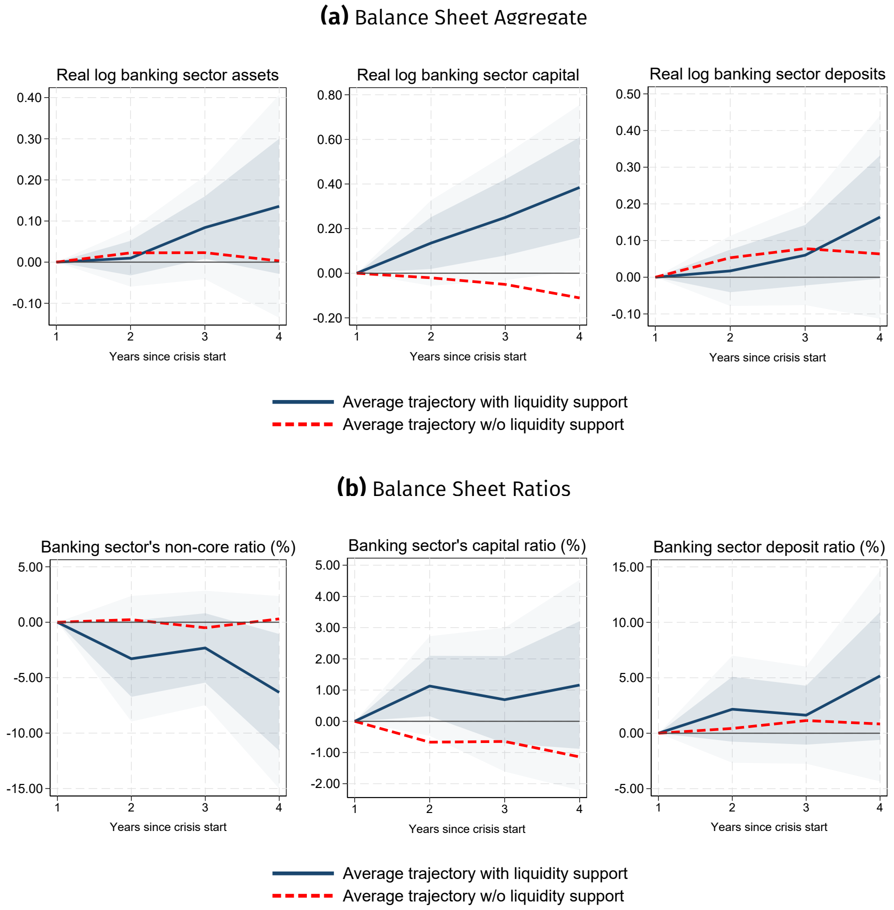


Figure 3.J.1. Reaction of distressed banking systems to belief-driven central bank interventions

Notes: Panel (a) of the figure shows changes in log real banking sector assets, log real banking sector capital and log real banking sector deposits after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Panel (b) of the figure shows changes in the banking sector noncore funding ratio, the banking sector capital ratio and the banking sector deposit ratio after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. In addition, Panel (a) controls for the contemporaneous value (at $h = 1$) and two lags of real banking sector asset growth, real banking sector capital growth and real banking sector deposit growth while Panel (b) instead adds controls for the contemporaneous value (at $h = 1$) and two lags of the banking sector capital ratio and deposit ratio (noncore funding ratio controls would be collinear). Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries. Estimates from LP-IV using governor beliefs to instrument central bank balance sheet expansions for various dependent variables. Each panel plots corresponding impulse response estimates $\hat{\beta}_h$ with 90% confidence intervals based on standard errors clustered on countries. Sample covers an imbalanced panel of 17 advanced economies from 1870 to 2015, excluding domestic war episodes.

Appendix 3.K Tables with LP-IV estimates

This appendix presents regression statistics for the LP-IV model of Equations (3.4) and (3.5) underlying results shown in Figures 3.11 and 3.12.

Table 3.K.1. LP-IV estimates underlying Figure 3.11

(a) Log money aggregate M3

	(1) $h=2$	(2) $h=3$	(3) $h=4$
Liquidity support ($m_{it+1}=1$), instrumented	0.055	0.164**	0.250**
	(0.035)	(0.069)	(0.102)
Macro controls	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
F (first stage)	17.10	17.10	17.87
R^2 (within)	0.18	0.09	0.06
Crises	77	77	76

(b) Log real GDP

	(1) $h=2$	(2) $h=3$	(3) $h=4$
Liquidity support ($m_{it+1}=1$), instrumented	0.071***	0.114**	0.108*
	(0.027)	(0.052)	(0.058)
Macro controls	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
F (first stage)	15.52	15.52	16.62
R^2 (within)	0.07	0.00	0.01
Crises	78	78	77

(c) Log consumer price index

	(1) $h=2$	(2) $h=3$	(3) $h=4$
Liquidity support ($m_{it+1}=1$), instrumented	0.104**	0.200**	0.229**
	(0.048)	(0.088)	(0.103)
Macro controls	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
F (first stage)	15.52	15.52	16.62
R^2 (within)	0.19	0.18	0.18
Crises	78	78	77

Notes: The table shows estimates of Equations (3.4) and (3.5) on the sample of financial crises dated by Baron, Verner, and Xiong (2021). In Panel (a), the dependent variable is the cumulative change in log money aggregate M3 at different horizons since the first crisis year $h=1$. In Panel (b), the dependent variable is the cumulative change in the log real GDP per capita at different horizons since the first crisis year $h=1$. In Panel (b), the dependent variable is the cumulative change in the log CPI at different horizons since the first crisis year $h=1$. Robust standard errors clustered on the country level are shown in parentheses. Macroeconomic controls include the contemporaneous value (at $h=1$) and two lags of real GDP growth, inflation, real investment growth and real stock price growth as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Country fixed effects absorb time-invariant but horizon-specific heterogeneity across countries.

Table 3.K.2. LP-IV estimates underlying Figure 3.12

(a) Log real stock price index

	(1)	(2)	(3)
	$h = 2$	$h = 3$	$h = 4$
Liquidity support ($m_{it+1} = 1$), instrumented	0.455**	0.259	0.137
	(0.189)	(0.207)	(0.284)
Macro controls	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
F (first stage)	10.86	11.57	11.33
R^2 (within)	0.10	0.21	0.11
Crises	63	64	63

(b) Log real investment

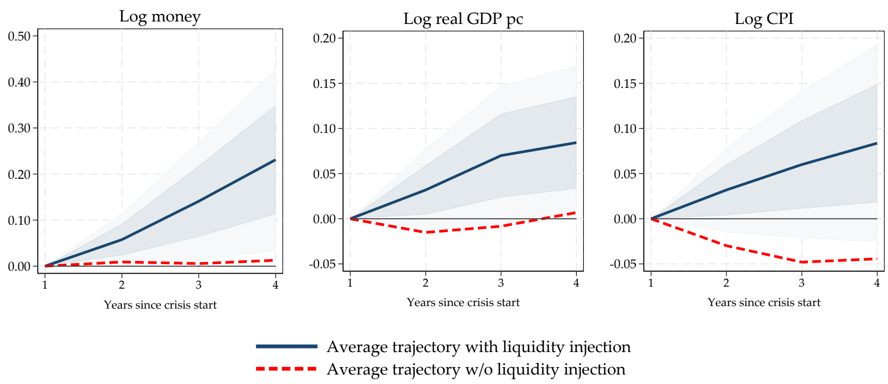
	(1)	(2)	(3)
	$h = 2$	$h = 3$	$h = 4$
Liquidity support ($m_{it+1} = 1$), instrumented	0.354*	0.505***	0.503***
	(0.194)	(0.191)	(0.193)
Macro controls	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
F (first stage)	11.57	11.57	11.33
R^2 (within)	0.12	0.07	0.15
Crises	64	64	63

Notes: The table shows estimates of Equations (3.4) and (3.5) on the sample of financial crises dated by Baron, Verner, and Xiong (2021). In Panel (a), the dependent variable is the cumulative change in log real investment at different horizons since the first crisis year $h = 1$. In Panel (b), the dependent variable is the cumulative change in the log real stock price index at different horizons since the first crisis year $h = 1$. Robust standard errors clustered on the country level are shown in parentheses. Macroeconomic controls include the contemporaneous value (at $h = 1$) and two lags of real GDP growth, inflation, real investment growth and real stock price growth as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Country fixed effects absorb time-invariant but horizon-specific heterogeneity across countries. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

Appendix 3.L Robustness of estimates

This appendix shows estimates from various alternative setups of LP-IV regressions. We augment controls, restrict the sample, use alternative financial crisis indicators or adopt different measures of liquidity support. Conclusions remain qualitatively insensitive to all those variations.

(a) Controlling for the existence of national deposit insurance



(b) Include episode fixed effects

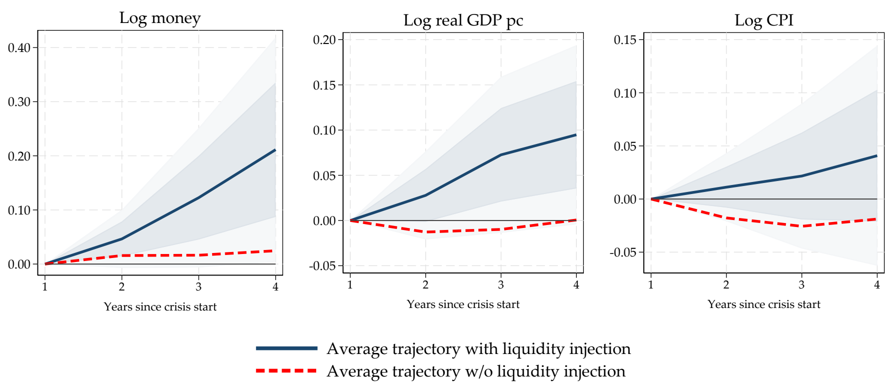
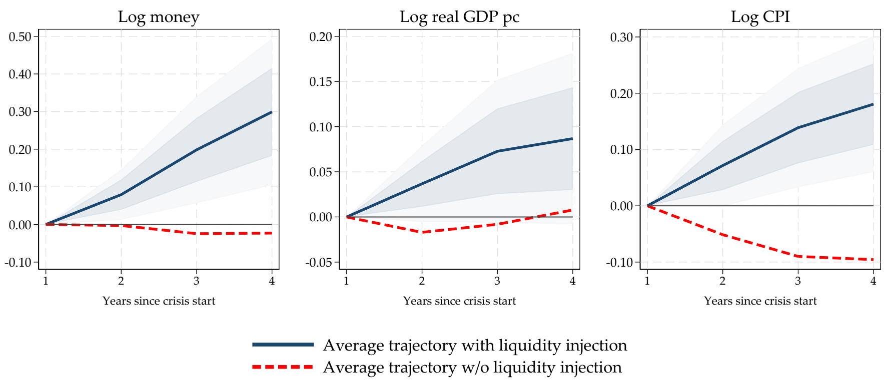


Figure 3.L.1. Controlling for institutional context

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on baseline macroeconomic controls described in the main text on page 167 In addition, Panel (a) controls for a binary variable indicating the presence of an explicit mandatory deposit insurance (Demirguc-Kunt and Detragiache, 2002) while Panel (b) instead adds two horizon-specific time period fixed effects: (i) classical gold standard and (ii) post WW2.

(a) Policy rate changes



(b) Government expenditures

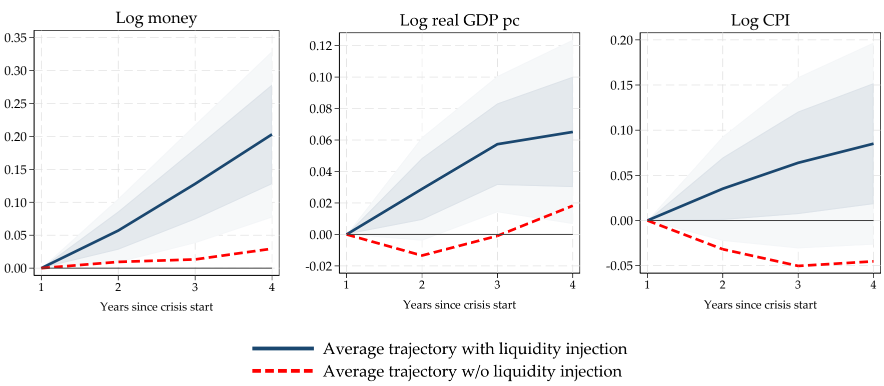


Figure 3.L.2. Adding controls for other policy changes

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on baseline macroeconomic controls described in the main text on page 167 In addition, Panel (a) adds controls for policy rate changes while Panel (b) instead adds controls for government expenditure growth, both with the same lag structure as for GDP growth and inflation.

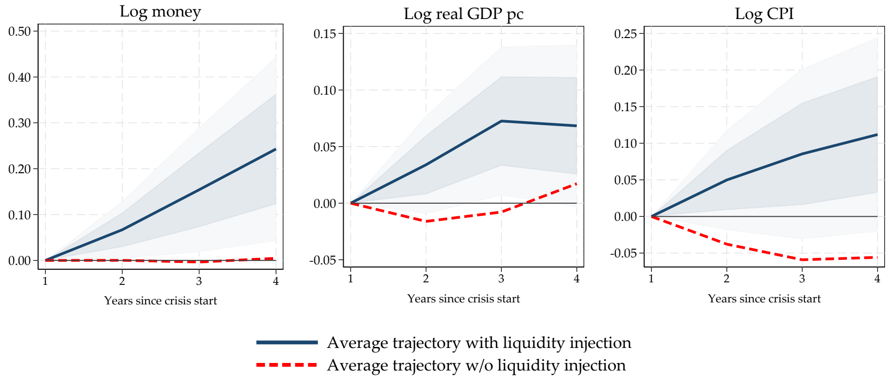


Figure 3.L.3. Adding controls for bank capitalisation

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. In addition, this specification controls for measure of bank leverage ratio in year before financial crisis as collected by Jordà et al. (2020). Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

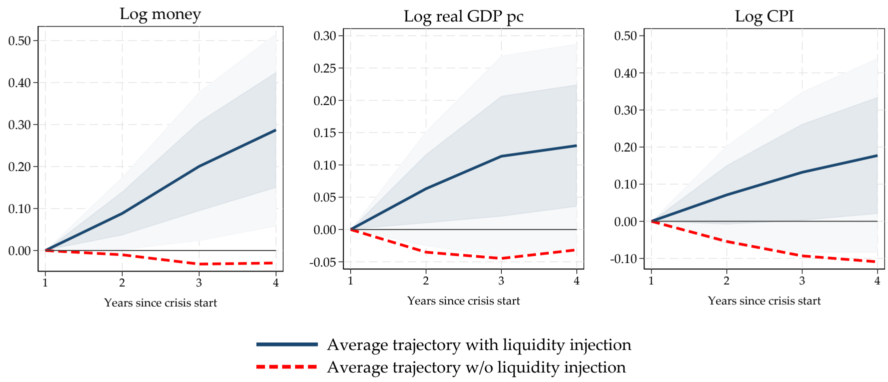
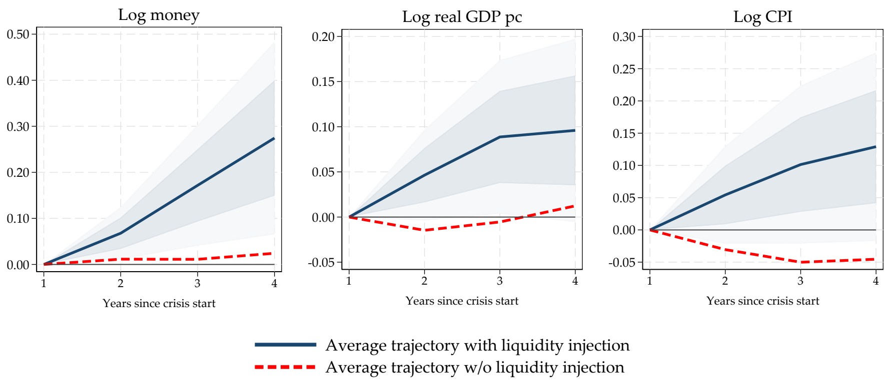


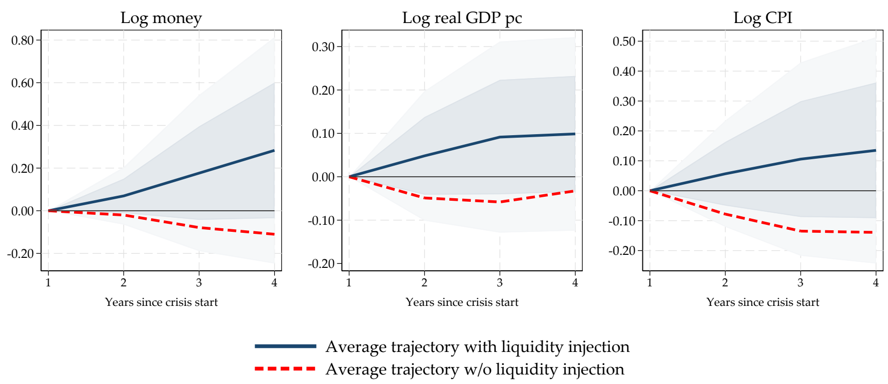
Figure 3.L.4. Without any controls except country fixed effects

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. This specification drops all controls except country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

(a) Central bank balance sheet growth beyond 20% threshold



(b) Central bank balance sheet growth beyond 10% threshold



(c) Continuous measure of balance sheet growth

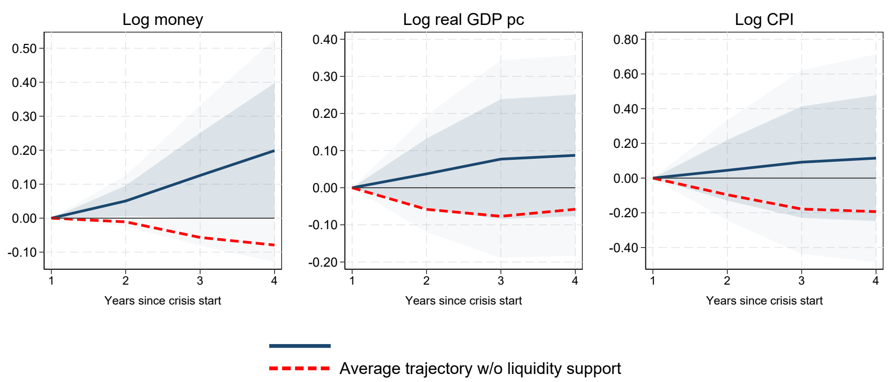
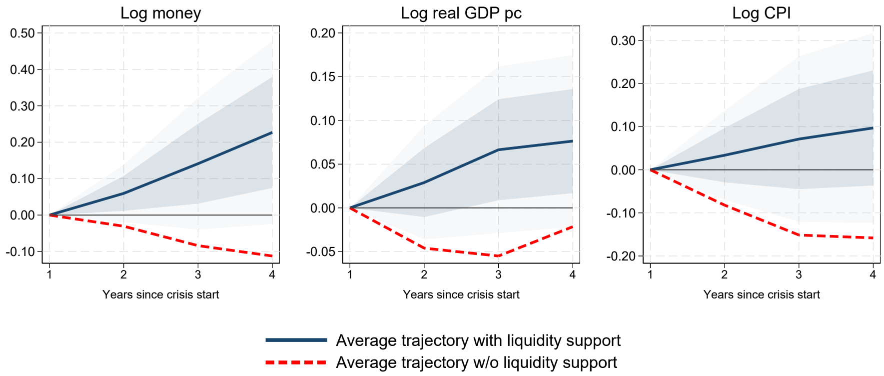


Figure 3.L.5. Alternative approaches to measure liquidity support

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). In Panel (a), liquidity support is defined as +20% annual central bank balance sheet growth or more during the first or second year of the crisis. In Panel (b), liquidity support is defined as +10% annual central bank balance sheet growth or more during the first or second year of the crisis. In Panel (c) liquidity support is measured by the bi-annual growth of the central bank balance sheet during the first and second year of the crisis and results are shown +30% growth, the average balance sheet growth rate conditional on the baseline +15% threshold. Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Controls are the same as in the baseline, see main text page 167.

(a) Measuring liquidity support via expansions in central bank deposits



(b) Measuring liquidity support via expansions in central bank liabilities other than deposits

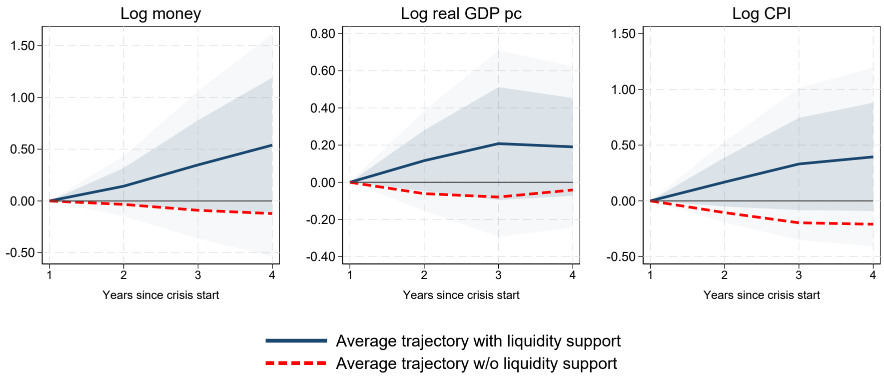


Figure 3.L.6. The role of central bank reserves

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). In Panel (a) liquidity support is defined as growth in central bank deposits of at least 15% during the first and second year of the crisis. In Panel (b) liquidity support is defined as growth in central bank liabilities other than deposits of at least 15% during the first and second year of the crisis. Central bank deposits in our data are dominated by banking sector reserves, but can include treasury or other public accounts where source data is to coarse. Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

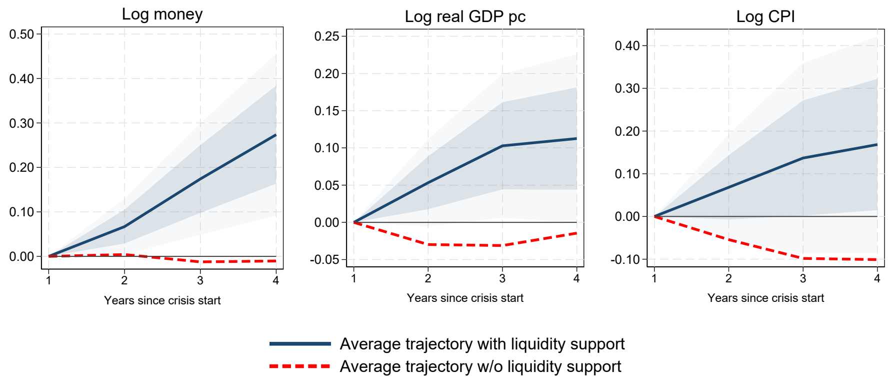
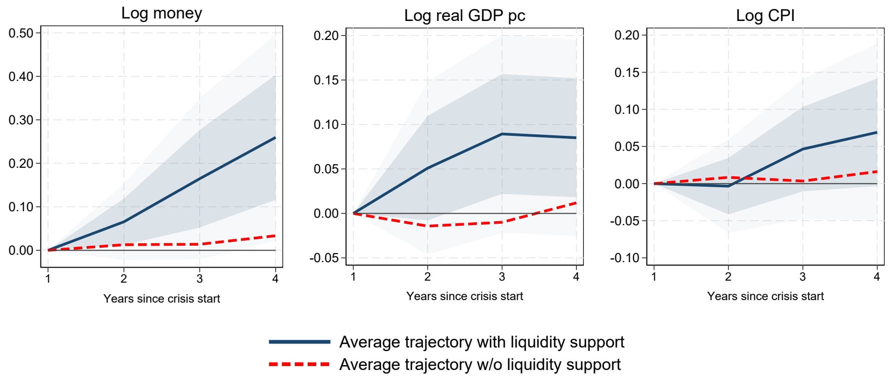


Figure 3.L.7. Measuring expansions in real terms

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Liquidity support is defined as +15% real annual central bank balance sheet growth or more during the first or second year of the crisis. Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

(a) JST crisis sample



(b) RR crisis sample

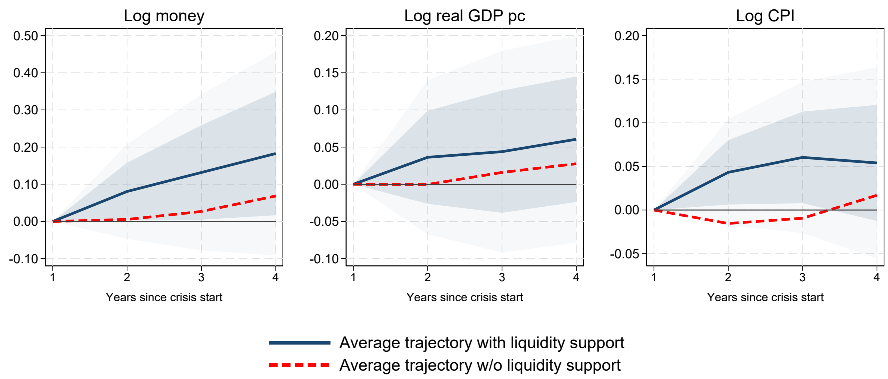
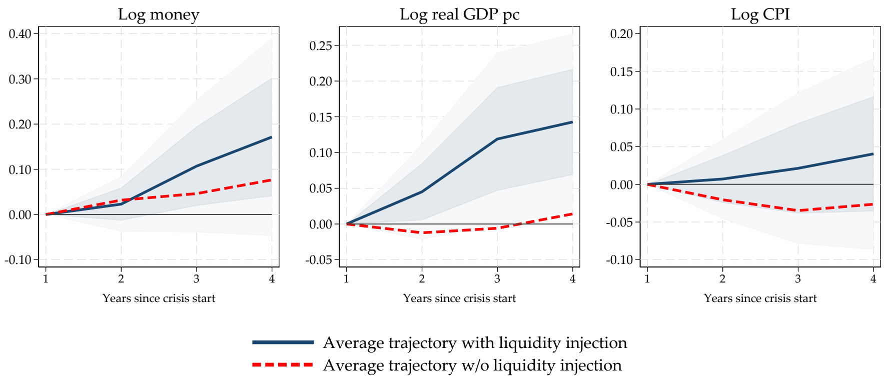


Figure 3.L.8. Alternative chronologies of financial crises

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5) for alternative crisis samples: Panel (a) dates financial crises using narrative chronology of Jorda, Schularick, and Taylor (2017). Panel (b) dates financial crises using narrative chronology of Reinhart and Rogoff (2009). Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

(a) Dropping the Great Financial and subsequent crises



(b) Dropping the Great Depression

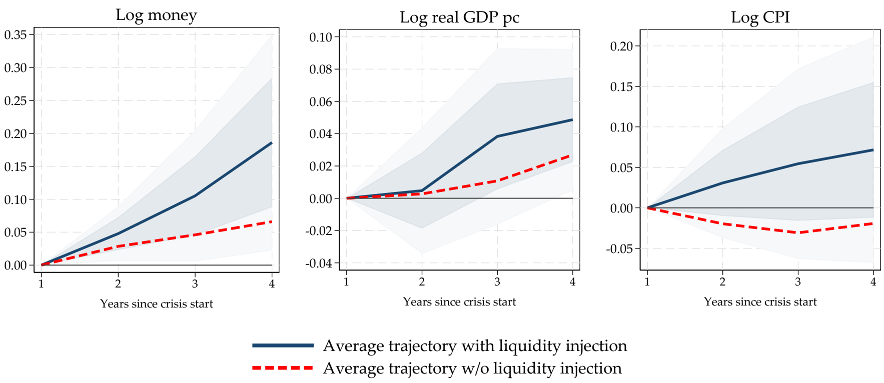


Figure 3.L.9. Dropping major crisis clusters

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5), for alternative crisis samples: Panel (a) shows results obtain after omitting all banking crises starting 2007 or later. Panel (b) shows results obtain after omitting all banking crises starting between 1929 and 1933. Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval ($\pm$ one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

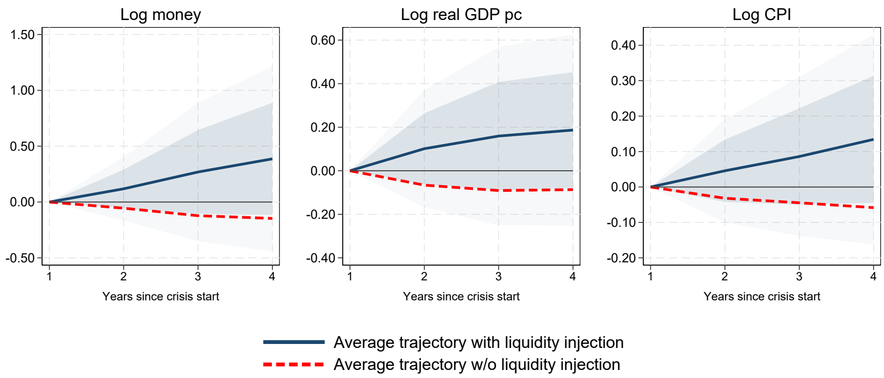


Figure 3.L.10. Subsample of "imported crises"

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5), using a subsample of 58 crises occurring during the later stages of an international crisis cluster, i.e., crises more exogenous to domestic economic conditions. We operationalise a crisis cluster as the set of crises with starting years coinciding or directly neighbouring the starting year of another. We then exclude all crises starting in the cluster's first year. For the Great Financial Crises, we include all crises except the US event. Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

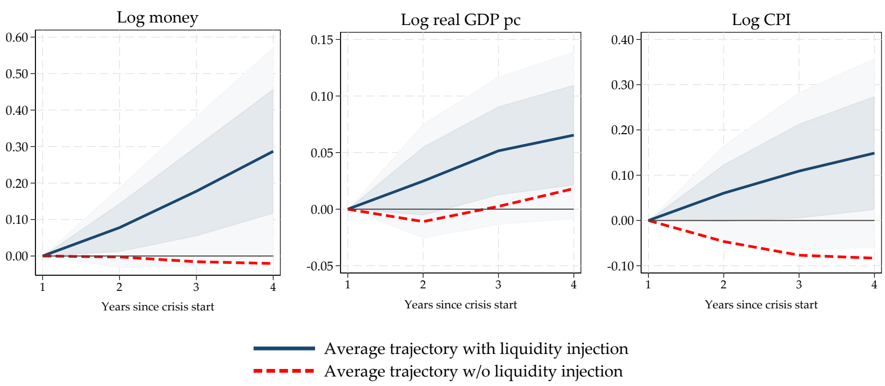


Figure 3.L.11. Using government ideology where central bank enjoyed little independence

Notes: The figure shows changes in log money aggregate M3, log real GDP per capita and log CPI after a financial crises if the central bank provides liquidity support (solid blue) or not (dashed red). Results are based on LP-IV estimation of Equations (3.4) and (3.5). Replace the governor coding by a coding of government ideology instead for central banks that rank low on indices of central bank independence as measured by Garriga (2016): we impute the government policy stance for all central bank country-years in which the central bank index is recorded as less than 0.5, for our banking crisis years, we count 19 such instances. In these cases, we impute center-right/conservative-led government = hawk ; centrist/center-left/left-led government = dove/pragmatist. Uncertainty about the effect of liquidity support is represented by lightly (darkly) shaded area marking its 90% confidence interval (± one standard error) obtained with robust standard errors clustered on the country level. Estimates are conditional on macroeconomic controls including the contemporaneous value (at $h = 1$) and two lags of real GDP growth and inflation as well as the three-year growth in real bank lending to the private sector prior to the financial crisis. Local projections include country fixed effects to absorb time-invariant but horizon-specific heterogeneity across countries.

Appendix 3.M Moral hazard

3.M.1 Examples of central bank policy motivated by concerns about moral hazard

- According to Bordo and James (2007, 81), monetary policies of the Banque de France during the first decades of the Third Republic (then under governors Pierre Magnin and Georges Pallain) were heavily influenced by moral hazard concerns - with Clement Juglar in 1884 allegedly expressing widespread non-interventionist policy sentiments by declaring that "A crisis for a nation is the operation made necessary to re-establish an equilibrium broken by speculation" (ibid.).
- Similar biases are documented for the Bank of England's governors: not least, the clear refusal to aid the tumbling house of Overend and Gurney in 1866 was underpinned by the belief that "even systemically important businesses did not labour under a 'too-big-to-fail' guarantee, thus eliminating the moral hazard problem from the policy equation. The path chosen by the Governors in 1866 effectively circumvented the moral hazard problem since the Bank's intervention in the wholesale market through the discount houses ensured both that the payments system was stabilized and that systemic risks from contagion effects were rendered manageable. Figuring prominently in the Bank's calculations was the belief that long-term benefits derived from refusing to rescue insolvent institutions may outweigh the temporary fruits of cooperation" Schneider (2021). Such biases at "the Bank" are widely documented well into the interwar period Gregory (1929).
- Fed governor Eugene Meyer, by his own account, was deeply influenced by his teacher William Graham Sumner, and his influential model of "laissez faire" economic liberalism - an economic Darwinism that sharply contrasted even with the mildly interventionist RFC institutional policies of 1933 and following, which he reluctantly supported after considerable political pressures (Meyer, 1954).
- Indeed, Meltzer (2005, 464ff.) and others (e.g. Calomiris (1997)) demonstrate how the entire pre-Great Depression era was dominated on a more general level by laissez-faire ideology - both on the policy- and on the private market-, banking-, sides, with market meltdowns viewed as "purgative" processes: Marriner Eccles (soon-to-be Fed governor) reports the prevailing consensus of the pre-1933 environment as amounting to the belief that "a depression was a scientific operation of economic laws...a deflation in values, and a scaling down of the debt structure to meet existing price levels, would in time create a self-corrective [sic] force".
- More recent case studies have often focused on the case of the "Greenspan Put" (Miller, Weller, and Zhang, 2002; Bornstein and Lorenzoni, 2018), associated with the October 1987 stock market crash in the U.S.: while we do not record a "major" expansion event on the balance sheet basis for any advanced economy then, proponents of the existence of such moral hazard features attached to a "Fed put" are positing that the phenomenon has been

present ever since, and especially during financial crises - thus rationalizing a test of such assumptions for all events since then. [79]

3.M.2 Distance to next financial crisis

In our dataset, we can test whether the duration to the next banking crises differs by governor attitude. In fact, estimates in Figure 3.M.1 show that the next banking crash came on average almost 10 years earlier if the current financial crisis was governed by doves ($\hat{\mu} = 16.8$ years) as opposed to hawkish central bank leadership ($\hat{\mu} = 26.3$ years). A two-sample one-sided t-test rejects equality at the 5% significance level.[80] Looking at the full distributions on the left of the same figure reveals that the majority of financial crises under hawks were followed by another within 25 years. By contrast, the probability to wait 30 years of longer for the next crisis to arrive is considerable under hawks.

Results presented in Figure 3.M.1 shed no light on quantitative link to expansion size. Moreover, different pre-crisis dynamics or country fixed effects might affect estimates. In that sense, they do not yet show to what extent generous liquidity drives these differences. To test the narrower hypothesis, we regress the time to the next financial crisis on liquidity injection ($m_{i,t+1} = 1$), instrumented by governor attitude as before and conditioning on the same set of business cycle controls as in the previous LP-IV analyses. The sample now consists of 59 financial crises, after dropping 17 crises for which the following financial crisis was not observed by 2020. Table 3.M.1 details estimation results. The instrumented second-stage coefficient qualitatively confirms the moral hazard hypothesis. Quantitatively, balance sheet expansions could reduce the time to the next financial crisis by 40 years – yet, statistical uncertainty is large: the 95% confidence interval covers reductions of 6 to 74 years.

79. For instance Hall (2011) posits that a standard Taylor rule model for the Fed meaningfully improves once asset price dynamics are taken into account over the period 1987-2008. Hall on this basis concludes that "agents' confidence in a stronger response of the US central bank to significant market declines urging to an easing of monetary conditions in their favour was therefore not unfounded".

80. Differences magnify when including the most recent financial crisis assuming that the next crisis would strike in 2022.

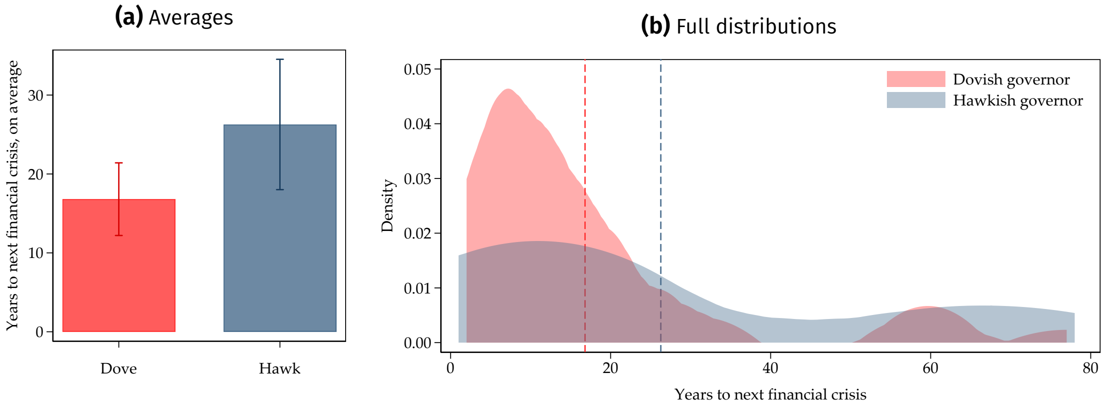


Figure 3.M.1. Time to next financial crisis, by governor attitude

Notes: The left panel shows average number of years to the next financial crisis across all 70 financial crises for which the next crisis has been observed yet, by attitude of central bank governor during current crisis. Error bars mark the 90% CI. A two-sample one-sided t-test rejects equality at the 5% significance level. The right panel shows the kernel density estimates for the same sample, by governor attitude. Vertical dashed lines mark corresponding averages.

Table 3.M.1. Balance sheet expansions reduce time to next financial crisis

	(1) Years to next crisis
Liquidity injection $m_{it(f)+1}$, instrumented	-40.2**
	(17.4)
Macro controls	Yes
Country FE	Yes
First stage F	11.51
R^2	0.08
Crises	59

Notes: Two-stage-least-squares regression uses the instrument of governor attitude g_{it+1}, replicating the IV setting from the previous section. Macroeconomic controls identical to baseline specification. Country fixed effects absorbed by within-estimator. Robust standard errors in parentheses. ***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

3.M.3 Predictive power of liquidity injections for fragile credit booms

Table 3.3 shows evidence for the predictive power of liquidity injection during last crises for fragile credit booms, i.e., booms that end in financial crises, going forward. Figure 3.M.2 below plots the receiver operating characteristic (ROC) curve for the logit model with and without the injection indicator. As can be seen, controls including a third-order polynominal of time since the last crisis, controls for the current macroeconomic environment that the one leading up to the last crisis and country fixed effects already give strong predictive power for fragile credit booms. The area under the curve (AUC) is 0.9366. Yet, adding the liquidity injection indicator pushes the ROC out further, weakly improving the sensitivity for any level of specificity and yielding an

AUC of 0.9517. The χ^2 statistic for a test of equality between the two AUCs is 3.31—despite the large baseline AUC—implying a p-value of 0.0687.

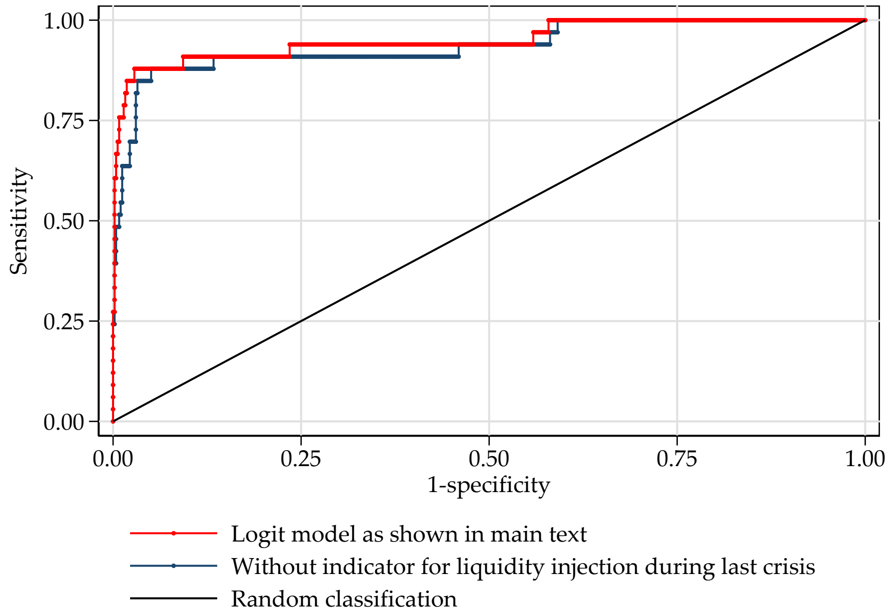


Figure 3.M.2. ROC curves for predicting fragile credit booms

Notes: ROC curves for the logit model presented in Table 3.3 as well as for the same mode but excluding the injection indicator. AUCs are 0.9517 and 0.9366, respectively, and the test on equality returns a p-value of 0.0687.

Appendix 3.N Back of the envelope calculation of net value of liquidity support

Our results suggest that central bank liquidity injections during crises come with a trade-off: They bolster short-term growth by containing financial fallout, but threaten long-term growth by sowing financial stability risks. Based on our estimates, we gauge the conditions under which such interventions raise the net present value of output, when under which they are not.

Since the trade-off is intertemporal in nature, assumptions about the discount rate as well as trend growth are critical. To assess the sensitivity of conclusions to discount rates, we will compute changes in net present value of output for three different values: 1%, 3% and 5%. Similarly, we will consider three different trend growth rates: 1%, 3% and 5%. This yields a matrix of nine assumption combinations. Across all nine combinations, we assume that crisis liquidity injections boost output according to our point estimates:

To be conservative, we assume the differential to close by horizon five .This allows us to compute the short-term gain of liquidity interventions.

	No injection $(\hat{\alpha}_h + \hat{\gamma}_h \bar{x}_{it+1})$	Injection $(\hat{\alpha}_h + \hat{\gamma}_h \bar{x}_{it+1} + \hat{\beta}_h)$	Difference $(\hat{\beta}_h)$
$h = 2$	-0.015	0.035	0.050
$h = 3$	-0.005	0.075	0.080
$h = 4$	0.005	0.080	0.075

To compute interventions' cost of future instability, we assume that an additional crisis occurs after ten years with a probability $p = 15.8\%$.[81] Furthermore, we assume that a financial crisis mutes growth during the first ($h = 0$) and second ($h = 1$) year—irrespective of central bank policy.[82] Finally, we assume economies to back to trend by $h = 5$, i.e., the horizon at which we also assume the gap between intervention an no intervention to be closed, see above. We consider i) the case in which the future governor does not intervene again and i) a central bank that will continue to intervene, risking a indefinite sequence of future crises.

Based on discount rate ρ and trend growth γ, we can compute the net present value of liquidity injections for case i) as follows:

$$\begin{aligned}
&\frac{\hat{\beta}_2 y_0}{1+\rho} + \frac{\hat{\beta}_3 y_0}{(1+\rho)^2} + \frac{\hat{\beta}_4 y_0}{(1+\rho)^3} - p\Big(\frac{y_0(1+\gamma)^{10} - y_0(1+\gamma)^9}{(1+\rho)^{10}} + \frac{y_0(1+\gamma)^{11} - y_0(1+\gamma)^9}{(1+\rho)^{11}} \\
&\quad + \frac{y_0(1+\gamma)^{12} - y_0(1+\gamma)^9(1+\hat{\alpha}_2 + \hat{\gamma}_2 \bar{x}_{i0})}{(1+\rho)^{12}} \\
&\quad + \frac{y_0(1+\gamma)^{13} - y_0(1+\gamma)^9(1+\hat{\alpha}_3 + \hat{\gamma}_3 \bar{x}_{i0})}{(1+\rho)^{13}} \\
&\quad + \frac{y_0(1+\gamma)^{14} - y_0(1+\gamma)^9(1+\hat{\alpha}_4 + \hat{\gamma}_4 \bar{x}_{i0})}{(1+\rho)^{14}}\Big)
\end{aligned}$$

$$\begin{aligned}
= y_0\Big(&\frac{\hat{\beta}_2}{1+\rho} + \frac{\hat{\beta}_3}{(1+\rho)^2} + \frac{\hat{\beta}_4}{(1+\rho)^3} - p\frac{(1+\gamma)^{10}}{(1+\rho)^{10}}\Big(\frac{1-(1+\gamma)^{-1}}{1} + \frac{(1+\gamma)-(1+\gamma)^{-1}}{1+\rho} \\
&+ \frac{(1+\gamma)^2 - (1+\gamma)^{-1}(1+\hat{\alpha}_2 + \hat{\gamma}_2 \bar{x}_{i0})}{(1+\rho)^2} \\
&+ \frac{(1+\gamma)^3 - (1+\gamma)^{-1}(1+\hat{\alpha}_3 + \hat{\gamma}_3 \bar{x}_{i0})}{(1+\rho)^3} \\
&+ \frac{(1+\gamma)^4 - (1+\gamma)^{-1}(1+\hat{\alpha}_4 + \hat{\gamma}_4 \bar{x}_{i0})}{(1+\rho)^4}\Big)\Big)
\end{aligned}$$

In case ii) the loss from the next crisis is smaller due to interventions, but this in turn risks future crises:

81. We estimate that liquidity injections elevate crisis risk over the next 20 years by 3.7 to 15.8 percentage points. We use the largest of our estimates to be conservative. Moreover, effects seem mostly driven by horizons 10 to 15, so we settle for a ten years, again to be conservative.

82. This is motivated by evidence from our sample, where average real GDP growth is zero during those two years, i.e., forgoing average trend growth of about 2.6%.

$$
\begin{aligned}
&\frac{\hat{\beta}_2 y_0}{1+\rho} + \frac{\hat{\beta}_3 y_0}{(1+\rho)^2} + \frac{\hat{\beta}_4 y_0}{(1+\rho)^3} - p\Big(\frac{y_0(1+\gamma)^{10} - y_0(1+\gamma)^9}{(1+\rho)^{10}} + \frac{y_0(1+\gamma)^{11} - y_0(1+\gamma)^9}{(1+\rho)^{11}} \\
&\quad + \frac{y_0(1+\gamma)^{12} - y_0(1+\gamma)^9(1+\hat{\alpha}_2+\hat{\gamma}_2\bar{x}_{i0}+\hat{\beta}_2)}{(1+\rho)^{12}} \\
&\quad + \frac{y_0(1+\gamma)^{13} - y_0(1+\gamma)^9(1+\hat{\alpha}_3+\hat{\gamma}_3\bar{x}_{i0}+\hat{\beta}_3)}{(1+\rho)^{13}} \\
&\quad + \frac{y_0(1+\gamma)^{14} - y_0(1+\gamma)^9(1+\hat{\alpha}_4+\hat{\gamma}_4\bar{x}_{i0}+\hat{\beta}_4)}{(1+\rho)^{14}} \\
&\quad - p^2\Big(\frac{y_0(1+\gamma)^{20} - y_0(1+\gamma)^{19}}{(1+\rho)^{20}} + \frac{y_0(1+\gamma)^{21} - y_0(1+\gamma)^{19}}{(1+\rho)^{21}} \\
&\quad + \frac{y_0(1+\gamma)^{22} - y_0(1+\gamma)^{19}(1+\hat{\alpha}_2+\hat{\gamma}_2\bar{x}_{i0}+\hat{\beta}_2)}{(1+\rho)^{22}} \\
&\quad + \frac{y_0(1+\gamma)^{23} - y_0(1+\gamma)^{19}(1+\hat{\alpha}_3+\hat{\gamma}_3\bar{x}_{i0}+\hat{\beta}_3)}{(1+\rho)^{23}} \\
&\quad + \frac{y_0(1+\gamma)^{24} - y_0(1+\gamma)^{19}(1+\hat{\alpha}_4+\hat{\gamma}_4\bar{x}_{i0}+\hat{\beta}_4)}{(1+\rho)^{24}}\Big) \\
&\quad \ldots
\end{aligned}
$$

$$
\begin{aligned}
= y_0\Big(&\frac{\hat{\beta}_2}{1+\rho} + \frac{\hat{\beta}_3}{(1+\rho)^2} + \frac{\hat{\beta}_4}{(1+\rho)^3} - \sum_{j=1}^{\infty} p^j \frac{(1+\gamma)^{10j}}{(1+\rho)^{10j}}\Big(\frac{1-(1+\gamma)^{-1}}{1} + \frac{(1+\gamma)-(1+\gamma)^{-1}}{1+\rho} \\
&+ \frac{(1+\gamma)^2 - (1+\gamma)^{-1}(1+\hat{\alpha}_2+\hat{\gamma}_2\bar{x}_{i0}+\hat{\beta}_2)}{(1+\rho)^2} \\
&+ \frac{(1+\gamma)^3 - (1+\gamma)^{-1}(1+\hat{\alpha}_3+\hat{\gamma}_3\bar{x}_{i0}+\hat{\beta}_3)}{(1+\rho)^3} \\
&+ \frac{(1+\gamma)^4 - (1+\gamma)^{-1}(1+\hat{\alpha}_4+\hat{\gamma}_4\bar{x}_{i0}+\hat{\beta}_4)}{(1+\rho)^4}\Big)\Big)
\end{aligned}
$$

Tables 3.N.2 and 3.N.1 show very similar results for case i) and case ii) respectively. Strikingly, the net present value of interventions is positive across almost all considered assumption combinations and substantially above 10% of current GDP under many plausible assumptions. Only when future output is substantially larger and discount rates are low will future crises be costly enough to swamp the benefits of near-term interventions.

Table 3.N.1. Net present value of output changes, case (i)

		Discount rate		
		5%	3%	1%
	5%	0.077	0.041	-0.014
Trend growth	3%	0.136	0.124	0.104
	1%	0.172	0.175	0.175

Notes: The net present value of liquidity injections in response to a financial crisis expressed as a share of current GDP under different assumptions for social discount rates and real trend growth. These figures account both for short-run stabilization gains as well as long-run financial instability costs and are computed under the assumption that there are no interventions during a potential future crisis.

Table 3.N.2. Net present value of output changes, case (ii)

		Discount rate		
		5%	3%	1%
	5%	0.088	0.048	-0.023
Trend growth	3%	0.152	0.145	0.130
	1%	0.182	0.189	0.195

Notes: The net present value of liquidity injections in response to a financial crisis expressed as a share of current GDP under different assumptions for social discount rates and real trend growth. These figures account both for short-run stabilization gains as well as long-run financial instability costs and are computed under the assumption that the central bank would intervene again during potential future crises.

Placebo test: Random governor classifications

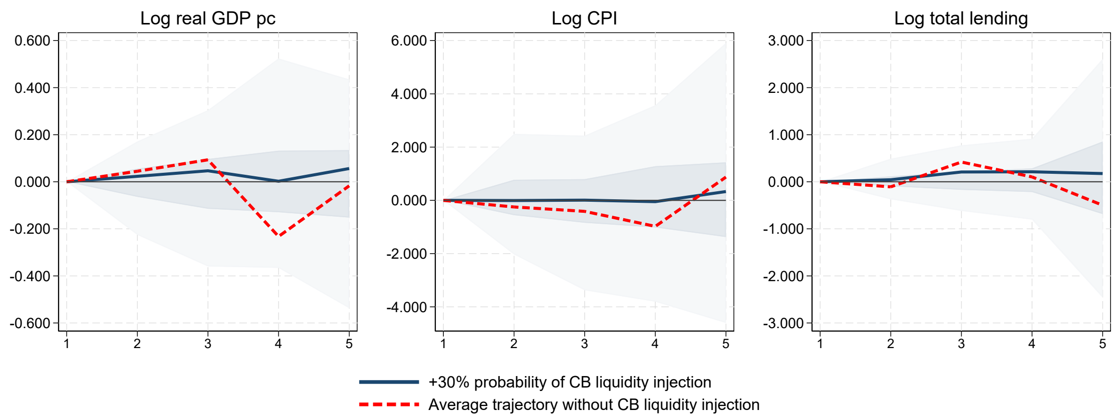


Figure 3.N.1. LP-IV with placebo instruments

Notes: Monte Carlo estimates from 1000 random governor classifications with the same hawk/dove proportions. Lines mark average estimates, (dark) shaded areas mark 5th (16th) and 95th (84th) percentiles.

Appendix 3.O Selected long series of central bank total assets

Sweden and Britain: Figure 3.O.1 shows total central bank assets/British NGDP between 1700-2016 on the basis of Dimsdale and Thomas (2017), and current GDP estimates at market prices via Broadberry et al. (2015). Britain has of course served as a key case study to study financial-institutional modernization, and serves as the classic case of an early centralized public financial system. [83] World War Two and the post-2008 expansion stand out here on a historic scale - but

83. Following Dincecco (2011)'s classification, who posits a completion of fiscal centralization for England in the year 1066, which is echoed in related literature.

we note that pre-GFC all-time records were not in fact set during 1939-1945, but rather during the early years of the Bank of England, following its 1694 inception.

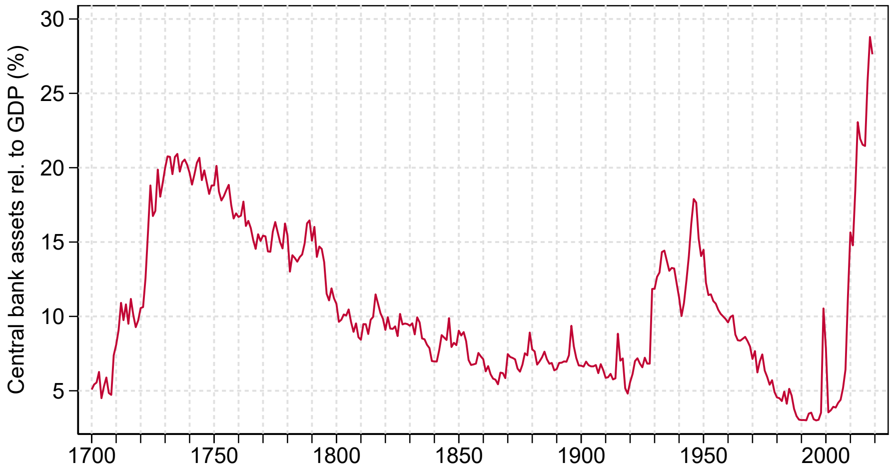


Figure 3.O.1. Bank of England, total assets, 1700-2020

Notes: In percent of current U.K. GDP (contemporary borders).

Figure 3.O.1 shows sharp asset expansions beginning around the time of the South Sea Bubble, with total BoE assets relative to GDP reaching a peak of 24% by 1735: representative of the fact that many early central banks were able to provide substantial liquidity volumes even under gold standard regimes, and were initially not bound to target real economic activity.[84]

Figure 3.O.2 displays Riksbank total assets as a share of Swedish GDP, 1668-2020, on the basis of recently released data (Fregert, 2014). Sweden - contrasting with the British case - serves as an example of a historical "laggard" in the development of public finance, and from its inception kept its central bank formally under public (Parliamentary) ownership.[85] We observe that a public-ownership status did not preclude substantial active central bank balance sheet expansions relative to GDP, either, and that they were not exclusive to the floating currency regime era. Once more, large asset expansions can be linked directly to the motivation to reduce liquidity risks in financial markets: in the Swedish case the most dramatic increase in total assets over the very long term is recorded for the 1750-1765 period, when the share surged from below 20% to a record 49.8% in 1759. The backdrop was the Seven Years' War – with the costly Pomeranian Campaign almost exclusively financed by rapid Riksbank note issuance – the erosion of silver

84. In nominal terms, the key expansion years for total BoE assets at the time are 1720 (+19.5% year-on-year), 1723 (+24.1%), and 1724 (+19.1%). None of these years technically qualifies as a “major” expansion event along our definitions; the 1720 expansion is driven by an expansion in non-public securities (+133% year-on-year), and 1723-4 by a jump in government security assets, see Dimsdale and Thomas (2017, sheet A.23).

85. Dincecco (2011) posits a fiscal centralization for Sweden only by the year 1840, almost eight centuries after the English centralization. The 1668 and 1719 statutes explicitly formalized ownership of the Riksbank by the Riksdag, and contained a pledge by the King to respect the Bank’s independence, see (Fregert and Jonung, 1996).

prices, and heavy bank runs in Stockholm during the 1740s, eventually triggering a suspension of convertibility by 1745 and a period of floating currency in Sweden (Heckscher, 1954; Fregert and Jonung, 1996).

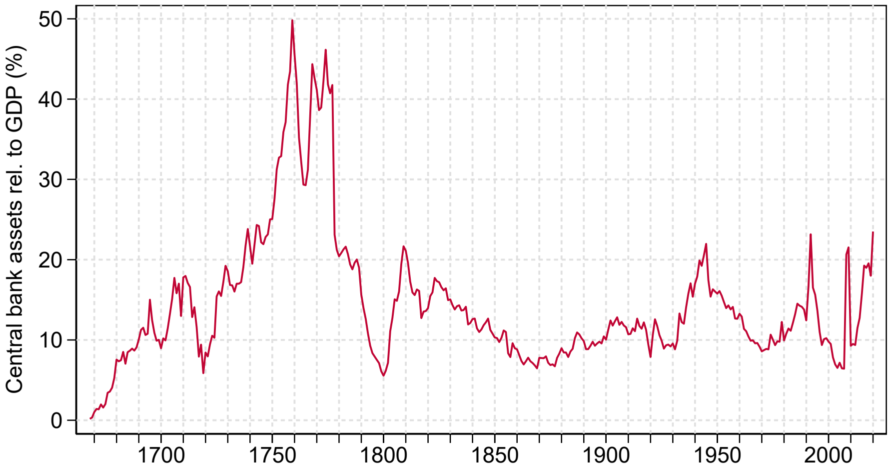


Figure 3.O.2. Riksbank, total assets, 1668-2020

Notes: In percentage of current Swedish GDP.

Appendix 3.P Data Appendix - Sources of Central Bank Balance Sheet Data

Australia

Assets: Total

- 1920 to 1945: from National Library of Australia, "Queanbeyan Age and Queanbeyan Observer ", various issues, accessible online (link)
- 1950 to 1997: from Reserve Bank of Australia, File "3.6 Assets", accessible online (link)
- 1998 to 2014: from Reserve Bank of Australia, File "A1.1 Liabilities and Assets", accessible online (link), column "Total Assets", June-values.
- 2015 to 2020: from Reserve Bank of Australia, File "A1.1 Liabilities and Assets", accessible online. (link), column "Total Assets". Weekly data, average of June-values.

Assets: Government debt

- 1920 to 1945: from S. J. Butlin, A. R. Hall and R. C. White, "Australian Banking and Monetary Statistics 1817-1945", Reserve Bank of Australia, Occasional Paper No. 4A, Sydney, 1971, page 136, table 9, series "Govt. And Municipal Securities", converted to AUD.
- 1950 to 1997: from Reserve Bank of Australia, File "3.6 Assets", accessible online (link)
- 1998 to 2015: from Reserve Bank of Australia. Statistics. Statement of Liabilities and Assets. Summary historical data. Excel file A1 - Liabilities and Assets - Summary. (link)

Assets: Gold

- 1920 to 1945: from National Library of Australia, "Queanbeyan Age and Queanbeyan Observer ", various issues, accessible online (link)
- 1950 to 1997: from Reserve Bank of Australia, File "3.6 Assets", accessible online (link)
- 1998 to 2014: from Reserve Bank of Australia, File "A1.1 Liabilities and Assets", accessible online (link), column "Gold and foreign exchange", June-Entry.
- 2015 to 2020: from Reserve Bank of Australia, File "A1.1 Liabilities and Assets", accessible online. (link), "Gold and foreign exchange". Weekly data, average of June-values.

Assets: Foreign

- NA

Liabilities: Notes and coin

- 1950 to 1997: from Reserve Bank of Australia, File "3.5 Liabilities", accessible online (link), column "Bills and Notes".
- 1998 to 2014: from Reserve Bank of Australia, File "A1.1 Liabilities and Assets", accessible online (link), column "Notes on Issue", June-Entry.

- 2015 to 2020: from Reserve Bank of Australia, File "A1.1 Liabilities and Assets", accessible online. (link), column "Notes on Issue". Weekly data, average of June-values.

Liabilities: Deposits

- 1920 to 1945: from S. J. Butlin, A. R. Hall and R. C. White, "Australian Banking and Monetary Statistics 1817-1945", Reserve Bank of Australia, Occasional Paper No. 4A, Sydney, 1971, page 135, table 9, sum of series "Total deposits" and "Balances due to other banks", converted to AUD.
- 1960 to 1997: from Reserve Bank of Australia, File "3.5 Liabilities", accessible online (link). Sum of columns "Notes on issues", "Non-callable/SRD", "Overseas Institutions", "Commonwealth", "State" and "Other".
- 1998 to 2014: from Reserve Bank of Australia. Statistics. Statement of Liabilities and Assets. Summary historical data. Excel file A1 - Liabilities and Assets - Summary. (link)
- 2015 to 2020: from Reserve Bank of Australia, File "A1.1 Liabilities and Assets", accessible online. (link), Sum of columns "Exchange Settlements Balances" and "Deposits". Weekly data, average of June-values

Liabilities: Foreign

- NA

Belgium

Assets: Total

- 1870 to 1914: from National Bank of Belgium, Annual Report, various issues, "Total Assets" or "Total Actif", accessible online (link)
- 1916 to 1998: from National Bank of Belgium, Annual Report, various issues, "Total Assets" or "Total Actif", accessible online (link)
- 1999 to 2020: from National Bank of Belgium, NBB Stat, Financial Institutions, National Bank of Belgium, "Assets", accessible online (link). M12 value. Converted to BEF

Assets: Government debt

- 1870 to 1914: from National Bank of Belgium, Annual Report, various issues, accessible online (link), Sum of Columns "Prets sur fonds publics" and "Fonds public".
- 1916 to 1938: from National Bank of Belgium, Annual Report, various issues, accessible online (link), Sum of Columns "Prets sur fonds publics" and "Fonds public".
- 1939 to 1990: from National Bank of Belgium, Annual Report, various issues, column "Government debt". Accessible online (link).

Assets: Gold

- 1870 to 1914: from National Bank of Belgium, Annual Report,"Caisse: Espèces et lingots" or "Or a l'etranger" or "Gold", series ends in 1990 when Belgium started to value gold holdings at market prices, various issues, accessible online (link).
- 1916 to 1998: from National Bank of Belgium, Annual Report,"Caisse: Espèces et lingots" or "Or a l'etranger" or "Gold", series ends in 1990 when Belgium started to value gold holdings at market prices, various issues, accessible online (link).
- 1999 to 2020: from National Bank of Belgium, NBB Stat, Financial Institutions, National Bank of Belgium, "Assets", accessible online (link). M12 value. Converted to BEF

Assets: Foreign

- 1944 to 1998: from National Bank of Belgium, Annual Report, various issues, Sum of "Creances en devices etrangeres", "Billets et monnaies etrangers", "Avoirs en devises etrangeres", "Effets en francs belges sur l'etranger", "Accord "Union Europeenne de Paiements": francs belges" and "Creances sur l'etranger dans le cadre d'accords de paiement". Accessible online (link).
- 1999 to 2020: from National Bank of Belgium, NBB Stat, Financial Institutions, National Bank of Belgium, sum of "Claims on non-euro area residents denominated in foreign currency", "Receivables from the IMF", "Claims on non-euro area residents denominated in euro" and "Intra-eurosystem claims" accessible online (link). M12 value. Converted to BEF

Liabilities: Notes and coin

- 1870 to 1914: from National Bank of Belgium, Annual Report, various issues, column "Billets de banque en circulation". Accessible online (link).
- 1916 to 1998: from National Bank of Belgium, Annual Report, various issues, column "Billets de banque en circulation". Accessible online (link).
- 1999 to 2020: from National Bank of Belgium, NBB Stat, Financial Institutions, National Bank of Belgium, "Banknotes in Circulation", accessible online (link). M12 value, converted to BEF

Liabilities: Deposits

- 1870 to 1914: from National Bank of Belgium, Annual Report, various issues, column "Comptes courants crediteurs". Accessible online (link).
- 1916 to 1987: from National Bank of Belgium, Annual Report, various issues, column "Comptes courants crediteurs". Accessible online (link).
- 1988 to 2020: from International Monetary Fund, International Financial Statistics, Monthly Report, various issues, series "Central bank, reserve deposits of other depository corporations", December values.

Liabilities: Foreign

- 1946 to 1998: from National Bank of Belgium, Annual Report, various issues, accessible online (link).

Canada

Assets: Total

- 1935 to 2020: from Statistics Canada, “Bank of Canada, Assets and Liabilities, at Months-end” (Table 176-0010), accessible online (link), December values.

  Assets: Government debt

- 1935 to 2020: from Statistics Canada, “Bank of Canada, Assets and Liabilities, at Months-end” (Table 10-10-0108-01), column “Direct and guaranteed securities”, accessible online (link), December values.

  Assets: Gold

- NA

  Assets: Foreign

- 1935 to 1980: from Statistics Canada, “Bank of Canada, Assets and Liabilities, at Months-end” (Table 10-10-0108-01), accessible online (link), December values.

  Liabilities: Notes and coin

- 1935 to 2020: from Statistics Canada, “Bank of Canada, Assets and Liabilities, at Months-end” (Table 10-10-0108-01), column “Total, Notes in circulation”, accessible online (link), December values.

  Liabilities: Deposits

- 1935 to 2020: from Statistics Canada, “Bank of Canada, Assets and Liabilities, at Months-end” (Table 10-10-0108-01), sum of columns “Government of Canada”, “Government of Canada enterprises”, “foreign central banks and official institutions”, “members of the Canadian Payments Association” and “other”, accessible online (link), December values.

  Liabilities: Foreign

- 1945 to 2020: from Statistics Canada, “Bank of Canada, Assets and Liabilities, at Months-end” (Table 10-10-0108-01), accessible online (link), December values.

Denmark

Assets: Total

- 1865 to 1874: via Svendsen et al. (1968a), Dansk Pengehistorie 1700-1960.

- 1875 to 2005: from Nationalbank of Denmark, working paper “Monetary Trends and Business Cycles in Denmark 1875-2005”, Table A1, accessible online (link).
- 2006 to 2019: from Nationalbank of Denmark, “Report and Accounts”, various issues, accessible online (link).

Assets: Government debt

- 1865 – via Svendsen et al. (1968a).

Assets: Gold

- 1865 to 1874: via Svendsen et al. (1968a).
- 1875 to 2005: from Nationalbank of Denmark, working paper “Monetary Trends and Business Cycles in Denmark 1875-2005”, Table A1, accessible online (link).
- 2006 to 2019: from Nationalbank of Denmark, “Report and Accounts”, various issues, accessible online (link).

Assets: Foreign

- 2006 to 2019: from Nationalbank of Denmark, “Report and Accounts”, various issues, accessible online (link).

Liabilities: Notes and coin

- 1875 to 2005: from Nationalbank of Denmark, working paper “Monetary Trends and Business Cycles in Denmark 1875-2005”, Table A1, column “Currency”, accessible online (link).
- 2006 to 2019: from Nationalbank of Denmark, “Report and Accounts”, various issues, accessible online (link).

Liabilities: Deposits

- 1875 to 2005: from Nationalbank of Denmark, working paper “Monetary Trends and Business Cycles in Denmark 1875-2005”, Table A1, accessible online (link).
- 2006 to 2019: from Nationalbank of Denmark, “Report and Accounts”, various issues, accessible online (link).

Liabilities: Foreign

- 2006 to 2019: from Nationalbank of Denmark, “Report and Accounts”, various issues, accessible online (link).

Finland

Assets: Total

- 1813 to 1865: from Asp (1898), Tables 1-24.
- 1870 to 1992: from Bank of Finland, “Suomen Pankin Keskustelualoitteita”, Table “Suomen Pankin Tase 1868-1992”, column “Saatavat”, accessible online (link)
- 1993 to 1998: from Bank of Finland, Annual Report of 1998 and Statistical Yearbook, Various Issues, accessible online (link).
- 1999 to 2020: from Bank of Finland. Series: Total assets. (link)

Assets: Government debt

- 1813 to 1865: from Asp (1898), Tables 4 and 21 ("Depositionsfond, Staatsdarlehen, und Reservefond, in Rubel Silber").

Assets: Gold

- 1842 to 1865: from Asp (1898), Table 17 ("Bestand der Valuta, in Rubel Silber").
- 1993 to 1998: from Bank of Finland, Annual Report of 1998 and Statistical Yearbook, Various Issues, accessible online (link).
- 1999 to 2020: from Bank of Finland. Series: Gold. (link)

Assets: Foreign

- 1842 to 1865: from Asp (1898), Table 18 ("Auslaendische Correspondenten, Darlehen gegen Hypothek u. diskont. inlaendische Wechsel).
- 1870 to 1992: from Bank of Finland, “Suomen Pankin Keskustelualoitteita”, Ikonen Vappu, Suomen Pankin tase vuosina 1868-1992, Table “Suomen Pankin Tase 1868-1992”, column “Ulkomaiset saatavat”, accessible online (link).
- 1993 to 1998: from Bank of Finland, Annual Report of 1998 and Statistical Yearbook, various issues, Sum of “Special drawing rights”, “IMF reserve tranche”, “Convertible Currencies”, accessible online (link).
- 1999 to 2020: from Bank of Finland. Sum of series “Claims on non-euro area residents denominated in foreign currency”, “Claims on euro area residents denominated in foreign currency” and “Claims on non-euro area residents denominated in euro” (link)

Liabilities: Notes and coin

- 1870 to 1992: from Bank of Finland, “Suomen Pankin Keskustelualoitteita”, Table “Suomen Pankin Tase 1868-1992”, column “Liikkeessä oleva setelistö”, accessible online (link).
- 1993 to 1998: from Bank of Finland, series “Banknotes in circulation”, accessible online (link)

Liabilities: Deposits

- 1870 to 1992: from Bank of Finland, “Suomen Pankin Keskustelualoitteita”, Table “Suomen Pankin Tase 1868-1992”, sum of column “Velat julkiselle sektorille” and “Bank Deposits”, accessible online (link)
- 1993 to 1998: from Bank of Finland, Annual Report of 1998 and Statistical Yearbook, various issues, Sum of “Liabilities to financial Institutions”, “Liabilities to the public sector” and “Liabilities to corporations”, accessible online (link).
- 1999 to 2020: from Bank of Finland, sum of series “Liabilities to euro area credit institutions related to monetary policy operations denominated in euro”, “Deposits, balances and other liabilities”, accessible online (link)

Liabilities: Foreign

- 1878 to 1879: from Bank of Finland, “Suomen Pankin Keskustelualoitteita”, Table “Suomen Pankin Tase 1868-1992”, column “Ulkomaiset velat”, accessible online (link).
- 1889 to 1992: from Bank of Finland, “Suomen Pankin Keskustelualoitteita”, Table “Suomen Pankin Tase 1868-1992”, column “Ulkomaiset velat”, accessible online (link).
- 1993 to 1998: from Bank of Finland, Annual Report of 1998 and Statistical Yearbook, various issues, Sum of “Foreign Currency Liabilities” and “Other Foreign Liabilities”, accessible online (link).
- 1999 to 2020: from Bank of Finland., sum of series “Liabilities to non-euro area residents denominated in euro”, “Liabilities to euro area residents denominated in foreign currency”, “Liabilities to non-euro area residents denominated in foreign currency”, “Intra-Eurosystem liabilities” and “Counterpart of special drawing rights allocated by the IMF” (link)

France

NGDP basis:

- We rely on Ridolfi and Nuvolari (2021) over 1800-1850, who report annual per capita Gross Domestic Product in real GK$ 1990 prices, and apply the 1764 current GDP benchmark figure in Riley (1987), and using French population data sourced from Dupaquier (1988).[86] We switch to Mitchell (2013) over 1851-69, and JST afterwards.

Assets: Total

- 1800-1839: Courtois (1881), Annexe P, “Tableau des operations et des chiffres des principaux comptes de la Banque de France, annee par annee, du 20 fevrier 1800 au 31 decembre 1847”.

86. We thank Leonardo Ridolfi for comments on this approach.

- 1840 to 1998: from P. Baubeau (2018) "The Bank of France's balance sheets database, 1840–1998", Cambridge University Press, Financial History Review, series "Total Actif", last December values, accessible online (link).
- 1999 to 2020: from Bank of France, Webstat, Monetary Statistics, MFI Balance Sheets; BdF Statement, "Total Assets", converted to FRF, accessible online (link), December values.

Assets: Government debt

- 1840 to 1998: from P. Baubeau (2018) "The Bank of France's balance sheets database, 1840–1998", Cambridge University Press, Financial History Review, last December values, accessible online (link).ia Baubeau (2018).
- 1999 to 2020: from Bank of France, Webstat, Monetary Statistics, MFI Balance Sheet, BdF Statement, "Assets, Resident general government loans (stock)", accessible online (link).

Assets: Gold

- 1840 to 1998: from P. Baubeau (2018) "The Bank of France's balance sheets database, 1840–1998", Cambridge University Press, Financial History Review, series "Or", last December values, accessible online (link)
- 1999 to 2020: from Bank of France, Webstat, Monetary Statistics, MFI Balance Sheets; BdF Statement, "Assets Gold (stock)", converted to FRF, accessible online (link), December values.

Assets: Foreign

- 1915 to 1939: from Bank of France, "Situation hebdomodaire de la Banque de France 1898-1974", Comptes Courants et Devises, accessible online (link).
- 1941 to 1973: from Bank of France, "Situation hebdomodaire de la Banque de France 1898-1974", Comptes Courants et Devises, accessible online (link).
- 1995 to 1998: from P. Baubeau (2018) "The Bank of France's balance sheets database, 1840–1998", Cambridge University Press, Financial History Review, series "Avoirs et placements en devises", December values, accessible online (link).
- 1999 to 2023: from Bank of France, Webstat, Monetary Statistics, MFI Balance Sheets, BdF Statement, sum of "Assets - Rest of the World" and "Assets other Euro area Countries", converted to FRF, accessible online (link), December values.

Liabilities: Notes and coin

- 1840 to 1998: from P. Baubeau (2018) "The Bank of France's balance sheets database, 1840–1998", Cambridge University Press, Financial History Review, series "Billets en circulation", December values, accessible online (link).

- 1999 to 2023: from Bank of France, Webstat, Monetary Statistics, MFI Balance Sheets, BdF Statement, “Liabilities, Banknotes and coins in circulation (stock)”, converted to FRF, accessible online (link), December values.

  Liabilities: Deposits

- 1840 to 1998: from P. Baubeau (2018) "The Bank of France’s balance sheets database, 1840–1998", Cambridge University Press, Financial History Review, series "Comptes courants des établissements astreints à la constitution de réserves", December values, accessible online (link).
- 1999 to 2023: from Bank of France, Webstat, Monetary Statistics, MFI Balance Sheets, BdF Statement, Liabilities, “Residents deposits (stock)”, converted to FRF, accessible online (link) December values.

  Liabilities: Foreign

- 1962 to 1973: from Bank of France, “Situation hebdomodaire de la Banque de France 1898-1974”, Comptes des banques institutions et personnes étrangères, accessible online (link).
- 1990 to 2023: from Bank of France, Webstat, Monetary Statistics, MFI Balance Sheets, BdF Statement, sum of “deposits of extra euro area” and “other euro area countries deposits”, converted to FRF, accessible online (link), December values.

Germany

NGDP basis:

- We rely on Pfister (2022) over 1817-69, who reports annual per capita Gross National Income in current prices, and multiply this figure with Prussian population estimates sourced from Hohorst (1977).

Assets: Total

- 1817-1850: Royal Bank of Prussia basis, via Niebuhr (1854), Geschichte der Königlichen Bank in Berlin. Von der Gründung derselben (1765) bis zum Ende des Jahres 1845.
- 1851-1872: Royal Bank of Prussia, via annual reports of Bankverwaltungsrat (1851-1872).
- 1876 to 1922: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Summe der Aktiva bzw. Passiva“, accessible online (link).
- 1924 to 1944: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Summe der Aktiva bzw. Passiva“, accessible online (link).
- 1948 to 1974: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CIII 1.01 „Aktiva und Passiva des Zentralbanksystems“, column „Aktiva gesamt“, accessible online (link).

- 1975 to 2001: from Deutsche Bundesbank, Geschäftsberichte, Various Issues, Table „Ausweise der deutschen Bundsbank“, accessible online (link)
- 2002 to 2023:

Assets: Government debt

- 1876 to 1922: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, sum of columns „Noten anderer Banken“ and „Deckungsfähige Devisen“. Accessible online (link).
- 1928 to 1945: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, sum of columns „Noten anderer Banken“ and „Deckungsfähige Devisen“. Accessible online (link).
- 1948 to 1974: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CIII 1.01 „Aktiva und Passiva des Zentralbanksystems“, sum of columns „Reserveposition im IWF“, “Devisen und Sorten” and “Auslandswechsel“, accessible online (link).
- 1975 to 2001: from Deutsche Bundesbank, Geschäftsberichte, various issues, table „Ausweise der deutschen Bundsbank“, sum of columns „Reservepositionen im internationalen Währungsfonds“, „Forderungen an den EFWZ“, „Devisen und Sorten insgesamt“ and „Kredite und sonstige Forderungen an das Ausland“, accessible online (link).
- 2002 to 2023: from Deutsche Bundesbank, Geldmengenaggregate, konsolidierter Ausweis des Eurosystems, series „General government debt“, converted to DM, accessible online (link).

Assets: Gold

- 1876 to 1877: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Gold in Barren und Münzen“, accessible online (link).
- 1880 to 1882: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Gold in Barren und Münzen“, accessible online (link).
- 1884 to 1886: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Gold in Barren und Münzen“, accessible online (link).
- 1898: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Gold in Barren und Münzen“, accessible online (link).
- 1891 to 1922: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Gold in Barren und Münzen“, accessible online (link).
- 1924 to 1945: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Gold in Barren und Münzen“, accessible online (link).
- 1951 to 1974: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CIII 1.01 „Aktiva und Passiva des Zentralbanksystems“, column „Gold“., accessible online (link).

- 1975 to 2001: from Deutsche Bundesbank, Geschäftsberichte, various issues, table „Ausweise der deutschen Bundsbank“, accessible online (link). Note: gold makes a re-evaluation jump from 1998 to 1999.
- 2002 to 2023: from Deutsche Bundesbank, Geldmengenaggregate, konsolidierter Ausweis des Eurosystems, series „Gold“, converted to DM, accessible online (link).

Assets: Foreign

- 1876 to 1922: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, sum of columns „Noten anderer Banken“ and „Deckungsfähige Devisen“, accessible online (link).
- 1924 to 1945: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, sum of columns „Noten anderer Banken“ and „Deckungsfähige Devisen“, accessible online (link).
- 1948 to 1974: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CIII 1.01 „Aktiva und Passiva des Zentralbanksystems“, sum of columns „Reserveposition im IWF“, “Devisen und Sorten” and “Auslandswechsel”, accessible online (link).
- 1975 to 2001: from Deutsche Bundesbank, Geschäftsberichte, various issues, table „Ausweise der deutschen Bundsbank“, sum of columns „Reservepositionen im internationalen Währungsfonds“, „Forderungen an den EFWZ“, „Devisen und Sorten insgesamt“ and „Kredite und sonstige Forderungen an das Ausland“, accessible online (link).
- 2002 to 2019: from Deutsche Bundesbank, Geldmengenaggregate, konsolidierter Ausweis des Eurosystems, series „Claims on non-eure area residents denominated in foreign currency“ converted to DM, accessible online (link).

Liabilities: Notes and coin

- 1876 to 1922: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Summe der Aktiva bzw. Passiva“, accessible online (link).
- 1924 to 1945: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Summe der Aktiva bzw. Passiva“, accessible online (link).
- 1948 to 1974: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CIII 1.01 „Aktiva und Passiva des Zentralbanksystems“, column „Banknotenumlauf“, accessible online (link).
- 1975 to 2001: from Deutsche Bundesbank, Geschäftsberichte, various issues, table „Ausweise der deutschen Bundsbank“, accessible online (link).
- 2002 to 2023: from Deutsche Bundesbank, Geldmengenaggregate, konsolidierter Ausweis des Eurosystems, series „Banknotes in circulation“, converted to DM, accessible online (link).

Liabilities: Deposits

- 1876 to 1922: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Einlagen insgesamt“, accessible online (link).
- 1924 to 1945: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CI 1.01 „Ausweis der Reichsbank“, column „Einlagen insgesamt“, accessible online (link).
- 1948 to 1974: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CIII 1.01 „Aktiva und Passiva des Zentralbanksystems“, sum of columns „Einlagen inländische Kreditinstitute“ and „Einlagen zusammen“, accessible online (link).
- 1975 to 2001: from Deutsche Bundesbank, Geschäftsberichte, various issues, sum of „Einlagen von Kreditinstituten insgesamt“, „Einlagen von öffentlichen Haushalten insgesamt“, „Sondereinlagen des Bundes und der Länder“ and „Einlagen von anderen inländischen Einlegern insgesamt“, accessible online (link).
- 2002 to 2023: from Deutsche Bundesbank, Geldmengenaggregate, konsolidierter Ausweis des Eurosystems, sum of series “Liabilities to euro area credit institutions related to monetary policy operations denominated in euro”, “[…] current account”, “[…] deposit facility”, “[…] fixed term deposits”, “[…] fine-tuning reserse operations”, “[…] deposit related to margin calls”, “[…] general government”, “other liabilities to euro-area credit institutions denominated in euro” and “liabilities to other euro area residents denominated in euro”, converted to DM, accessible online (link)

Liabilities: Foreign

- 1949 to 1974: from Deutsches Geld- und Bankwesen in Zahlen 1876-1975, table CIII 1.01 „Aktiva und Passiva des Zentralbanksystems“, column „Ausländische Einleger“, accessible online (link).
- 1975 to 2001: from Deutsche Bundesbank, Geschäftsberichte, various issues, table „Ausweise der deutschen Bundsbank“, accessible online (link).
- 2002 to 2023: from Deutsche Bundesbank, Geldmengenaggregate, konsolidierter Ausweis des Eurosystems, series: “Claims on non-euro area residents denominated in foreign currency and in euro”, accessible online (link). Converted to DEM.

Italy

NGDP basis:

- We rely on current per capita income figures for Northern Italy in Malanima (2011), appendix table 2, column 7 ("Per capita GDP in Florentine lire, current prices"). These per capita figures are then multiplied by population estimates for The Republic of Siena in Baroch, Batou, and Chavre (1988).

Assets: Total

- 1626 to 1725: Sienese Monte, via Camaiti (1956), L'attivita bancaria a Siena nel seicento attraverso la ricostruzione e l'analisi statistica di cento bilanci del Monte dei Paschi di Siena.
- 1845 to 1861: Conte (1990) Banca di Genova-Banca Nazionale, 283ff.
- 1862 to 1893: Da Pozzo and Felloni (1964), La Borsa Valori Di Genova nel secolo XIX, "Principali voci contabili della Banca Nazionale".
- 1894 to 1936: from De Mattia, R. (1967). I bilanci degli istituti di emissione italiani dal 1845 al 1936. Roma: Banca d'Italia.
- 1937 to 1998: from Banca d'Italia, Serie storica bilanci Banca d'Italia (IBIS), series "Attivo: Totale dei conti patrimoniali", December values, accessible online (https://ibis.bancaditalia.it/ibis).
- 1999 to 2023: from Banca d'Italia. Statistical Database. Topics, International Monetary Fund's Special Data Dissemination Standard Plus (SDDS Plus) statistics, Bank of Italy balance sheet aggregates. Series: Total assets, converted to ITL, accessible online (link), December values.

Assets: Government debt

- 1845 to 1861: Conte (1990) Banca di Genova-Banca Nazionale, 283ff.
- 1894 to 1936: from De Mattia, R. (1967). I bilanci degli istituti di emissione italiani dal 1845 al 1936. Roma: Banca d'Italia.
- 1965 to 1998: from Banca d'Italia, Serie storica bilanci Banca d'Italia (IBIS), December values, accessible online (link).

Assets: Gold

- 1894 to 1936: from De Mattia, R. (1967). I bilanci degli istituti di emissione italiani dal 1845 al 1936. Roma: Banca d'Italia.
- 1937 to 1998: from Banca d'Italia, Serie storica bilanci Banca d'Italia (IBIS), series "Attivo: Oro a riserva", December values, accessible online (link).
- 1999 to 2023: from Banca d'Italia, Statistical Database, series "Gold and gold receivables".

Assets: Foreign

- 1890 to 1926: from Mattia (1967). I bilanci degli istituti di emissione italiani dal 1845 al 1936. Roma: Banca d'Italia.
- 1936 to 1965: from Banca d'Italia, Serie storica bilanci Banca d'Italia (IBIS), December values, accessible online (link).
- 1999 to 2023: from Banca d'Italia, Statistical Database, series "Claims on non-Euro-area residents, in euro and foreign currency", converted to ITL.

Liabilities: Notes and coin

- 1894 to 1936: from Mattia (1967). I bilanci degli istituti di emissione italiani dal 1845 al 1936. Roma: Banca d'Italia.
- 1937 to 1998: from Banca d'Italia, Serie storica bilanci Banca d'Italia (IBIS), series "Passivo: Circolazione di biglietti", December values, accessible online (link).
- 1999 to 2023: from Banca d'Italia, statistical Database, series, "Banknotes in circulation".

Liabilities: Deposits

- 1626 to 1725: Sienese Monte, via Camaiti (1956), *L'attivita bancaria a Siena nel seicento attraverso la ricostruzione e l'analisi statistica di cento bilanci del Monte dei Paschi di Siena.*
- 1894 to 1936: from Mattia (1967). I bilanci degli istituti di emissione italiani dal 1845 al 1936. Roma: Banca d'Italia.
- 1963 to 2023: from International Monetary Fund, International Financial Statistics, Monthly Report, various issues, series "Central bank, reserve deposits of other depository corporations", December values.

Liabilities: Foreign

- 1936 to 1936: from Mattia (1967). I bilanci degli istituti di emissione italiani dal 1845 al 1936. Roma: Banca d'Italia.
- 1937 to 1991: from Banca d'Italia, Serie storica bilanci Banca d'Italia (IBIS), December values, accessible online (link).
- 1999 to 2023: from Banca d'Italia, Statistical Database, series "Liabilities on non-Euro-area residents, in euro and foreign currency".

Japan

Assets: Total

- 1882 to 1965: from 100-year statistics of the Japanese economy, table 63 "Accounts of the Bank of Japan", column "Total Assets or Liabilities".
- 1966 to 1984: from Statistics Japan, Chapter 14 Finance and Insurance, Table 14 "Assets and Liabilities of Trust Fund Bureau, Ministry of Finance, accessible online (link).
- 1985 to 1997: from Statistics Japan. Chapter 14 Finance and Insurance. 14- 2 Accounts of Bank of Japan (1949--2005), accessible online (link)
- 1998 to 2023: from Bank of Japan. Series: BJ'MABJMTA Total Assets. Dec value, levels, accessible online (link)

Assets: Government debt

- 1882 to 1965: from 100-year statistics of the Japanese economy, table 63 "Accounts of the Bank of Japan", Sum of columns "Loans to Gov't" and "Gov't securities".

- 1966 to 1984: from Statistics Japan, Chapter 14 Finance and Insurance, Table 14 "Assets and Liabilities of Trust Fund Bureau, Ministry of Finance, accessible online (link).
- 1985 to 1997: from 1985-1997 from Statistics Japan. Chapter 14 Finance and Insurance. 14-2 Accounts of Bank of Japan (1949--2005), accessible online (link)
- 1998 to 2023: from Bank of Japan. Series: BJ'MABJMA5
- Bank of Japan Accounts/Assets/Japanese Government Securities(f), Dec values, levels, accessible online (link)

Assets: Gold

- 1882 to 1965: from 100-year statistics of the Japanese economy, table 63 "Accounts of the Bank of Japan", column "Cash and Gold Bullion".
- 1966 to 1984: from Statistics Japan, Chapter 14 Finance and Insurance, Table 14 "Assets and Liabilities of Trust Fund Bureau, Ministry of Finance, accessible online (link).
- 1985 to 1997: from 1985-1997 from Statistics Japan. Chapter 14 Finance and Insurance. 14-2 Accounts of Bank of Japan (1949--2005), accessible online (link)
- 1998 to 2023: from Bank of Japan. Series: BJ'MABJMA1 Bank of Japan Accounts/Assets/Gold(a), Dec values, levels, accessible online (link)

Assets: Foreign

- 1955 to 1997: from Statistics Japan, Chapter 14 Finance and Insurance, Table 14 "Assets and Liabilities of Trust Fund Bureau, Ministry of Finance, accessible online (link).
- 1998 to 2023: from Bank of Japan. Series: BJ'MABJMA12 Bank of Japan Accounts/Assets/Foreign Currency Assets, Dec values, levels, accessible online (link)

Liabilities: Notes and coin

- 1885 to 1965: from 100-year statistics of the Japanese economy, table 63 "Accounts of the Bank of Japan", column "Bank Notes Issued".
- 1966 to 1984: from Statistics Japan, Chapter 14 Finance and Insurance, Table 14 "Assets and Liabilities of Trust Fund Bureau, Ministry of Finance, accessible online (link).
- 1985 to 1997: from Statistics Japan. Chapter 14 Finance and Insurance. 14- 2 Accounts of Bank of Japan (1949--2005), accessible online (link)
- 1998 to 2023: from Bank of Japan, series BJ'MABJML1 Bank of Japan Accounts/Liabilities and Net Assets/Banknotes, Dec values, levels, accessible online (link)

Liabilities: Deposits

- 1882 to 1945: from 100-year statistics of the Japanese economy, table 63 "Accounts of the Bank of Japan", column "Deposits".

- 1963 to 2023: from International Monetary Fund, International Financial Statistics, Monthly Report, various issues, series "Central bank, reserve deposits of other depository corporations", December values.

  Liabilities: Foreign

- NA

Netherlands

NGDP basis:

- We rely on Smits, Horlings, and Zanden (2000) from 1807, who report annual Gross National Income in current prices (table F.1, in guilders); and between 1611-1806, we use Zanden and Leeuwen (2012) for NGDP, using interpolated decadal figures (appendix table 2, in guilders).

Assets: Total

- 1611 to 1814: Bank of Amsterdam, via Dillen (1934).
- 1815 to 1864: De Nederlandsche Bank, via Van der Borght (1896).
- 1865 to 1919: Dutch Nationaal Archief, *De Nederlandsche Bank N.V.: Jaarverslagen,* F1100212/2013, 457652-457793.
- 1920 to 1990: from De Nederlandsche Bank 2000C, Nederlandse financiele instellingen in de twintigste eeuw: balansreeksen en naamlijst van handelsbanken DNB Statistische Cahiers Nr. 3. Series: Balans totaal.
- 1991 to 2023: from table T5:1 Balance Sheet of the Nederlandsche Bank (monetary presentation), “Total Assets”, converted to NLG, accessible online (link).

  Assets: Government debt

- 1865 to 1919: Dutch Nationaal Archief, *De Nederlandsche Bank N.V.: Jaarverslagen,* F1100212/2013, 457652-457793.
- 1920 to 1990: from De Nederlandsche Bank, Nederlandse financiele instellingen in de twintigste eeuw: balansreeksen en naamlijst van handelsbanken DNB Statistische Cahiers Nr. 3., “Vorderingen op het binnenland – Schatkistpapier“, “Weekstaatpost Neederlandse Munten”, “Schotkistpapier dor DNB gekocht”, “Schuldbrieven door DNB gekocht“.

  Assets: Gold

- 1865 to 1919: Dutch Nationaal Archief, *De Nederlandsche Bank N.V.: Jaarverslagen,* F1100212/2013, 457652-457793.

- 1920 to 1990: from De Nederlandsche Bank, Nederlandse financiele instellingen in de twintigste eeuw: balansreeksen en naamlijst van handelsbanken DNB Statistische Cahiers Nr. 3., sum of "Goud"," imf"," bijzondere trekkingsrechten" and "Ecu's".

Assets: Foreign

- 1900 to 1990: from De Nederlandsche Bank, Nederlandse financiele instellingen in de twintigste eeuw: balansreeksen en naamlijst van handelsbanken DNB Statistische Cahiers Nr. 3., Sum of "Goud"," imf"," bijzondere trekkingsrechten" and "Ecu's".

Liabilities: Notes and coin

- 1900 to 1990: from De Nederlandsche Bank, Nederlandse financiele instellingen in de twintigste eeuw: balansreeksen en naamlijst van handelsbanken DNB Statistische Cahiers Nr. 3., "Bankbiljetten in omloop".
- 1991 to 2023: from table T5:1 Balance Sheet of the Nederlandsche Bank (monetary presentation), "Currency in Circulation", converted to NLG, accessible online (link).

Liabilities: Deposits

- 1900 to 1990: from De Nederlandsche Bank, Nederlandse financiele instellingen in de twintigste eeuw: balansreeksen en naamlijst van handelsbanken DNB Statistische Cahiers Nr. 3., sum of "Passiva: tegoeden van Rijk" and "Passiva: tegoeden van Banken en anderen".
- 1991 to 2023: from table T5:1 Balance Sheet of the Nederlandsche Bank (monetary presentation), "Total Deposits of Euro Area Residents", converted to NLG, accessible online (link).

Liabilities: Foreign

- 1947 to 1990: from De Nederlandsche Bank, Nederlandse financiele instellingen in de twintigste eeuw: balansreeksen en naamlijst van handelsbanken DNB Statistische Cahiers Nr. 3., "Passiva: Nietingezetenen".

Norway

Assets: Total

- 1870 to 1944: from Norges Bank, Balance Sheets from 1817 onwards. Series: Total Asset, levels, acessible online (link), December values.
- 1946 to 2023: from Norges Bank, Balance Sheets from 1817 onwards. Series: Total Asset, levels, acessible online (link), December values.

Assets: Government debt

- 1973 to 2002: from Norges Bank, Balance Sheets from 1817 onwards, accessible online (link).

Assets: Gold

- 1946 to 2011: from Norges Bank, Balance Sheets from 1817 onwards, accessible online (link). Note: missing data for 1945 and 1992 to 2003.

Assets: Foreign

- 1887 to 1944: from Norges Bank, Balance Sheets from 1817 onwards, sum of “Reserveposition in the IMF”, “Loans to IMF”, “SDRs”, “Foreign exchange reserves”, “Equivalent value of IMF”, “Other Foreign assets”, “Bank deposits abroad”, “Foreign treasury bills”, “Foreign bearer bonds” and “Other foreign assets”, accessible online (link).
- 1946 to 2011: from Norges Bank, Balance Sheets from 1817 onwards, sum of “Reserveposition in the IMF”, “Loans to IMF”, “SDRs”, “Foreign exchange reserves”, “Equivalent value of IMF”, “Other Foreign assets”, “Bank deposits abroad”, “Foreign treasury bills”, “Foreign bearer bonds” and “Other foreign assets”, accessible online (link).

Liabilities: Notes and coin

- 1870 to 1944: from Norges Bank, Balance Sheets from 1817 onwards, series “Notes and Coins in circulation”, December values, accessible online (link).
- 1946 to 2023: from Norges Bank, Balance Sheets from 1817 onwards, series “Notes and Coins in circulation”, December values, accessible online (link).

Liabilities: Deposits

- 1870 to 1944: from Norges Bank, Balance Sheets from 1817 onwards, sum of "Sight deposits: Domestic Banks" and "State accounts", December values, accessible online (link).
- 1960 to 2023: from International Monetary Fund, International Financial Statistics, Monthly Report, various issues, series "Central bank, reserve deposits of other depository corporations", December values.

Liabilities: Foreign

- 1950 to 2011: from Norges Bank, Balance Sheets from 1817 onwards, accessible online (link).

Portugal

Assets: Total

- 1870 to 1946: from Nuno Valério (2001). Estatísticas Históricas Portuguesas. Cuadro 7.6.B – series “Assets”.
- 1947 to 1995: from Banco de Portugal, Séries longas para a economia portugesa pós II Guerra Mundial, Parte I – Estatísticas monetárias e financeiras, Balanco do Banco de Portugal, accessible online (link).

- 1996 to 1998: Banco de Portugal, Annual Reports, various issues, accessible online (link).
- 1999 to 2023: from Banco de Portugal. BPstat Estatísticas Online, Estatísticas monetarias e financeiras, Institucoes financeiras monetarias, Balanco de Banco de Portugal, series "Total assets", December values, converted to PTE, accessible online (link).

Assets: Government debt

- 1888 to 1946: from Nuno Valério (2001). Estatísticas Históricas Portuguesas, Table 7.
- 1947 to 1995: from Banco de Portugal, Séries longas para a economia portugesa pós II Guerra Mundial, Parte I – Estatísticas monetárias e financeiras, Balanco do Banco de Portugal, accessible online (link).
- 1996 to 1998: Banco de Portugal, Annual Reports, Various Issues. Sum of "Current accounts of the Autonomous Regions" and "Portuguese metal coin held in reserve", accessible online (link).

Assets: Gold

- 1947 to 1995: from Banco de Portugal, Séries longas para a economia portugesa pós II Guerra Mundial, Parte I – Estatísticas monetárias e financeiras, Balanco do Banco de Portugal, accessible online (link).
- 1996 to 1998: Banco de Portugal, Annual Reports, various issues, accessible online (link).
- 1999 to 2023: from Banco de Portugal. BPstat Estatísticas Online, Estatísticas monetarias e financeiras, Institucoes financeiras monetarias, Balanco de Banco de Portugal, series "Monetary gold", December values, converted to PTE, accessible online (link).

Assets: Foreign

- 1947 to 1964: from Banco de Portugal, Séries longas para a economia portugesa pós II Guerra Mundial, Parte I – Estatísticas monetárias e financeiras, Balanco do Banco de Portugal. Accessible online (link). Note: year 1965 appears to be an error in the source; data point set to missing.
- 1966 to 1995: from Banco de Portugal, Séries longas para a economia portugesa pós II Guerra Mundial, Parte I – Estatísticas monetárias e financeiras, Balanco do Banco de Portugal. Accessible online (link).
- 1996 to 1998: Banco de Portugal, Annual Reports, Various Issues. Sum of "Deposits and other Investments", "Foreign Securities", "International Monetary Fund", "European Monetary Institute" and "Other international organisations". Accessible online (link).
- 1999 to 2023: from Banco de Portugal. BPstat Estatísticas Online. Estatísticas monetarias e financeiras, Institucoes financeiras monetarias, Balanco de Banco de Portugal, sum of assets vis-a-vis nonresidents: "SDR", "IMF", "Credits", "Securities other than shares" and "Shares and other equity", December values, converted to PTE, accessible online (link).

Liabilities: Notes and coin

- 1870 to 1946: from Nuno Valério (2001). Estatísticas Históricas Portuguesas, Table 7.6.
- 1947 to 1995: from Banco de Portugal, Séries longas para a economia portugesa pós II Guerra Mundial, Parte I – Estatísticas monetárias e financeiras, Balanco do Banco de Portugal, accessible online (link).
- 1996 to 1998: Banco de Portugal, Annual Reports, Various Issues. Accessible online (link).
- 1999 to 2023: from Banco de Portugal. BPstat Estatísticas Online. Estatísticas monetarias e financeiras, Institucoes financeiras monetarias, Balanco de Banco de Portugal, series, "Notes and coins", December values, converted to PTE, accessible online (link).

Liabilities: Deposits

- 1947 to 1996: from Banco de Portugal, Séries longas para a economia portugesa pós II Guerra Mundial, Parte I – Estatísticas monetárias e financeiras, Balanco do Banco de Portugal, accessible online (link).
- 1976 to 2020: from International Monetary Fund, International Financial Statistics, Monthly Report, various issues, series "Central bank, reserve deposits of other depository corporations", December values.

Liabilities: Foreign

- 1996 to 1998: Banco de Portugal, Annual Reports, various issues, sum of "Non-resident credit institutions", "International Monetary Fund", "European Monetary Institute", "Other international institutions" and "Other non-residents", accessible online (link).

Spain

NGDP basis:

- We use Alvarez-Nogal and Escosura (2013)'s series.

Assets: Total

- 1587 to 1805: Public Banks of Naples, via Balletta (2018). Note: since the Kingdom of Naples constituted a Spanish possession until the Napoleonic era, governed by a Spanish viceroy, we treat the Public Banks of Naples as Spanish institutions, in line with related literature.
- 1830-1870: Banco de San Fernando/Banco d'Espana, via de Lorca (1999) and Martin-Acena (2017).
- 1870 to 1935: from Banco de Espana, BIEST - Sistema de búsqueda de información estadística, Publicaciones, Boletín Estadístico, 7. Banco de Espana, December values, converted to ESP, accessible online (link).

- 1980 to 2023: from Banco de Espana, BIEST - Sistema de búsqueda de información estadística, Publicaciones, Boletín Estadístico, 7. Banco de Espana, December values, converted to ESP, accessible online (link).

  Assets: Government debt

- 1870 to 1935: Carreras, Albert and Tafunell, Xavier, "Estadísticas historicas de Espana, Siglos, XIX-XX, Volumen 1", Capitulo 9, Sistema moneatrio y financiero, Cuadro 9.9.
- 1948 to 1992: Carreras, Albert and Tafunell, Xavier, "Estadísticas historicas de Espana, Siglos, XIX-XX, Volumen 1", Capitulo 9, Sistema moneatrio y financiero, Cuadro 9.9.

  Assets: Gold

- NA

Assets: Foreign

- 1980 to 2023: from Banco de Espana, BIEST - Sistema de búsqueda de información estadística, Publicaciones, Boletín Estadístico, Banco de Espana, December values, converted to ESP, accessible online (link).

  Liabilities: Notes and coin

- 1870 to 1935: from Carreras, Albert and Tafunell, Xavier, "Estadísticas historicas de Espana, Siglos, XIX-XX, Volumen 1", Capitulo 9, Sistema moneatrio y financiero, Cuadro 9.9.
- 1941 to 1979: from Carreras, Albert and Tafunell, Xavier, "Estadísticas historicas de Espana, Siglos, XIX-XX, Volumen 1", Capitulo 9, Sistema moneatrio y financiero, Cuadro 9.9.
- 1980 to 2023: from Banco de Espana, BIEST - Sistema de búsqueda de información estadística, Publicaciones, Boletín Estadístico, 7, Banco de Espana, December values, converted to ESP, accessible online (link).

  Liabilities: Deposits

- 1870 to 1935: from Carreras, Albert and Tafunell, Xavier, "Estadísticas historicas de Espana, Siglos, XIX-XX, Volumen 1", Capitulo 9, Sistema moneatrio y financiero, Cuadro 9.9.
- 1941 to 1972: from Carreras, Albert and Tafunell, Xavier, "Estadísticas historicas de Espana, Siglos, XIX-XX, Volumen 1", Capitulo 9, Sistema moneatrio y financiero, Cuadro 9.9.
- 1980 to 2023: from Banco de Espana, BIEST - Sistema de búsqueda de información estadística, Publicaciones, Boletín Estadístico, 7, Banco de Espana, December values, converted to ESP, accessible online (link).

  Liabilities: Foreign

- NA

Sweden

NGDP basis:

- Prior to 1870, we rely on NGDP figures in Edvinsson (2014), table II.A4.1, "GDP by activity in current prices".

Assets: Total

- 1668 to 2011: Fregert (2014).
- 2012 to 2023: from Sveriges Riksbank, “The Riksbank’s assets and liabilities, the Weekly Report”, Issues of last December-week, “Gold”, 31th of December values, levels, accessible online (link).

Assets: Government debt

- 1668 to 2011: Fregert (2014). From 1858, Fregert (2014) consolidates Swedish government bonds together with other domestic assets into "domestic assets" – the decomposition is available via Simonsson (1931), which we use.

Assets: Gold

- 1668 to 2011: Fregert (2014).
- 2012 to 2023: from Sveriges Riksbank, “The Riksbank’s assets and liabilities, the Weekly Report”, Issues of last December-week, “Gold”, 31th of December values, levels, accessible online (link).

Assets: Foreign

- 1668 to 2011: Fregert (2014).
- 2012 to 2023: from Sveriges Riksbank, “The Riksbank’s assets and liabilities, the Weekly Report”, Issues of last December-week. “Claims on residents outside Sweden denom-
- inated in foreign currency”. 31th of December values, levels, accessible online (link).

Liabilities: Notes and coin

- 1668 to 2011: Fregert (2014).
- 2012 to 2023: from Sveriges Riksbank, “The Riksbank’s assets and liabilities, the Weekly Report”, Issues of last December-week, “Bank Notes and Coins in Circulation”, 31th of December values, levels, accessible online (link).

Liabilities: Deposits

- 1668 to 2011: Fregert (2014).

- 2012 to 2023: from Sveriges Riksbank, “The Riksbank’s assets and liabilities, the Weekly Report”, Issues of last December-week, “Liabilities to Swedish credit institutions related to monetary policy operations denominated in Swedish Kronor”, 31th of December values, levels, accessible online (link).

Liabilities: Foreign

- NA

Switzerland

Assets: Total

- 1907 to 1995: from Swiss National Bank, Balance Sheets and Income Statements table 1.1, accessible online (link).
- 1996 to 2023: from Swiss National Bank, “Bilanzpositionen der SNB”, December values, accessible online (link).

Assets: Government debt

- NA

Assets: Gold

- 1907 to 1995: from Swiss National Bank, Balance Sheets and Income Statements table 1.1, accessible online (link).
- 1996 to 2020: from Swiss National Bank, “Bilanzpositionen der SNB”, December values, accessible online (link).

Assets: Foreign

- 1907 to 1995: from Swiss National Bank, Balance Sheets and Income Statements, table 1.1, sum of column “International Payment Instruments”, “Reserve Position in the IMF” and “Foreign Currency Investments”, accessible online (link).
- 1996 to 2023: from Swiss National Bank, “Bilanzpositionen der SNB”, sum of “Devisenanlagen”, “Reservepositionen beim IWF” and “Internationale Zahlungsmittel”, December values, accessible online (link).

Liabilities: Notes and coin

- 1907 to 1995: from Swiss National Bank, Balance Sheets and Income Statements table 2.1, accessible online (link).
- 1996 to 2023: from Swiss National Bank, “Bilanzpositionen der SNB”, December values, accessible online (link).

Liabilities: Deposits

- 1907 to 1995: from Swiss National Bank, Balance Sheets and Income Statements table 2.1, accessible online (link).
- 1996 to 2023: from Swiss National Bank, “Bilanzpositionen der SNB”, sum of “Girokonten inländischer Banken”, “Girokonten ausländischer Banken“ and “Übrige Sichtverbindlichkeiten", December values, accessible online (link).

Liabilities: Foreign

- 1961 to 1995: from Swiss National Bank, Balance Sheets and Income Statements table 2.1, accessible online (link).
- 1996 to 2020: from Swiss National Bank, “Bilanzpositionen der SNB”, December values, accessible online (link).

United Kingdom

Assets: Total

- 1700 to 2016: via Dimsdale and Thomas (2017), “The Bank of England’s historical balance sheet”, accessible online (link).
- 2017-2023: via Bank of England (2024).

Assets: Government debt

- 1700 to 2016: via Dimsdale and Thomas (2017), “The Bank of England’s historical balance sheet”, accessible online (link).
- 2017-2023: via Bank of England (2024).

Assets: Gold

- 1700 to 2016: via Dimsdale and Thomas (2017), “The Bank of England’s historical balance sheet”, accessible online (link).
- 2017-2023: via Bank of England (2024).

Assets: Foreign

- NA

Liabilities: Notes and coin

- 1700 to 2020: via Dimsdale and Thomas (2017), “The Bank of England’s historical balance sheet”, accessible online (link).
- 2017-2023: via Bank of England (2024).

Liabilities: Deposits

- 1700 to 1986: via Dimsdale and Thomas (2017), “The Bank of England’s historical balance sheet”, accessible online (link).
- 1987 to 2023: from International Monetary Fund, International Financial Statistics, Monthly Report, various issues, series "Central bank, reserve deposits of other depository corporations", December values.

Liabilities: Foreign

- NA

United States

NGDP basis:

- Between 1870-2002, we rely on NGDP in Sutch (2006), resident population multiplied by nominal p.c. GDP.
- From 2003-2023, via Bureau of Economic Analysis [creator], via FRED [distributor], series "GDP".

Assets: Total

- 1792 to 1848: Bank of the United States, via Baker et al. (2019), “The Balance Sheets of the Bank of the United States”.
- 1914 to 2002: from Federal Reserve System Archives (FRASER), Annual Reports of the Board of Governors, accessible online (link), digitised by C. Bao, J. Chen, N. Fries, A. Gibson, E. Paine, and K. Schuler (2018) “The Federal Reserve System’s Weekly Balance Sheet since 1914”, Johns Hopkins University, series "Total assets", December values, accessible online (link).
- 2003 to 2020: from Federal Reserve Bank of St. Louis, Economics Data, Sources, Board of Governors of the Federal Reserve System (US), H.4.1 Factors Affecting Reserve Balances, Series “All Federal Reserve Banks: Total Assets”, annual data end of year values, levels, accessible online (link).

Assets: Government debt

- 1792 to 1848: Bank of the United States, via Baker et al. (2019), “The Balance Sheets of the Bank of the United States”.
- 1914 to 2018: from Federal Reserve System Archives (FRASER), Annual Reports of the Board of Governors, digitised by C. Bao, J. Chen, N. Fries, A. Gibson, E. Paine, and K. Schuler (2018) “The Federal Reserve System’s Weekly Balance Sheet since 1914”, Johns Hopkins University, series "Total U.S. Treasury securities ", December values, via FRED [distributor], series "RAGSTUSTS".

- 2019 to 2023: from Board of Governors [creator], via FRED [distributor], series H.4.1 Factors Affecting Reserve Balances, series "Assets: Securities Held Outright: Federal Agency Debt Securities" and "Assets: Securities Held Outright: U.S. Treasury Securities", annual data end of year values, levels, via FRED [distributor].

Assets: Gold

- 1792 to 1848: Bank of the United States, via Baker et al. (2019), "The Balance Sheets of the Bank of the United States".
- 1914 to 2017: from Federal Reserve System Archives (FRASER), Annual Reports of the Board of Governors, accessible online (link), digitised and extended by C. Bao, J. Chen, N. Fries, A. Gibson, E. Paine, and K. Schuler (2018) "The Federal Reserve System's Weekly Balance Sheet since 1914", Johns Hopkins University, series "Gold and gold certificate reserves", December values, accessible online (link).

Assets: Foreign

- 1792 to 1848: Bank of the United States, via Baker et al. (2019), "The Balance Sheets of the Bank of the United States".

Liabilities: Notes and coin

- 1792 to 1848: Bank of the United States, via Baker et al. (2019), "The Balance Sheets of the Bank of the United States".
- 1914 to 1983: from Federal Reserve System Archives (FRASER), Annual Reports of the Board of Governors, accessible online (link), digitised by C. Bao, J. Chen, N. Fries, A. Gibson, E. Paine, and K. Schuler (2018) "The Federal Reserve System's Weekly Balance Sheet since 1914", Johns Hopkins University, series "Federal Reserve notes in actual circulation", December values, accessible online (link).
- 1984 to 2020: from Federal Reserve Bank of St. Louis, Economics Data, Sources, Board of Governors of the Federal Reserve System (US), H.4.1 Factors Affecting Reserve Balances, series "Currency in Circulation", annual data end of year values, levels, accessible online (link).

Liabilities: Deposits

- 1792 to 1848: Bank of the United States, via Baker et al. (2019), "The Balance Sheets of the Bank of the United States".
- 1914 to 2017: from Federal Reserve System Archives (FRASER), Annual Reports of the Board of Governors, accessible online (link), digitised by C. Bao, J. Chen, N. Fries, A. Gibson, E. Paine, and K. Schuler (2018) "The Federal Reserve System's Weekly Balance Sheet since 1914", Johns Hopkins University, series "Total deposits", December values, accessible online (link).

Liabilities: Foreign

- 1792 to 1848: Bank of the United States, via Baker et al. (2019), “The Balance Sheets of the Bank of the United States”.

- 1914 to 2018: FRED [distributor], series "LDFBFOA".

Data References

Abildgren, Kim. 2017. “175 years of financial risks and returns in central banking: Danmarks Nationalbank 1839-2014.” *Financial History Review* 24 (3): 307–29.

Alvarez-Nogal, Carlos, and Prados de la Escosura. 2013. “The Rise and Fall of Spain (1270-1850).” *Economic History Review* 66 (1): 1–37.

Asp, Thore. 1898. *Die Geschichte des finländischen Bank- und Münzwesens bis 1865.* C. und J. Goeller.

Baker, Zackary, George Gulino, Adil Javat, and Kurt Schuler. 2019. “The Balance Sheets of the Bank of the United States.” *JHU Studies in Applied Economics Working Paper,* no. 132, 1–18.

Balletta, Francesco, Luigi Balletta, and Lilia Costabile. 2018. “The Investments of the Neapolitan Public Banks: A Long Run View (1587–1806).” In *Financial Innovation and Resilience,* edited by Lilia Costabile and Larry Neal, 95–123.

Barbour, Violet. 1963. *Capitalism in Amsterdam in the 17th century. Reprint of the 1950 edition.* University of Michigan Press.

Baron, Matthew, Emil Verner, and Wei Xiong. 2021. “Banking crises without panics.” *Quarterly Journal of Economics* 131 (1): 51–113.

Baubeau, Patrice. 2018. “The Bank of France’s balance sheets database, 1840–1998: an introduction to 158 years of central banking.” *Financial History Review* 25 (2): 203–30.

BdP. 2011. *Banco de Portugal Annual Report - Activities and Statements 2010.* BdP Publishing Unit.

Bindseil, Ulrich. 2019. *Central Banking before 1800: A Rehabilitation.* Oxford: Oxford University Press.

BoE. 1999. *Bank of England. Annual Report 1999.* BoE Publications Department.

BoF. 2012. *Bank of Finland Annual Report 2011.* Edita Prima Oy.

BoJ. 1906. *Annual Report of the Bank of Japan (1905).* Japan Times Office.

Bombrini, Carlo. 1881. *Petizione del comm. Carlo Bombrini, direttore generale della Banca nazionale nel Regno d’Italia, al Parlamento nazionale sul disegno di legge presentato alla Camera dei deputati dal Ministro delle finanze (interim del tesoro) di concerto col Ministro di agricoltura, industria e commercio nella tornata del 15 novembre 1880 : provvedimenti per l’abolizione del corso forzoso.* Officine del Consorzio degli instituti de emissione.

Bordo, Michael, and Harold James. 2007. “From 1907 to 1946: a happy childhood or a troubled adolescence?” In *The Swiss National Bank 1907–2007,* edited by Ulrich Kohli. NZZ Libro.

Bordo, Michael D., and Klodiana Istrefi. 2023. “Perceived FOMC: The Making of Hawks, Doves and Swingers.” *Journal of Monetary Economics* forthcoming.

Born, Karl E. 1987. “Luther, Hans.” In *Neue deutsche Biographie, Vol. 15,* edited by Otto zu Stolberg-Wernigerode et al., 544–47. Duncker Humblot.

Bornstein, Gideon, and Guido Lorenzoni. 2018. “Moral Hazard Misconceptions: The Case of the Greenspan Put.” *IMF Economic Review* 66: 251–86.

Broadberry, Stephen, Bruce Campbell, Alexander Klein, Mark Overton, and Bas van Leeuwen. 2015. *British Economic Growth, 1270-1870.* Cambridge University Press.

Calomiris, Charles. 1997. *The Postmodern Bank Safety Net: Lessons from Developed and Developing Economies.* AEI Press.

Calomiris, Charles W., and Urooj Kahn. 2015. “An Assessment of TARP Assistance to Financial Institutions.” *Journal of Economic Perspectives,* 53–80.

Camaiti, Romolo. 1956. “L’attivita bancaria a Siena nel seicento attraverso la ricostruzione e l’analisi statistica di cento bilanci del Monte dei Paschi di Siena.” *Archivi storici delle aziende di credito* 1: 35–114.

Colajanni, Napoleone. 1893. *Banche e Parlamenti.* Fratelli Treves.

Conte, Leandro. 1990. *La Banca Nazionale. Formazione e attivita di una banca di emissione, 1843-1861.* Edizioni Scientifiche Italiane.

Courtois, Alphonse. 1881. *Histoire des Banques en France. 2nd ed.* Guillaumin et Cie Paris.

Cova, Alberto. 1972. *Il Banco di S.Ambrogio nell'economia milanese dei secoli XVII e XVIII.* A. Giuffre.

Delabrousse, Lucien. 1916. *Joseph Magning et sons temps, 1824-1910.* Felix Alcan.

Demirguc-Kunt, Asli, and Enrica Detragiache. 2002. "Does Deposit Insurance increase banking system stability? An empirical investigation." *Journal of Monetary Economics* 49: 1373–406.

Demirgüç-Kunt, Asli, and Enrica Detragiache. 2002. "Does deposit insurance increase banking system stability? An empirical investigation." *Journal of Monetary Economics* 49: 1371–406.

Denzel, Markus A. 2012. *Der Nürnberger Banco Publico, seine Kaufleute und ihr Zahlungsverkehr (1621-1827).* Franz Steiner Verlag.

Dimsdale, Nicholas, and Ryland Thomas. 2017. "A Millennium of Macroeconomic Data." *OBER Dataset - Bank of England.*

Dincecco, Mark. 2011. *Political transformations and public finance: Europe, 1650-1913.* Cambridge University Press.

DNB. 2012. *Annual Report 2011.* De Nederlandsche Bank.

Dupaquier, Jacques. 1988. *Histoire de la population française, 4 vols.* Presses Universitaires de France.

Edvinsson, Rodney. 2014. "The Gross Domestic Product of Sweden Within Present Borders, 1620-2012." In *Historical Monetary Statistics of Sweden, Volume II,* 101–82. Riksbank.

Elmer, Heidi, Gabriela Guibourg, David Kjellberg, and Marianne Nessen. 2012. "The Riksbank's monetary policy measures during the financial crisis – evaluation and lessons learnt." *Sveriges Riksbank Economic Review,* no. 3, 1–24.

Espeli, Harald. 2014. "'Cooperation on a purely matter-of-fact basis': the Norwegian central bank and its relationship to the German supervisory authority during the occupation, 1940–1945." *Scandinavian Economic History Review* 62 (2): 188–212.

Federico, Pablo, Carlos Vegh, and Guillermo Vuletin. 2014. "Reserve requirement policy over the business cycle." NBER Working Paper 20612.

Fregert, Klas. 2014. "The Riksbank's Balance Sheet, 1668-2011." In *Historical Monetary Statistics of Sweden, Volume II: House prices, stock returns, national accounts, and the Riksbank balance sheet 1620-2012,* edited by Rodney Edvinsson, Tor Jacobson, and Daniel Waldenström, 339–93. Ekerlids Förlag.

Fregert, Klas, and Lars Jonung. 1996. "Inflation and switches between specie and paper standards in Sweden 1668-1931: a public finance interpretation." *Scottish Journal of Political Economy* 43 (4): 444–67.

Garriga, Ana Carolina. 2016. "Central Bank Independence in the World: A New Data Set." *International Interactions* 42 (5): 849–68.

Green, E.H.H. 1988. "Rentiers versus Producers? The Political Economy of the Bimetallic Controversy c.1880-1898." *English Historical Review* 103 (408): 588–612.

Greenspan, Alan. 1999. "Remarks by Chairman Alan Greenspan Before the World Bank Group and the International Monetary Fund, Program of Seminars, Washington, D.C. September 27, 1999."

Greenspan, Alan. 2002. "Testimony of Mr Alan Greenspan, Chairman of the Board of Governors of the US Federal Reserve System, before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, 23 April 2002."

Gregory, Theodore. 1929. *Selected Statutes, Documents, and Reports Relating to British Banking, 1832-1928.* Humphrey Illford.

Hall, Pamela. 2011. "Is there any evidence of a Greenspan put?" *SNB Working Paper,* no. 6, 1–38.

Heckscher, Eli F. 1954. *An Economic History of Sweden.* Harvard University Press.

Hibbs, Douglas A. 1977. "Political parties and macroeconomic policy." *American Political Review* 71 (4): 1467–87.

Hohorst, Gerd. 1977. *Wirtschaftswachstum und Bevölkerungsentwicklung in Preussen, 1816 bis 1914.* Arno Press.

Hvidsten, Velte. 2013. "Norges Banks balanse 1817-1945: Konsolidering av delregnskapene." *Norges Bank Staff Memo,* no. 11, 1–112.

Imhülsen, D.A. 1989. "Berg, Norbertus Petrus van den (1831-1917)." *Biografisch Woordenboek van Nederland,* 44–45.

Israel, Jonathan I. 1989. *Dutch Primacy in World Trade, 1585-1740.* Oxford University Press.

Johnston, R. A. 1983. "Financial Markets – Liberty or License? Stan Kelly Memorial Lecture, June 21, 1983."

Jorda, Oscar, Moritz Schularick, and Alan M. Taylor. 2017. "Macrofinancial History and the New Business Cycle Facts." In *NBER Macroeconomics Annual 2016, volume 31,* edited by Martin Eichenbaum and Jonathan A. Parker. Chicago: University of Chicago Press.

Jordà, Òscar, Björn Richter, Moritz Schularick, and Alan M. Taylor. 2020. "Bank capital redux: Solvency, liquidity, and crisis." *Review of Economic Studies* 88 (1): 260–86.

Lubitz, Raymond. 1978. "The Italian economic crises of the 1970's." *Federal Reserve Board International Finance Discussion Papers,* no. 120.

Magazine, Tabletalk. September 11, 1930. "Prominent Personalities – Sir Robert Gibson."

Malanima, Paolo. 2011. "The long decline of a leading economy: GDP in central and northern Italy, 1300-1913." *European Review of Economic History* 15 (2): 169–219.

Mattia, Renato De. 1967. *I Bilanci Istituti Emissione Italiani 1845 1936.* Banca d'Italia.

Meltzer, Alan M. 2005. *A History of the Federal Reserve, Vol. 1: 1914-1951.* Chicago University Press.

Metrick, Andrew, and Paul Schmelzing. 2024. "Banking-Crisis Interventions Across Time and Space." NBER Working Paper No. 29281.

Meyer, Eugene. 1954. "From Laissez Faire with William Graham Sumner to the RFC." *Public Policy* V: 3–27.

Miller, Marcus, Paul Weller, and Lei Zhang. 2002. "Moral Hazard and the US Stock Market: Analysing the 'Greenspan Put'." *Economic Journal* 112 (478): 171–86.

NorgesBank. 2001. *Norges Bank Annual Report and Accounts 2000.* Reclamo Grafisk Senter.

NorgesBank. 2006. *Norges Bank Annual Report and Accounts 2005.* Reclamo Grafisk Senter.

Pfister, Ulrich. 2022. "Economic growth in Germany, 1500–1850." *Journal of Economic History* 82 (4): 1071–107.

Ponti, Ermanno. 1951. *Il Banco di Santo Spirito. E la sua funzione Economica in Roma Papale (1605-1870).* Poligrafica Laziale.

Poschinger, Heinrich von. 1876. *Bankgeschichte des Königreichs Bayern.* Eduard Besold.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2009. *This Time is Different. Eight Centuries of Financial Folly.* Princeton University Press.

Ridolfi, Leonardo, and Nuvolari. 2021. "L'Histoire Immobile? A Reappraisal of French Economic Growth Using the Demand-Side Approach, 1280-1850." *European Review of Economic History* 25 (3): 405–28.

Schneider, Sabine. 2021. "The politics of last resort lending and the Overend and Gurney crisis of 1866." *Economic History Review.*

Shizume, Masato. 2020. "The Historical Evolution of Monetary Policy (Goals and Instruments) in Japan: From the Central Bank of an Emerging Economy to the Central Bank of a Mature Economy." In *Handbook of the History of Money and Currency,* edited by Stefano Battilossi, Youssef Cassis, and Kazuhiko Yago, 923–53. Springer.

Silva, Nuno Miguel Ferreira da. 2010. *A cortiça nos debates parlamentares da nação portuguesa (1839-1899).* University of Porto Dissertation.

Simonsson, K. 1931. *Sveriges Riksbank 1668–1918/1924. Bankens tillkomst och verksamhet, V Vols.* Norstedt.

Sims, Christopher A. 2001. "Fiscal Aspects of Central Bank Independence," 1–13.

Smits, Jan-Pieter, Edwin Horlings, and Jan Luiten van Zanden. 2000. "Dutch GDP and its Components 1800-1913." *Groningen Monograph Series* 5: 1–259.

Steffan, Franz, and Walter Diehm. 1955. *Die Bayerische Staatsbank, 1780-1955.* Kieser Augsburg.

Sutch, Richard. 2006. "National Income and Product." In *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition,* edited by Susan B. Carter et al. Cambridge University Press.

Svendsen, Knud, Svend Hansen, Erling Olsen, and Erik Hoffmeyer. 1968a. *Dansk Penghistorie, Bind 1, 1700-1914.* Andelsbogtrykkeriet i Odense.

Svendsen, Knud, Svend Hansen, Erling Olsen, and Erik Hoffmeyer. 1968b. *Dansk Penghistorie, Bind 2, 1914-1960.* Andelsbogtrykkeriet i Odense.

Telegraph, The Daily. 1998. *Bonn set to win 'Mr Euro' bank battle.* Via Gale, April 15, 1998.

Trichet, Jean-Claude. 2003. "Monetary policy in 2003. Statement at the Forum Institut for Management, December 2, 2003."

Trichet, Jean-Claude. 2004. "Opening Remark at Press Briefing to ECB Financial Stability Report 2004, December 15, 2004."

Trichet, Jean-Claude. 2005. "Asset Price Bubbles and Monetary Policy. Speech at the Mas Lecture Singapore, June 8, 2005."

Tucci, Ugo. 1973. "Convertibilita e copertura metallica della moneta del Banco Giro Veneziano." *Studi Veneziani* 15: 349–448.

Usher, Abbott Payton. 1943. *The Early History of Deposit Banking in the Mediterranean.* Harvard University Press.

Webb, Stephen B. 1985. "Government Debt and Inflationary Expectations as Determinants of the Money Supply in Germany, 1919-23." *Journal of Money, Credit, and Banking* 17 (4): 479–92.

Wee, Herman van der, and Mounique Verbreyt. 2009. *A Small Nation in the Turmoil of the Second World War: Money, Finance and Occupation (Belgium, Its Enemies, Its Friends, 1939-1945).* Universitaire Press Leuven.

Zanden, Jan Luiten van, and Bas van Leeuwen. 2012. "Persistent but not Consistent: the growth of national income in Holland, 1347-1807." *Explorations in Economic History* 49 (2): 119–30.