Essays in Applied Macroeconomics

Inaugural-Dissertation

zur Erlangung des Grades eines Doktors
der Wirtschafts- und Gesellschaftswissenschaften

durch

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

vorgelegt von

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2023

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Tag der mündlichen Prüfung:	19. September 2023

Acknowledgements

First of all, I want to thank Ricardo for always being by my side in the good and bad moments of life. Words cannot describe all the support he has given me throughout these past few years. As a co-author, as a friend, and as a husband, he has been my rock while riding the emotional roller coaster of the PhD. Thank you for always being there and for choosing to share your life with me.

I also want to thank my family and friends, especially my mom, for her unconditional support and for raising me the way she did, which brought me where I am today; and my sisters, for always being there when I needed it.

I want to thank my supervisors Moritz Kuhn and Moritz Schularick for their support, invaluable inputs, and advice over the last years, and Amelie for being on the committee.

I am thankful to my coauthors Mathias and Ricardo for all the hours of interesting discussion and for all the challenges we overcame together.

I am also grateful for the support from the University of Bonn, in particular, the Bonn Graduate School of Economics and the Institute for Macroeconomics and Econometrics. I want to thank all the faculty and fellow students from whom I learned a lot.

I am thankful for the financial support from *Fundação para a Ciência e Tecnologia* (SFRH/BD/144820/2019) and the *Deutsche Forschungsgemeinschaft* (German Research Foundation) under Germany's Excellence Strategy (EXC 2126/1 - 390838866) and under the RTG 2281 - The Macroeconomics of Inequality.

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Introduction

This dissertation consists of three independent research studies. All of them use empirical databases and methods to shed light on important topics. The first chapter provides a full picture of the effects of government spending in the Eurozone economy, including transmission mechanisms, regional spillovers, sectoral heterogeneity, and state dependencies. The second chapter focuses on the political consequences of fiscal austerity by estimating its impact on the vote share of the extreme right and left parties, political fragmentation, and trust in the incumbent government. The third chapter uses micro-level data to characterize earnings dynamics in Germany and describes the role of public and private insurance in protecting German households against individual income shocks.

Chapter 1: The Effects of Government Spending in the Eurozone

How does fiscal policy affect the Eurozone economy? Over the last decade, this topic has gained renewed attention among academics and policymakers alike. As the main policy interest rate of the European Central Bank (ECB) reached its lower bound, economic commentators have frequently asked for more fiscal actions to stimulate the economy. More recently, the Covid-19 rescue package implemented by the European Commission has re-emphasized the need for more precise knowledge concerning the impact and scope of government spending on the Eurozone economy. Despite the increased interest in the effects of fiscal policy in the Eurozone, the literature still lacks a thorough analysis that is able to address these important questions. In this paper, we aim to fill this gap by providing new empirical evidence on the economic impact of fiscal policy and its transmission mechanism in the Eurozone focusing on regional data.

Our empirical analysis employs a newly assembled rich dataset, ARDECO, which offers series on output, private investment, employment, hours worked, and wages at different regional aggregations and sectoral divisions. For identification, we use a Bartik type instrument, which identifies the effect of government spending on economic activity by relating the changes in *regional* government spending to the differential regional exposure to changes in *national* government spending (Bartik, 1991). We combine the Bartik instrument with instrumental variable local projections to estimate fiscal multipliers and impulse responses.

Our baseline estimates reveal a government spending relative output multiplier of 2.2, which implies a €1.2 increase (decrease) in relative private sector production for every €1 increase (decrease) in relative government production. Moreover, we find an employment multiplier of 1.4, which shows that changes in regional government spending have sizeable effects on local labor markets. In particular, our estimates imply that a €1 million increase in government spending creates 33 new jobs four years after the shock materialized or, in other words, a cost per job created of about €30,000.

To shed light on the underlying fiscal transmission mechanism, we estimate the responses of several interesting variables to the regional fiscal shock. We find that an increase in regional government spending leads to a significant increase in private investment. This crowding-in of private investment can be rationalized by a strong and persistent rise in labor productivity and total factor productivity. Thus, our evidence points towards strong positive supply side effects of government spending changes, in line with recent U.S. evidence by Auerbach, Gorodnichenko, and Murphy (2020) and Jørgensen and Ravn (2022). Furthermore, the fiscal stimulus induces a significant rise in durable consumption (measured by the number of motor vehicles) together with higher real wages and an increase (decrease) in the labor share (markup). We also take a closer look at the effects on regional labor markets and find that higher regional government spending induces a considerable increase in total hours worked. Interestingly, the bulk of this increase is accounted for by the extensive margin (total number of employees), whereas the intensive margin (hours per employee) barely responds to the regional fiscal shock.

Although the close trade linkages across European regions within the European single market might suggest strong spillover effects, our estimates reveal only small (and mostly insignificant) fiscal spillovers which raises questions about the widely shared belief among policy circles of positive and sizable fiscal spillovers (e.g., In't Veld (2016)). Finally, our findings reveal strong heterogeneities across economic sectors, states of the economy, and member states.

Chapter 2: The Political Costs of Austerity

Anti-establishment and EU-skeptic parties have gained significant support since the Great Recession and the subsequent European Sovereign Debt Crisis. Higher vote shares for these parties have increased partisan conflict and led to more fragmented parliaments. The resultant polarized political environment is economically significant, as political tension is generally associated with higher policy uncertainty and lower economic growth. Interestingly, the rise in support for extreme parties occurred in a period of significant fiscal policy interventions. In this paper, we empirically investigate the causal link between fiscal consolidations and rising polarization and provide new evidence on the political costs of fiscal austerity.

To this end, we assemble a novel regional dataset on election outcomes that provides detailed voting results on regional, national, and European elections. Then,

we rely on party classifications by Funke, Schularick, and Trebesch (2016) and Algan, Guriev, Papaioannou, and Passari (2017) to define parties at the far-right and far-left of the political spectrum. We identify exogenous changes in regional public spending using a Bartik-type instrument (Bartik, 1991) that combines *regional* sensitivities to changes in *national* government expenditures with the narrative national consolidation measure. The narrative series contains only those changes in the national primary balance-to-GDP ratio that are motivated by a desire to reduce budget deficits. The identified fiscal actions represent responses to past decisions and economic conditions rather than to current and prospective conditions. Therefore, there should be no systematic correlation between the identified national fiscal actions and other developments that affect economic activity in the short term.

Our results show that fiscal consolidations are associated with significant political costs: a 1% reduction in regional public spending leads to an increase in extreme parties' vote share of around 3 percentage points. The higher vote share captured by extreme parties can be explained by a fall in voter turnout together with an increase in the total votes for these parties. Thus, in response to fiscal consolidations, fewer people vote and those who do exhibit a higher tendency to vote for extreme parties. In addition, austerity increases fragmentation, which, based on previous evidence on the negative economic impact of partisan conflict (Azzimonti, 2011; Funke, Schularick, and Trebesch, 2020), suggests that austerity affects economic outcomes through a more polarized political environment. When differentiating between election types and far-left and far-right parties, we find only mild differences in political outcomes.

We also try to understand whether austerity-driven recessions yield different political outcomes than general economic downturns do. Our estimates imply that recessions that coincide with fiscal consolidations lead to a significantly larger increase in the vote share for extreme parties than those that unrelated to austerity. We link this result to a potential trust channel of fiscal consolidations by showing that people's trust in the government deteriorates much more strongly during austerity recessions compared to non-austerity recessions. This might point toward a "doom loop" between distrust in the political system and more extreme voting following fiscal consolidations.

Chapter 3: Earnings Dynamics in Germany

Earnings risk affects important decisions, including consumption, savings, and labor supply. Households can, on the one hand, self-insure against earnings shocks by adjusting savings and labor supply (of both head and spouse), but also benefit from public insurance through taxes and transfers, which can complement or replace the need to self-insure. Thus, earnings dynamics play a key role in models of household behavior which are important tools for macroeconomics research. This paper studies the distribution and dynamics of earnings shocks in Germany and the role of insurance mechanisms against them.

First. I find strong deviations from normality and salient heterogeneities in the distribution and dynamics of earnings changes across age groups and along the earnings distribution. results also show that there are clear asymmetries in the mean reversion of earnings shocks that are not compatible with frequent modeling choices of earnings dynamics, like AR(1) processes. For poor workers, negative shocks are transitory and positive changes are permanent. However, as we move to the top of the earnings distribution, negative shocks become more permanent and positive more transitory.

Secondly, the drivers of large earnings swings differ according to the earnings distribution and sign and size of the shock. Large income changes experienced by poor workers are driven by a mix of hours and wage changes, which is consistent with unemployment spells and job switches. However, wage growth becomes considerably more relevant than hours towards the top of the distribution, highlighting the job stability of the top earners.

Finally, I quantify the role of families and the welfare system in attenuating individual earnings changes across income groups. On average, spouses' labor supply remains unchanged after a change in the heads' earnings, which implies that families' ability to self-insure against income risk is solely driven by income pooling. On the other hand, the German government is able to provide considerable insurance as taxes and transfers significantly reduce the pass-through of large individual earnings shocks to the household level, especially for the bottom earners.

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Chapter 1

The Effects of Government Spending in the Eurozone

Joint with Ricardo Duque Gabriel and Mathias Klein

1.1 Introduction

How does fiscal policy affect the Eurozone economy? Over the last decade, this topic has gained renewed attention among academics and policymakers alike. As the main policy interest rate of the European Central Bank (ECB) reached its lower bound, economic commentators have frequently asked for more fiscal actions to stimulate the

* We are grateful to the editor Guido Lorenzoni and to one anonymous referee for many valuable comments. We thank Davide Auteri, Benjamin Born, Maria Coelho, Jerome Creel, Dario Diodato, Miguel Faria-e-Castro, Ben Gardiner, Yuriy Gorodnichenko, Ethan Ilzetzki, Gernot Müller, Evi Pappa, Gert Peersman, Anna Rogantini Picco, Farzad Saidi, Anna Stansbury, Ulf Söderström, Nora Traum, David Vestin, Karl Walentin, Francesco Zanetti, Donghai Zhang and participants at the Bonn-Mannheim PhD Workshop 2020, 8th UECE Conference on Economic and Financial Adjustments in Europe, 14th RGS of Economics Doctoral Conference, Royal Economic Society 2021 Annual Conference, 27th International Conference on Computing in Economics and Finance, 25th Spring Meeting of Young Economists, 2nd DIW Workshop for Women in Macroeconomics, Finance and Economic History, XXVIII Encuentro de Economía Pública, 14th Annual Meeting of the Portuguese Economic Journal, 3rd International Conference on European Studies, 3rd Warsaw Money-Macro-Finance Conference, VfS Annual Conference 2021, and at seminars at the European Central Bank, University of Bonn and Sveriges Riksbank for their comments and discussions. We would like to thank Sveriges Riksbank for hosting Ricardo and Sofia while conducting part of the research that led to this paper. We acknowledge financial support from the Fundação para a Ciência e Tecnologia [projects references SFRH/BD/144581/2019 and SFRH/BD/144820/2019] the Deutsche Forschungsgemeinschaft (German Research Foundation) under Germany's Excellence Strategy [EXC 2126/1 - 390838866] and under the RTG 2281 - The Macroeconomics of Inequality. The opinions expressed in this article are the sole responsibility of the authors and should not be interpreted as reflecting the views of Sveriges Riksbank.

economy. Indeed, in one of his last press conferences, parting ECB President Mario Draghi stated that "...now it's high time I think for the fiscal policy to take charge" (Draghi, 2019). Moreover, motivated by the close trade linkages among member states of the European single market, there is particular interest in how fiscal interventions spill over from one region to another (Blanchard, Erceg, and Lindé, 2016). More recently, the Covid-19 rescue package implemented by the European Commission has re-emphasized the need for more precise knowledge concerning the impact and scope of government spending on the Eurozone economy.[1]

Despite the increased interest in the effects of fiscal policy in the Eurozone, the literature still lacks a thorough analysis that is able to address these important questions. In this paper, we aim to fill this gap by providing new empirical evidence on the economic impact of fiscal policy and its transmission mechanism in the Eurozone focusing on regional data. In particular, we follow recent studies on the U.S. economy (Chodorow-Reich, Feiveson, Liscow, and Woolston, 2012; Nakamura and Steinsson, 2014; Bernardini, Schryder, and Peersman, 2020) and use regional variation in government spending to estimate how fiscal policy shapes the economy. Our contribution is threefold. First, we compute regional output and employment multipliers for the Eurozone. Second, we analyze the underlying fiscal transmission mechanism in detail by providing novel evidence on how changes in regional government spending affect key variables including investment, productivity, wages, and hours worked. Thirdly, we investigate the significance of regional fiscal spillovers and test for heterogeneous effects across economic sectors, states of the economy, and member states.

Our empirical analysis employs a newly assembled rich dataset, ARDECO, which offers series on output, private investment, employment, hours worked, and wages at different regional aggregations and sectoral divisions. We use the sum of gross value added and intermediate consumption of the non-market sector as a measure of regional government spending. To justify this choice, we show that our measure and government spending are closely linked by definition and that both series' statistical properties are very similar at the national level. For identification, we use a Bartik type instrument, which identifies the effect of government spending on economic activity by relating the changes in *regional* government spending to the differential regional exposure to changes in *national* government spending (Bartik, 1991). We combine the Bartik instrument with instrumental variable local projections to estimate fiscal multipliers and impulse responses.

Using regional variation in government spending to map the impact of fiscal policy offers several advantages over studies focusing on the national level. First, because all regions are part of the monetary union, they are all subject to the ECB's

1. For a general discussion on the current challenges for fiscal policy in the Eurozone, see, e.g., Pappa (2020) or Bilbiie, Monacelli, and Perotti (2021).

monetary policy. Thus, by including time fixed effects in our regressions, we can control for confounding effects of monetary policy interventions, which is a common challenge when studying the effects of government spending at the national level. Second, our analysis at the regional level substantially increases the number of observations such that potential state-dependencies and heterogeneous effects across economic sectors can be estimated more accurately. Thirdly, the significant differences in intra-regional trade flows permit a highly detailed investigation into the size of fiscal spillovers. Similar to Nakamura and Steinsson (2014), our results show relative effects, that is, we estimate the impact of an increase in government spending in one region of the Eurozone relative to another on relative economic activity, the "open economy relative multiplier".

Our baseline estimates reveal a government spending relative output multiplier of 2.2, which implies a €1.2 increase (decrease) in relative private sector production for every €1 increase (decrease) in relative government production. Moreover, we find an employment multiplier of 1.4, which shows that changes in regional government spending have sizeable effects on local labor markets. In particular, our estimates imply that a €1 million increase in government spending creates 33 new jobs four years after the shock materialized or, in other words, a cost per job created of about €30,000. These results are robust to several modifications of the baseline model, like different constructions of the Bartik instrument, changes in the sample, and controlling for national tax policies and sovereign risk premia. Furthermore, to account for potential anticipation concerns, we show that the results remain when constructing the Bartik instrument by only using variations in national government spending that are orthogonal to past economic conditions, due to changes in national military spending or professional forecast errors.

To shed light on the underlying fiscal transmission mechanism, we estimate the responses of several interesting variables to the regional fiscal shock. We find that an increase in regional government spending leads to a significant increase in private investment. This crowding-in of private investment can be rationalized by a strong and persistent rise in labor productivity and total factor productivity. Thus, our evidence points towards strong positive supply side effects of government spending changes, in line with recent U.S. evidence by Auerbach, Gorodnichenko, and Murphy (2020b) and Jørgensen and Ravn (2022). Furthermore, the fiscal stimulus induces a significant rise in durable consumption (measured by the number of motor vehicles) together with higher real wages and an increase (decrease) in the labor share (markup). We also take a closer look at the effects on regional labor markets and find that higher regional government spending induces a considerable increase in total hours worked. Interestingly, the bulk of this increase is accounted for by the extensive margin (total number of employees), whereas the intensive margin (hours per employee) barely responds to the regional fiscal shock.

Using the full level of detail in the dataset, we determine which economic sectors are responsible for the significant crowding-in of private economic activity and

employment by estimating sector-specific fiscal multipliers. We find that the industry and (non-financial) services sectors account for the lion's share of the increase in private demand. While both sectors together make up for less than 60% of total private activity, they contribute to more than 75% of the fiscal policy induced private economic expansion. In light of the disproportional amplification effects of these two sectors, policymakers should target them specifically when designing stabilization measures. Although the close trade linkages across European regions within the European single market might suggest strong spillover effects, our estimates reveal only small (and mostly insignificant) fiscal spillovers which raises questions about the widely shared belief among policy circles of positive and sizable fiscal spillovers (e.g., In't Veld (2016)). Moreover, in light of these findings, recommendations to jump-start the European economy by increasing public spending in regions with fiscal capacity should be interpreted with caution since the positive spillover effects might be more limited than is conventionally thought.

Finally, we detect significant state dependencies. First, fiscal multipliers are significantly larger in economic recessions than in economic booms. Second, fiscal policy is significantly more effective in core countries of the Eurozone compared to periphery countries. However, in contrast to recent studies at the national level (Born, D'Ascanio, Müller, and Pfeifer, 2019; Barnichon, Debortoli, and Matthes, 2020), we find no evidence that the sign of the fiscal intervention considerably affects the size of the multiplier. Government spending stimulus-multipliers do not significantly differ from consolidation-multipliers.

What do our regional estimates imply for national multipliers? As argued by Chodorow-Reich (2019), cross-sectional multipliers provide a lower bound for the closed economy, deficit-financed, no-monetary-policy-response multiplier. Thus, our results would suggest a national output multiplier of above but close to 2 which is slightly larger than the multiplier of 1.7 proposed by Chodorow-Reich (2019) for the U.S. economy. While this value might appear large at first glance, one must keep in mind that our estimates abstract from any endogenous monetary policy tightening in response to the fiscal expansion, which according to standard theory, dampens the size of the multiplier. Against this background, time-series studies which estimate fiscal multipliers at the zero lower bound find multiplier magnitudes that are much more in line with our cross-sectional evidence (Miyamoto, Nguyen, and Sergeyev, 2018; Ramey and Zubairy, 2018; Klein and Winkler, 2021).

Our paper contributes to the recent and fast-growing literature that uses subnational data to estimate the impact of fiscal policy (Becker, Egger, and Von Ehrlich, 2010; Becker, Egger, and Von Ehrlich, 2013; Nakamura and Steinsson, 2014; Dupor and Guerrero, 2017; Auerbach, Gorodnichenko, and Murphy, 2020b; Bernardini, Schryder, and Peersman, 2020). So far, this literature mainly focuses on the U.S.

economy, with only limited evidence for the Eurozone.[2] In general, one could expect that fiscal multipliers differ between the U.S. and the European economy due to non-trivial differences in institutional constraints and characteristics of financial services, goods markets, and labor mobility, for example.

Some previous papers rely on sub-national data to study the economic effects of regional funds from the European Union (EU) (Becker, Egger, and Von Ehrlich, 2010, 2013; Coelho, 2019; Canova and Pappa, 2021). While these structural funds typically face a significant implementation lag and primarily intend to foster long-run growth of lagging regions, our analysis focuses on discretionary fiscal policy and our identification relies on variation in government spending and economic activity in the Eurozone.

Brueckner, Valentinyi, and Pappa (2019) use a similar dataset and investigate how the size of the fiscal spending multiplier depends on the degree of local autonomy across European regions. In contrast to their paper and much of the existing U.S. evidence, we take on a more general perspective and provide new insights into several important aspects of the fiscal transmission mechanism in the Eurozone. In other words, the dataset's level of detail enables us to zoom into a wide range of fiscal policy effects. In particular, the underlying drivers of our fiscal multiplier estimates, like the influence of fiscal policy on investment, productivity, (public and private) employment, or earnings can be considered carefully. Moreover, the dataset enables us to conduct a thorough investigation into regional fiscal spillovers and heterogeneous effects across economic sectors, states of the economy, and member states. Overall, we believe that our new insights have the potential to contribute to discussions among academics and policymakers about the gains and limitations of fiscal policy in the Eurozone.

The remainder of the paper is organized as follows. Section 2.2 describes the data we use. Section 2.3 presents the methodology. Section 2.4 shows our empirical results. Finally, Section 2.5 concludes.

1.2 Data

We use data from the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO), which is maintained and updated by the Joint Research Centre.[3] It is a highly disaggregated dataset across both sectoral and regional dimensions. The database contains a set of vari-

2. Studies on the Italian and Portuguese economies, respectively, are Acconcia, Corsetti, and Simonelli (2014) and Carvalho, Franco, and Peralta (2020). We refer the reader to Chodorow-Reich (2019) for an extensive survey on the cross-sectional evidence on fiscal stimulus using subnational data.

3. It can be found online here.

ous long time-series indicators for EU regions at several statistical scales. It expands the Cambridge Econometrics Dataset used by much of the literature on European regional dynamics (e.g., Badinger, Müller, and Tondl (2004)).

The database provides regional measures for output (gross domestic product (GDP) and gross value added (GVA)), investment, earnings, hours worked and employment for different economic sectors like industry, construction, financial, non-financial, and non-market services. The dataset is an annual unbalanced panel covering the period 1980–2017 for the European Union (EU) and some European Free Trade Association (EFTA) and candidate countries. By construction, ARDECO's regional data is consistent with the commonly used national accounts data (see Lequiller and Blades (2006) and Lequiller and Blades (2014) for more details on the construction of the national accounts data). In particular, the regional ARDECO time series are constructed in such a way that the country aggregates equal the corresponding time series in the National Accounts reported in the AMECO dataset.[4]

The data are divided into NUTS (Nomenclature of Territorial Units for Statistics) regions. NUTS is a geocode standard for referencing the subdivisions of countries for statistical purposes. The hierarchy of three NUTS levels (NUTS 1, 2, 3) is established by Eurostat in agreement with each member state, and for most countries the respective NUTS level corresponds to a specific administrative division within the country. ARDECO provides all data series at these regional disaggregation levels except for the NUTS 3, for which it reports only population, employment, GDP, and GVA.

Our baseline Eurozone sample covers 12 countries, namely the first Euro adopters Austria, Belgium, Finland, France, Ireland, Italy, Luxembourg, Germany, Greece, the Netherlands, Portugal, and Spain. We exploit NUTS 2 level data from 1999 (when the Euro was introduced) until 2017 for all countries except Greece, which joined the Euro in 2001. Therefore, we only use Greek data from 2001 onwards.[5] Our sample thus consists of regions that are part of a monetary union with a common policy interest rate set by the ECB. As the policy interest rate is the same for all regions of the Eurozone, our approach of estimating regional fiscal multipliers has the advantage that we can directly control for confounding monetary policy reactions, which is a common challenge for estimates at the country level (Nakamura and Steinsson, 2014). In total, our sample consists of 167 European regions which generates a much larger cross-sectional variation compared to previous studies on the U.S. states level (Nakamura and Steinsson, 2014; Bernardini, Schryder, and Peersman, 2020).

4. See Appendix 2.A.1 for more information.

5. See Table 2.A.1 for more details on the NUTS 2 classification for the countries used in the sample.

For our main analysis, we use data on demography (total population), labor markets (employment, employee compensation, total hours worked), capital formation (gross fixed capital formation) and output (GDP and GVA).[6]

1.2.1 Regional Government Spending Data

Official data on final consumption expenditure of the general government (henceforth, government spending) is not available at the European regional level. Hereinafter, in the spirit of Brueckner, Valentinyi, and Pappa (2019), we use the sum of GVA and intermediate consumption of the non-market sector as a proxy for government spending. GVA of the non-market sector is computed as the sum of compensation to employees (including social contributions), consumption of fixed capital (which measures the decline in value of fixed assets owned as a result of normal wear and tear and obsolescence), and taxes less subsidies on production.[7] [8] Because GVA of the non-market sector does not include intermediate consumption, which is, however, one of the main components of government spending, we use input-output (IO) tables from the PBL EUREGIO database to calculate regional intermediate consumption shares of the non-market sector which we then add to the GVA of the non-market sector.

Our regional measure (GVA plus intermediate consumption of the non-market sector) is a valid proxy for government spending for several reasons. First, as previously mentioned, ARDECO's regional data is consistent with the national accounts data by construction. By definition, there exists a close link between government spending and the GVA of the non-market sector. In particular, even though the non-market sector includes other institutional units, the general government is the main actor responsible for changes in the non-market GVA. The non-market sector consists of six sub-sectors from which the three largest are also closely linked to the general government in the national accounts. Taking the example of Finland, the only country in our sample which publishes the required detailed information, on average, 86% of the GVA of the three largest sub-sectors (public administration and defense, education, human health and social work activities) was booked by the general gov-

6. The construction of all variables used in the paper is described in the appendix, see Table 2.A.2.

7. For more details, see the Manual on Regional Accounts from Eurostat. Importantly, net taxes on production does not include neither consumption nor corporate taxes.

8. Data from PBL EUREGIO indicate that, for the regions in our sample and the period of 2000-2010, GVA of the non-market sector is composed on average of 67% compensation to employees, 30% consumption of fixed capital, and 3% net taxes on production. The PBL EUREGIO database is discussed in more detail in Appendix 1.A.3.

ernment during our sample period.[9] Consequently, almost the entire variation in the GVA of the non-market sector refers to activities by the general government.

Second, government spending and our proxy measure show very similar statistical properties. When running regressions at the national and regional level, we find a strong and significant relationship between both measures with estimated coefficients close to 1. We will thus refer to our regional proxy as government spending throughout the rest of the paper. More details on the series, data sources, and justification of our proxy choice are given in Appendix 1.A.2.[10]

1.3 Methodology

In estimating the effects of a regional government spending shock, we closely follow Bernardini, Schryder, and Peersman (2020). Particularly, we study the impact of regional government spending in the Eurozone by first examining the dynamics of the cumulative GDP and employment multipliers. To that end, we use local projections (Jordà, 2005) and estimate for each horizon $h = 0, \ldots, 4$, the following equation:

$$\sum_{m=0}^{h} z_{i,t+m} = \beta_h \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h(L) X_{i,t-k} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+m}, \qquad (1.3.1)$$

where $z_{i,t+m}$ is either the change in real per capita GDP, $\frac{Y_{i,t+m}-Y_{i,t-1}}{Y_{i,t-1}}$, or the change in the employment rate, $\frac{E_{i,t+m}-E_{i,t-1}}{E_{i,t-1}}$, in region i between time $t-1$ and time $t+m$. Following Nakamura and Steinsson (2014), the employment multiplier is measured in terms of the employment ratio. $\frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$ is the change in real per capita government spending in region i between time $t-1$ and time $t+m$, relative to real per capita GDP in $t-1$.[11] When $z_{i,t+m}$ indicates the change in real GDP, as government spending and GDP are in the same units, β_h directly yields, for each horizon h, the output multiplier. In the case of employment, β_h measures the employment multiplier as the change in the employment rate in response to a one percent increase in government spending relative to GDP.

9. Data for other countries not considered in our sample confirm this pattern. For example, for Estonia in 2018, 89% of public administration and defense, education, human health and social work activities GVA was booked by the general government, comparable to the 89% for Lithuania in 2019, 90% for Latvia in 2010, and 95% for Ukraine in 2015.

10. One should keep in mind that our regional government spending measure does not include investment expenditure and thus, does not account for procurement contracts related to fixed capital formation. Thus, our estimates have to be interpreted as government consumption multipliers.

11. Weighing by population is important to obtain more representative population average treatment effect estimates (Chodorow-Reich, 2020).

$(L)X_{i,t-k}$ is a vector of control variables with $k = 2$, and $\alpha_{i,h}$ and $\delta_{t,h}$ are respectively region and time fixed effects, which are included in the regressions to control for region-specific characteristics and common aggregate changes like, for example global shocks, and shocks that originate in another country and spill over to the Eurozone. Importantly, the time fixed effects absorb any endogenous monetary policy reaction by the ECB in response to an increase in government spending. Thus, our approach of using regional data to trace out the dynamic effects of a government spending shock does not face the problem of properly controlling for changes in the monetary policy stance, which is a common challenge for fiscal policy analyses at the national level. The vector of control variables includes two lags of the variable of interest (GDP growth or the growth rate in the employment ratio) and the growth rate in real per capita government spending. We use Driscoll and Kraay (1998) standard errors, which take into account the potential residual correlation across regions, as well as serial correlation and heteroskedasticity among the residuals over time.[12]

For identification, we follow, among others, Nekarda and Ramey (2011), Dupor and Guerrero (2017), and Perotti, Reis, and Ramey (2007) and instrument the change in government spending with a Bartik-type instrument (Bartik, 1991). We compute the instrument as

$$Bartik_{i,t} \;=\; s_i \times \frac{(G_{I,t} - G_{I,t-1})}{Y_{I,t-1}}, \tag{1.3.2}$$

where $s_i = \dfrac{\overline{G_i}}{\overline{G_I}}$ and $\overline{G_i}$ and $\overline{G_I}$ are averages of per capita government spending in region i and country I, respectively, in the five years preceding country I's Eurozone accession. In order to compute these averages, we use data from 1994 to 1998 for all countries in the sample except Greece, which joined the Eurozone in 2001 and for which we use 1996 to 2000. Intuitively, if s_i is above 1, region i spends more per capita than the national average. This implies that a disproportionate amount is spent in this region compared to other regions in the country. Figure 2.C.1 in the appendix shows a heat map depicting the share s_i for the considered NUTS 2 regions. There is considerable cross-sectional variation in this measure, ranging from 0.38 to 2.27. We calculate the lowest shares for Mayotte (France, 0.38), Peloponnese (Greece, 0.70), and Andalucia (Spain, 0.70), and the highest shares for Melilla (Spain, 2.27), Ceuta (Spain 2.16), and Brussels Capital District (Belgium, 2.10).[13] There is only small variation in the shares over time. When calculating time-varying

12. In the appendix, we show that our main results change marginally when dropping additional control variables and only including region and time fixed effects in the regressions (see Panel C of Table 1.C.3).

13. We show that our results change little when, instead of using per capita values, the regional shares are constructed using absolute values. In this case, the shares indicate a scaling factor and add up to one at the country level. We choose the per capita specification of the Bartik instrument as the

shares for each region, we find that the average standard deviation is 0.03. This low time variation justifies our choice of constant regional shares.[14]

The idea of the Bartik instrument is to scale national government spending such that spending varies more in regions with a larger predetermined share of national government spending. Moreover, as the predetermined share of average spending measures the differential exposure in regions to common national government spending changes, it helps to avoid confounding effects as argued by Goldsmith-Pinkham, Sorkin, and Swift (2020).[15]

More precisely, our identifying assumption is that central governments do not change spending because regions that receive a disproportionate amount of government spending are doing poorly relative to other regions. Intuitively, this assumption might be violated when focusing on high aggregation levels with only few regions within a country because politically and economically important regions could directly influence central government decisions. There is evidence that our analysis at the NUTS 2 level is not subject to this concern. In particular, for each region we construct a measure of the relative stance of the business cycle defined as the difference between the regions annual GDP growth rate and the average annual growth rate of all other regions within the same country. We regress the growth rate of national government spending on this regional business cycle indicator interacted with the regional shares, s_i. A negative coefficient would indicate a violation of our identifying assumption in the sense that national government spending would increase when regions spending relatively more are doing poorly compared to other regions. However, we find a small positive and insignificant coefficient suggesting that our identification strategy is valid.[16] Notably, we also conduct an additional robustness check where we show that the main results remain when going to the NUTS 3 level (with 922 regions in total), where direct influence of some regions on the central government should not be a severe concern after all.

Another potential concern with our estimation strategy would arise if regions receiving large amounts of national spending were more cyclically sensitive than

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baseline because it provides a higher F-statistic compared to the absolute level specification. We drop the region of Guadeloupe from our entire analysis because it shows an extremely high government spending share (above 100).

14. Nevertheless, in a robustness exercise, following Nekarda and Ramey (2011) and acknowledging that there might have been structural changes throughout the sample, we use the full Eurozone sample to compute the share s_i instead of the five years preceding the Eurozone accession. The main findings remain unchanged.

15. Figure 1.B.2 shows the evolution of $\frac{G_{i,t}}{G_{I,t}}$ over time for four selected regions. It reassures that the relationship between regional and national government spending per capita is very stable during the sample period.

16. We find similar results when running the regression only for the regions with the top 5%, top10%, or top 20% highest shares.

other regions. We use the standard deviation of output growth to compare the cyclical sensitivity of regions that receive large and small amounts of national spending. The standard deviations are almost identical in regions with above median national spending shares and in regions with below median national spending shares (0.028 versus 0.029), indicating that a difference in overall cyclical sensitivity does not bias our approach.

Notably, we demonstrate that our main findings are robust to replacing national government spending in the construction of the Bartik instrument by different measures of unexpected changes in national government expenditure. For this purpose, we will use the residual of an estimated fiscal spending rule, military spending changes, and the forecast error of government spending.

Besides computing output and employment multipliers, we further estimate impulse response functions for other important variables as

$$w_{i,t+m} = \beta_h \frac{G_{i,t} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h(L)X_{i,t-k} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+m}, \tag{1.3.3}$$

where $w_{i,t+m}$ is the growth rate of the variable of interest, $\frac{W_{i,t+m}-W_{i,t-1}}{W_{i,t-1}}$, for all variables except the labor share, for which we consider $w_{i,t+m}$ to be the difference in levels, $W_{i,t+m} - W_{i,t-1}$. $(L)X_{i,t-k}$ is a vector of control variables and $\alpha_{i,h}$ and $\delta_{t,h}$ are again region and time fixed effects, respectively. The vector of control variables now includes two lags of the respective variable of interest and real per capita government spending growth. β_h directly yields the response of the variable of interest to a one percent increase in government spending relative to GDP instrumented by the Bartik measure. One important difference between equations (2.D.1) and (2.3.1) is that equation (2.D.1) estimates the cumulated response to the cumulated government spending increase, whereas equation (2.3.1) estimates the cumulated response to a one-year change in government spending.

1.4 Results

1.4.1 Output and Employment Multipliers

We start by presenting the estimates of the output and employment multiplier of the baseline model. The main results are shown in Figure 2.D.1. Panels 1.4.1a and 1.4.1b show the cumulative GDP and employment multipliers estimated according to Equation (2.D.1). The solid line shows the point estimate β_h over a horizon of four years. Panels 1.4.1c, 1.4.1d, and 1.4.1e plot respectively the cumulated impulse responses of GDP, employment ratio, and government spending estimated according to Equation (2.3.1). The dark and light shadings are 68% and 95% Driscoll and Kraay (1998) adjusted confidence bands. Finally, Panel 1.4.1f depicts the F-Statistic

test of weak instruments for the first-stage regression of the output multiplier.[17] For just-identified specifications, it is equivalent to the Olea and Pflueger (2013) F-Statistic and the threshold is 23.1 for the 5% critical value. For easier visual comparison, we set an upper bound of 200 on the reported F-Statistic.

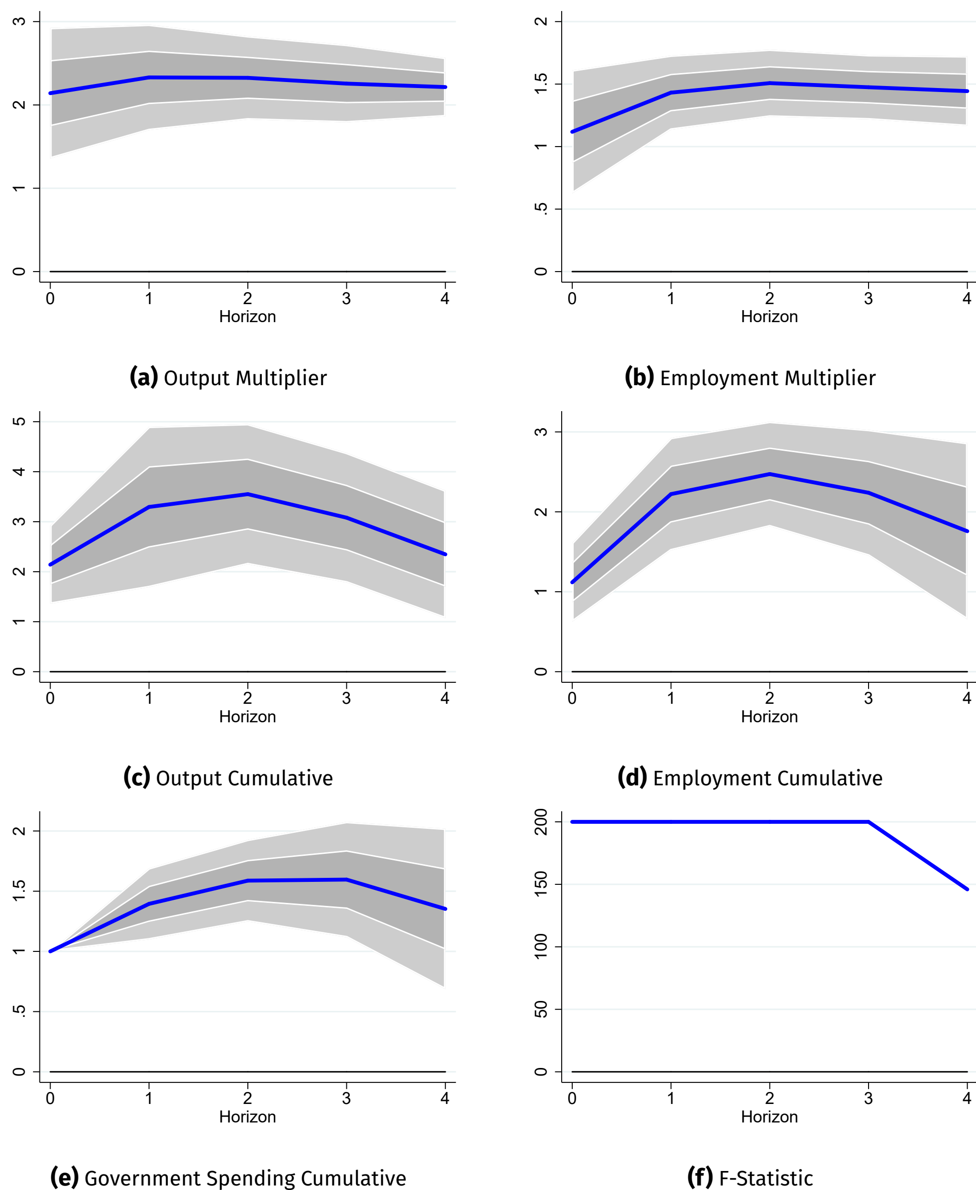
As Panel 1.4.1f shows, the Bartik measure is a strong instrument for regional government spending for all years of the forecast horizon. The computed F-Statistic is well above the threshold value of 23.1, suggesting that weak instruments are unlikely to be a concern for our analysis.

Our baseline estimates reveal an output multiplier of 2.14 on impact, which slowly increases to 2.21 four years after the shock materialized. This implies that a €1 increase (decrease) in relative government production leads to a €1.2 increase (decrease) in relative private sector production. The four-year multiplier is estimated relatively precisely with the 95% confidence band ranging from 1.86 to 2.56. Panels 1.4.1c and 1.4.1e show that the fairly stable output multiplier is due to similar hump-shaped responses in output and government spending. Government spending continuously increases up until three years after the shock and then converges back to steady state. Output shows a similar pattern, although the decline starts already in year 2. Importantly, GDP rises persistently by more than €2, which leads to the reported multiplier.

The employment multiplier as reported in Panel 1.4.1b behaves similarly to the output multiplier. On impact, we estimate an employment multiplier of 1.12, which then rises slightly to 1.44 at the end of the forecast horizon. Thus, besides boosting real economic activity, changes in regional government spending also have sizeable effects on local labor markets. Again, the estimates are highly significant and the 95% confidence band of the four-year employment multiplier ranges from 1.17 to 1.71. As shown in Panel 1.4.1d, employment significantly increases on impact and then rises for two years after the shock before slowly decreasing.

When decomposing the employment multiplier into employment in the private and public sectors, we find that both contribute to the positive impact of government spending on total employment. Figure 1.B.3 in the appendix shows the private and public employment multipliers. On average, private employment accounts for more than 2/3 of the total employment multiplier. Thus, the lion's share of the positive labor market effect of regional fiscal stimulus is due to employment changes in the private sector. Taken together, an increase in relative government spending leads to a strong and significant rise in relative private economic activity and employment implying that discretionary fiscal policy constitutes a powerful tool to stimulate regional economies in the Eurozone.

17. The F-Statistic for the first-stage regression of the employment multiplier is very similar to the one in Panel 1.4.1f since the only difference is the lagged control variables (GDP for the output multiplier and the employment ratio for the employment multiplier).



(a) Output Multiplier

(b) Employment Multiplier

(c) Output Cumulative

(d) Employment Cumulative

(e) Government Spending Cumulative

(f) F-Statistic

Figure 1.4.1. Output and Employment Multipliers. Panels 1.4.1a and 1.4.1b show the cumulative relative fiscal and employment multipliers estimated according to Equation (2.D.1). Panels 1.4.1c and 1.4.1d depict the underlying impulse responses of GDP and employment rate to the cumulative change in government spending which is plotted in Panel 1.4.1e and estimated according to Equation (2.3.1). Panel 1.4.1f shows the related first-stage F-Statistics over a four-year horizon. Shaded areas are 68% (dark) and 95% (light) confidence intervals.

Our estimates are comparable to previous regional fiscal multipliers documented for both Europe and the U.S.. Coelho (2019) finds an impact multiplier of 1.8 for European regions relying on structural funds distributed by the European Commission. Using provincial expenditure cuts in Italy, Acconcia, Corsetti, and Simonelli (2014) report a multiplier of 1.55 on impact and of 1.95 for the 1-year cumulative multiplier. For the U.S., Nakamura and Steinsson (2014) use regional variation in military buildups to compute 2-year output multipliers ranging from 1.4 in their baseline specification up to 2.5 when applying a Bartik instument approach as we do, and Bernardini, Schryder, and Peersman (2020) estimate an impact output multiplier of around 2 when applying a Bartik instrument and of 1.3 when using a Blanchard and Perotti (2002) recursive identification.[18] Regarding employment multipliers, evidence in the literature is more mixed. Contrarily to us, Becker, Egger, and Von Ehrlich (2010) and Coelho (2019) find no significant responses of employment to fiscal spending for European regions. For Portugal, using changes in government spending prior to local elections, Carvalho, Franco, and Peralta (2020) find an employment multiplier of 1.5. For the U.S., Nakamura and Steinsson (2014) find regional employment multipliers ranging from 1.3 in their preferred specification to 1.8 when applying a Bartik instument approach.

1.4.2 Robustness

Our main Eurozone multiplier estimates are robust to several modifications of the baseline model. We report a battery of robustness checks in Appendix 1.C. The estimates change only little when applying alternative ways to construct the Bartik instrument and using different ways to extract unexpected variation in national government spending. Our findings are also robust to changes in the sample and to additionally controlling for national tax policies and sovereign spreads. We further demonstrate that the estimates are not prone to dynamic and cross-sectional heterogeneity. The baseline multiplier estimates are also robust when following closely Nakamura and Steinsson (2014) and using national military spending interacted with region fixed effects as instrument. Furthermore, the results do not change much when not including lagged control variables in the regressions or excluding regions that spend disproportionately more per capita than the national average. We also reestimated the baseline model when excluding intermediate consumption from our proxy regional government spending series. Then, regional government spending is measured by the GVA of the non-market sector. As expected, the multipliers increase because the shock size (1% of GDP per capita) becomes larger relative to the baseline proxy used. To assess how important any individual country is for the results, we re-estimate the baseline regressions by sequentially dropping one country at a time. The obtained results are comparable to the baseline in every case. Finally, we

18. For a survey on regional fiscal multiplier estimates, see Chodorow-Reich (2019).

use a Bayesian approach and estimate multipliers by means of Bayesian local projections. The results are similar to our baseline estimates which implies that Bayesian local projections do not deliver a significant improvement for our analysis.

To sum up, our baseline findings are robust to several modifications. In the following, we will thus rely on our baseline specification to produce additional new insights into the fiscal transmission mechanism in the Eurozone.

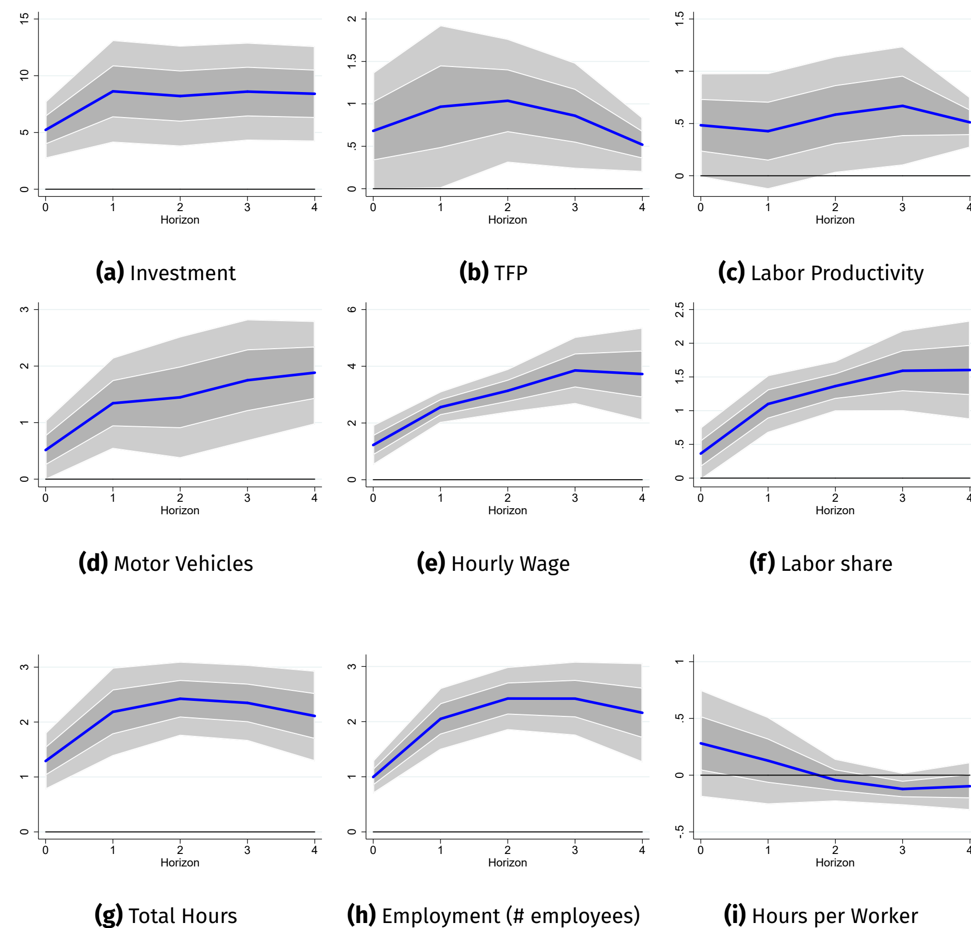
1.4.3 Impulse Response Analysis

To get a better understanding of the fiscal transmission mechanism in the Eurozone, this section presents additional impulse responses to a regional fiscal spending shock. More precisely, we report responses to a one percent increase in regional government spending relative to regional GDP, calculated based on Equation (2.3.1). The solid lines in Figure 2.4.5 show point estimates and the dark and light shadings again indicate 68% and 95% Driscoll and Kraay (1998) confidence bands. All responses are expressed in percent changes (growth rates) with the exception of the labor share response, which is presented as a percentage point change.

Our estimated regional output multiplier speaks in favor of a strong crowding-in of private demand following the regional fiscal expansion. Panel 2.4.5c of Figure 2.4.5 shows that a substantial component of the increase in private demand is due to an increase in private investment. The fiscal expansion leads to a significant and persistent increase in regional private investment expenditures. On impact, private investment increases by around 5%, which is roughly twice as large as the output response reported in Figure 2.D.1. Investment further increases in the first year after the shock and then slowly converges back to its pre-shock level. A complementary metric to quantify the investment response is the investment multiplier, which can be estimated in close analogy with the output multiplier described in Equation (2.D.1). The estimated private investment multiplier is presented in Figure 1.B.4 in the appendix, and we find that it is about half the size of the output multiplier. On impact, the investment multiplier is estimated to be around 1, slightly increasing to 1.1 four years after the spending increase. This finding supports the evidence reported in other studies which also find a rise in private investment following a fiscal spending stimulus at the national U.S. level (D'Alessandro, Fella, and Melosi, 2019) and at the regional level as a response to an increase in EU structural funds (Becker, Egger, and Von Ehrlich, 2013).

Panels 1.4.2b and 1.4.2c of Figure 2.4.5 provide a rationale for the strong private investment response. We find that productivity significantly increases in response to higher regional government expenditures. This is true when measuring productivity by total factor productivity (TFP) or labor productivity.[19] The maximum increase in TFP is slightly larger than the maximum rise in labor productivity and the peak

19. More details on the construction of our TFP variable can be found in Appendix 1.A.5.



(a) Investment **(b)** TFP **(c)** Labor Productivity

(d) Motor Vehicles **(e)** Hourly Wage **(f)** Labor share

(g) Total Hours **(h)** Employment (# employees) **(i)** Hours per Worker

Figure 1.4.2. Impulse Responses. These figures plot the response of a one percent increase of per capita government spending relative to per capita GDP. All responses are expressed in percent changes (growth rates) with the exception of the labor share variable, which is presented as a percentage point change (its difference). Shaded areas are 68% (dark) and 95% (light) confidence intervals.

response of TFP occurs somewhat earlier than the peak of labor productivity. The positive labor productivity response is in line with the regional U.S. evidence by Nekarda and Ramey (2011) and Auerbach, Gorodnichenko, and Murphy (2020b). In addition, Jørgensen and Ravn (2022) find that an aggregate government spending shock leads to a rise in (utilization-adjusted) TFP. To reconcile these positive supply side effects of fiscal policy, Auerbach, Gorodnichenko, and Murphy (2020b) propose a model with endogenous firm entry in which increasing government spending leads to a rise in the number of firms together with higher labor productivity. By introducing variable technology utilization into an otherwise standard New Keyne-

sian model, Jørgensen and Ravn (2022) demonstrate that productivity and investment increase after a fiscal expansion.[20] By making a rise in productivity an endogenous response to a government spending shock, these model extensions produce a crowding-in of private demand, which ultimately increases the government spending output multiplier. Our regional Eurozone evidence on a significant crowding in of private investment coupled with higher productivity following a fiscal spending shock reinforces these modeling choices and points towards an important role of fiscal policy in driving movements in productivity. Another important indicator for supply side effects following a government spending shock is the price response. In a standard New Keynesian model, higher government spending raises aggregate demand and pushes up prices. However, this price increase can be overturned when allowing for endogenous productivity (Jørgensen and Ravn, 2022). In the Appendix (Figure 1.B.5), we present the impulse response of inflation to the regional government spending shock. Inflation is measured as the growth rate of the regional consumer price index (CPI), which was retrieved from various national sources but is available only for a subset of the baseline sample.[21] An increase in regional public spending leads to a significant fall in inflation in the impact period and one year after the fiscal intervention. Thereafter the inflation response turns positive but is mostly insignificant. This evidence further highlights the importance of supply side effect for understanding the transmission mechanism of government spending shocks.

Official data for private consumption expenditure, the second-most important component of private demand, are not available at the regional European level. Nonetheless, we rely on a common proxy for durable consumption to learn more about households' consumption decisions following a regional fiscal expansion. We follow a related literature and use the per capita number of motor vehicles as a measure for durable consumption (Mian, Rao, and Sufi, 2013; Demyanyk, Loutskina, and Murphy, 2019).[22] Figure 2.4.5d shows that the number of vehicles rises significantly after a fiscal expansion. On impact, there is an increase of around 0.6%, which then persistently builds up to almost 2% at the end of the forecast horizon. Thus, higher public spending crowds in consumption expenditure and, in particular, durable purchases in line with the U.S. evidence by Demyanyk, Loutskina, and Murphy (2019) and Auerbach, Gorodnichenko, and Murphy (2020b).

Households' consumption expenditure should be closely linked to their disposable income stream in the sense that an increase in income might well lead to higher

20. A model with variable capital utilization can also generate a productivity increase following a fiscal spending expansion. However, as shown by Jørgensen and Ravn (2022), the required substantial increase in capital utilization is not supported by the data.

21. Regional CPI data at the NUTS 2 level is available for Austria (since 2010), Finland, Italy, Portugal, and Spain (since 2002). Data for Germany is available only at the NUTS1 level.

22. Data on the per capita number of motor vehicles are taken from Eurostat. For details, see Table 2.A.2 in the appendix.

(durable) consumption spending. Panel 2.4.5e indeed supports this hypothesis. Here, we report the real wage response expressed as average real compensation per hour worked. Wages increase significantly and persistently in response to the fiscal stimulus. On impact, wages rise by more than 1% and continue to increase until the end of the forecast horizon. The wage response to an aggregate government spending shock is the subject of a considerable debate with different results emerging from different identification schemes (Galı, López-Salido, and Vallés, 2007; Ramey, 2011). At the regional level, the results are also mixed. While Auerbach, Gorodnichenko, and Murphy (2020b) find a positive earnings response, Nekarda and Ramey (2011) report a fall in wages following higher government spending. Our finding of a significant increase in real wages is in line with standard New Keynesian models, where a positive government spending shock lowers the markup of price over marginal costs and thus leads to a rise in real wages.[23]

The labor share response as shown in Panel 2.4.5f further supports this line of reasoning.[24] The labor share significantly increases in response to the regional fiscal expansion. Four years after the fiscal shock, the labor share is around 1.6 percentage points higher. In accordance with our evidence, Cantore and Freund (2021) find that an aggregate government spending shock leads to a rise in the labor share, whereas Auerbach, Gorodnichenko, and Murphy (2020b) estimate an acyclical labor share response.[25] The inverse of the labor share is commonly used as a measure for the price-cost markup (Auerbach, Gorodnichenko, and Murphy, 2020b; Nekarda and Ramey, 2020).[26] When following this argument, our evidence implies that a government spending shock lowers the markup, thus giving rise to a countercyclical markup behavior. While other studies also report evidence in favor of a countercyclical markup at the aggregate U.S. level (Bils, 1987; Rotemberg and Woodford, 1999), Nekarda and Ramey (2020) show that an increase in government spending increases output and leads to a rise in the markup.

Finally, we take a closer look at the labor market responses to the regional fiscal spending expansion. Our estimates reveal a significant and persistent increase

23. Figure 1.B.6 shows that disposable income also increases following the regional fiscal stimulus. Contrary to our hourly wage measure, disposable income is calculated after taxes and additionally includes capital income.

24. Here, the labor share is defined as the ratio between total private compensation and gross value added in the private sector.

25. Cantore and Freund (2021) rationalize the increase of the labor share following a government spending shock in a two-agent New Keynesian model populated by capitalists and workers. Capitalists do not supply labor, and, thus, workers make up the entire labor force. The combination of an increase in labor demand due to additional government expenditures combined with no labor supply response by capitalists implies that the labor share rises.

26. The inverse of the labor share is a valid measure of the markup when assuming a Cobb-Douglas production function and abstracting from overhead labor.

in total hours worked as shown in Panel 1.4.2g. On impact, hours worked rise by more than 1% and then increase to 2.5% two years after the shock before slowly converging back to equilibrium. To better understand the driving forces of the increase in hours, we decompose the response into the extensive margin (the total number of employees) and the intensive margin (the number of hours worked per employee). As Panels 1.4.2h and 1.4.2i indicate, we find that the bulk of the increase is accounted for by the extensive margin. The total number of employees responds in a very similar manner as hours worked. In contrast, hours per worker are barely affected by the regional fiscal spending shock. These findings reconcile with our baseline employment multiplier estimates, which imply that the fiscal stimulus is associated with a significant increase in the employment rate. These results support the evidence by Auerbach, Gorodnichenko, and Murphy (2020b) and Carvalho, Franco, and Peralta (2020), who also find that most of the change in hours worked in response to demand shocks is due to adjustments in the extensive margin. Moreover, Serrato and Wingender (2016), Corbi, Papaioannou, and Surico (2019), and Canova and Pappa (2021) also estimate that an increase in regional fiscal spending significantly boosts regional employment. Analogously, Monacelli, Perotti, and Trigari (2010) show that a positive aggregate government spending shock leads to a significant reduction in the unemployment rate.

To quantify how fiscal spending materializes in jobs created, we do a back-of-the-envelope calculation using the estimated coefficients from the employment impulse response function and the average employment and output series in the sample. Our estimates imply that, if the government increases spending by €1 million, it creates 15 additional jobs in the year of the shock, of which 12 are in the private sector and 3 in the public sector, which is consistent with the low estimates for the public sector by Adelino, Cunha, and Ferreira (2017). Because the build-up in employment is very persistent, the stimulus of €1 million produces a total of 33 new jobs after four years, of which 22 are in the private sector and 11 in the public sector.[27] This corresponds to a cost per job created of approximately €30,000, in line with the U.S. estimates that range from roughly $25K to $125K as argued in Chodorow-Reich (2019) and in line with European estimates, for example, a cost per job of €24,000 estimated by Carvalho, Franco, and Peralta (2020).

Taken together, our impulse response analysis has presented several important insights into the fiscal transmission mechanism in the Eurozone. Higher regional government spending i) crowds in private investment through positive supply side effects (increasing productivity), ii) boosts (durable) consumption expenditure, iii)

27. To calculate the job costs across sectors, we re-estimate the employment response for the private and public sector, respectively. Then we apply a similar back-of-the-envelope calculation as done for total employment.

raises real wages while increasing (lowering) the labor share (markup), and iv) expands hours worked, which is mainly driven by increasing the number of employees.

1.4.4 Sectoral Analysis

Our main results show that an increase in regional government spending causes a significant crowding-in of private economic activity and employment. The richness of our dataset and, in particular, its sectoral division allows to get a better understanding of which sectors mainly contribute to these strong effects. In doing so, we first re-estimate the baseline multiplier regressions in Equation (2.D.1) but replace regional GDP and employment by GVA and employment of the private sector.[28] Second, we decompose these private sector multipliers into the specific components coming from different economic sectors, namely, agriculture, industry, construction, services, and finance.[29]

Table 1.4.1 presents the results. While Panel A presents the aggregate multipliers across all sectors, Panel B displays the multipliers for each economic sector separately. On impact, the industry and services sectors mainly contribute to the strong increase in private economic activity. Out of the €1.68 increase in private economic activity, the industry sector contributes with 70 cents and the services sector with 69 cents. Thus, taken together both sectors account for more than 82% of the on-impact increase in private economic activity which is much larger than their combined average share in total private activity (roughly 56%). Higher production in the construction sector adds 27 cents to the total effect and the finance sector only contributes with 5 cents. For all years, the contribution of the agriculture sector is estimated to be negative and increasing over time, reducing the total effect by 14 cents four years after the shock. While the contributions of the industry and services sectors are relatively stable over time, the finance (construction) sector gains (looses) importance in the medium run. At the end of the forecast horizon, the finance sector contributes with 40 cents to the aggregate effects. The stronger impact of the finance sector over time might be explained by a higher credit demand by private firms and households due to the expansionary effects of the fiscal expansion which looses borrowing constraints and reinforces a feedback loop between higher private demand, more credit, and increasing investment and productivity. Moreover, while the fiscal stimulus strongly favors the construction sector in the short-run it stimulates high-productive sectors relatively more over the medium run. In fact, with the

28. We use GVA as the output measure because GDP is not available at the sectoral level. We still normalize the responses such that, on impact, government spending increases by one percent of per capita GDP.

29. These sectors account on average for 2.7%, 25.7%, 8.2%, 30.6%, and 32.8% of the private economy's regional GVA, respectively.

exception of agriculture, the construction sector shows, on average, the lowest labor productivity level in our sample.

Table 1.4.1. Output and Employment Multipliers: Decomposition by Economic Sectors

	GVA Multiplier					Employment Multiplier				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline specification for the private sector										
Multiplier	1.68***	1.87***	1.88***	1.81***	1.72***	1.18***	1.52***	1.56***	1.52***	1.43***
	(0.51)	(0.42)	(0.32)	(0.29)	(0.24)	(0.33)	(0.26)	(0.24)	(0.22)	(0.23)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Multipliers by economic sectors										
Agriculture	-0.04	-0.04	-0.04	-0.09**	-0.14***	-0.04	0.01	0.01	0.02	0.04
	(0.07)	(0.08)	(0.08)	(0.04)	(0.03)	(0.10)	(0.07)	(0.06)	(0.05)	(0.05)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Industry	0.70**	0.66**	0.67***	0.67***	0.66***	0.28***	0.36***	0.39***	0.37***	0.38***
	(0.29)	(0.26)	(0.20)	(0.17)	(0.20)	(0.06)	(0.04)	(0.03)	(0.03)	(0.03)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Construction	0.27**	0.23***	0.23***	0.19***	0.17***	0.33***	0.39***	0.41***	0.35***	0.33***
	(0.11)	(0.06)	(0.05)	(0.05)	(0.04)	(0.08)	(0.08)	(0.07)	(0.07)	(0.08)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Services	0.69***	0.84***	0.82***	0.75***	0.65***	0.49***	0.63***	0.67***	0.67***	0.60***
	(0.17)	(0.12)	(0.10)	(0.08)	(0.08)	(0.11)	(0.09)	(0.10)	(0.09)	(0.07)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Finance	0.05	0.18	0.19	0.29***	0.40***	0.12*	0.12*	0.08	0.09*	0.08
	(0.21)	(0.13)	(0.13)	(0.10)	(0.07)	(0.07)	(0.07)	(0.07)	(0.05)	(0.06)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963

Notes: Industry includes all industry with the exception of construction. Services combine wholesale, retail, transport, accommodation and food services, information and communication. Finance refers to financial and business services. Here, all estimated multipliers are expressed in terms of GVA because output series are not available at the sectoral level. Therefore, the total multiplier (including all sectors) shows minor differences compared to the baseline output (GDP) multiplier. Additionally, we also exclude GVA of non-market sector as we want to analyze the private sector response.

In terms of the employment multiplier, the picture slightly differs. The services sector is the single most dominant contributor to the increase in aggregate private employment. This finding makes intuitive sense because the services sector includes particular labor-intensive work like hospitality or food services. The industry and construction sectors contribute by a similar amount, whereas the agriculture and finance sectors display the smallest contributions.

Investigating the sector-specific responses of additional variables further highlights the heterogeneous impact of fiscal policy across economic sectors in the Eurozone. In the appendix, we report the responses of investment, wages, and total hours (see Figures 1.B.7, 1.B.8, and 1.B.9). Investment increases particularly in the

industry, services, and with some delay also in the finance sectors, which are the strongest contributors to the aggregate output multiplier as well. While investment in the construction sector also rises in the first two years after the fiscal expansion, the response becomes negative thereafter. These results thus help understanding the different output responses across sectors.

Wages increase in all sectors with the most pronounced increase in the industry and construction sectors. Interestingly, while the responses of output and investment in the construction sector fall over time, wages slowly increase over the forecast horizon which might be due to sluggish wage negotiations in this sector. The industry, construction, and services sectors experience the strongest increases in hours worked, whereas the rise is more limited in the finance sector and hours even fall in the agriculture sector.

Taken together, while the increase in aggregate private economic activity is mainly coming from the industry and services sectors (and to some extent from the finance sector), the services sector is the main contributor to the aggregate increase in private employment. The disproportionate amplification effects of the industry and services sectors might be taken into consideration by policymakers when thinking about adequate fiscal stabilization measures.

1.4.5 Regional Fiscal Spillovers

The deep regional integration within the European single market has raised particular interest in how fiscal stimuli spill over from one region to another. In particular, in the presence of positive spillover effects, regions with ample fiscal capacity could use additional fiscal stimuli to boost demand from regions facing substantial economic slack (Blanchard, Erceg, and Lindé, 2016).

Moreover, from an econometric standpoint, the existence of positive (negative) spillover effects of one region's spending on another's outcomes could lead to an overestimation (underestimation) of the true effect of the own regional government spending change. For example, relative output might shift if an increase in one region's output is associated with reducing activity in another region. Strong worker flows from relatively weak to relatively strong performing regions can lead to such relative output shifts. Moreover, while our multiplier estimations assume an increase in one region's spending, other states face the burden of financing the regional stimulus. These channels can lead to negative fiscal spillovers, which would imply that our estimated multipliers are an underestimation of the total effect of public spending on a region. On the contrary, close trade and financial linkages might well induce positive fiscal spillovers, which then result in an overestimation of the impact on local and aggregate economic activity. The conventional wisdom underlying several recommendations shared across policy circles is that fiscal spillovers in the EU are positive and strong (In't Veld, 2016). In the following, we show that regional fiscal spillovers in the Eurozone are relatively small.

Ideally, we would use inter-regional bilateral trade flows to assess the contribution of region j's government spending shock to the spillovers experienced in region i. Unfortunately, these data are not available at the regional European level. However, we use estimates from Thissen, Lankhuizen, Oort, Los, and Diodato (2018), who construct a social accounting matrix with the most likely trade flows between European regions consistent with national accounts.[30] This dataset is the closest proxy for a matrix of bilateral trade between European regions.[31] It contains information for each pair of sector-region on how much each sector in a specific region imported from each individual sector and region. We aggregate this information by region such that we estimate the most likely trade flow between regions in the Eurozone.[32]

We extend the baseline specification (2.D.1) to account for regional fiscal spillovers. First, for each region i and horizon $h = 0, ..., 4$, we compute a weighted sum of spillover fiscal shocks as follows:

$$\sum_{j \neq i} \bar{w}_{i,j}(G_{j,t+m} - G_{j,t-1}),$$

where $G_{j,t}$ is government spending in region j in period t and $j \neq i$. $\bar{w}_{i,j}$ is the average trade weight between both regions for the period 2000-2010.

$$\bar{w}_{i,j} = \sum_{t=2000}^{2010} w_{i,j,t} \times \frac{1}{11}, \quad where \quad w_{i,j,t} = \frac{imports_{i,j,t}}{G_{j,t}}.$$

We follow Auerbach and Gorodnichenko (2013) and calculate $w_{i,j,t}$ as the ratio between imports in region j coming from region i and government spending in region j in year t. Hence, we account for both the spillovers from trade linkages and the size of the government in the importing regions. Because the trade data are only available for the period 2000–2010, we use the subsample to calculate average trade weights, $\bar{w}_{i,j}$, and hold them constant for the regressions on the entire sample. To assess the size of spillovers, we either use all trade partners, trade partners from the same country, or only i's top 10% of trade partners with regard to $\bar{w}_{i,j}$. Then, we estimate the own and spillover multipliers for each horizon $h = 0, ..., 4$:

30. Coelho (2019) uses the same dataset to study fiscal spillovers associated with structural funds financed by the European Commission.

31. The authors use a top-down approach to construct the time series of multiregional input-output tables, where national accounts in the format of national Supply, Use and Input-Output Tables are taken as given.

32. See Appendix 1.A.3 for more details and Table 1.A.6 for a visualization of our procedure.

$$\begin{aligned}\sum_{m=0}^{h} z_{i,t+m} =& \beta_h \sum_{m=0}^{h} \left(\frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} \right) \\ &+ \phi_h \sum_{m=0}^{h} \left(\frac{\sum_{j \neq i} \bar{w}_{i,j} (G_{j,t+m} - G_{j,t-1})}{Y_{i,t-1}} \right) \\ &+ \gamma_h(L) X_{i,t-k} + \alpha_{i,h} + \delta_{t,h} + \epsilon_{i,t+m}.\end{aligned} \tag{1.4.1}$$

For each horizon h, β_h directly yields the output or employment multiplier of a one percent increase in the own region government spending relative to GDP, and ϕ_h represents the spillover multipliers of a one percent change in trade partners' government spending. A positive (negative) ϕ_h implies that an increase in other regions' government spending raises (lowers) economic activity or employment in the own region. We again use Driscoll and Kraay (1998) standard errors to calculate confidence intervals.

Besides using the baseline instrument described in Equation (1.3.2) for the own regional government spending change, we now also construct an instrument for the regional spillover spending change. We compute this spillover Bartik instrument as:

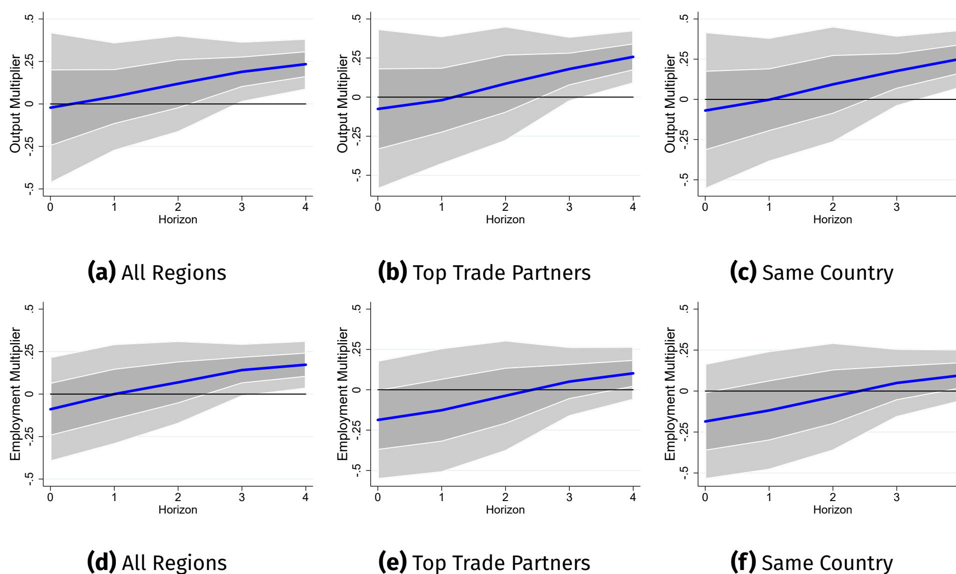
$$\frac{\sum_{j \neq i} \bar{w}_{i,j} \times (G_{J,t} - G_{J,t-1}) \times s_j}{Y_{I,t-1}}, \tag{1.4.2}$$

where, similarly to s_i, s_j is the ratio between average per capita government spending in region j belonging to country J.

Figure 1.4.3 shows the estimated spillover multipliers. Panel 1.4.3a shows the output multiplier estimates using all trade partners. The estimated spillover multiplier is small and insignificant for most periods of the forecast horizon. Only at the end of the forecast horizon, the multiplier becomes significant but the point estimate remains to be small with a value below 0.25. This general picture of small and mostly insignificant fiscal spillovers holds for employment (Panel 1.4.3d), and also when moving from all regions to only the top 10% trade partners (Panels 1.4.3b and 1.4.3e) or when restricting to regions within the same country (Panels 1.4.3c and 1.4.3f).

To put the magnitude of the spillover multipliers into perspective, remember that our baseline own output and employment multipliers were estimated to be around 2.2 and 1.4. Now, the respective spillover multipliers take on values below 0.25 for output and below 0.15 for employment, which implies that only around 1/10 of the baseline multiplier estimates can be explained by fiscal spillover effects. This insight is further supported by the estimated own multipliers according to Equation (1.4.1) which we report in the appendix (see Figure 1.B.10). Because the own multiplier estimates barely change compared to the baseline results, fiscal spillovers do not affect our main findings.

The finding of small fiscal spillovers also persist when looking at other variables than output and employment. In the appendix, we show the spillover responses



(a) All Regions **(b)** Top Trade Partners **(c)** Same Country

(d) All Regions **(e)** Top Trade Partners **(f)** Same Country

Figure 1.4.3. Output and Employment Spillover Multipliers. Panels 1.4.3a and 1.4.3d show the output and employment spillover multiplier taking into account the spillovers from all regions. Panels 1.4.3b and 1.4.3e consider only the spillovers from the main trade partners (top 10% of the weights). Panels 1.4.3c and 1.4.3f consider only trade partners from the same country. Shaded areas are 68% (dark) and 95% (light) Driscoll and Kraay (1998) confidence intervals.

when considering all regions for investment, consumption (again measured by the number of motor vehicles), and wages (see Figure 1.B.11).[33] For all these additional variables, the effects are limited even showing some evidence of negative spillovers, although the estimates are mostly insignificant. Thus, the results regarding the fiscal transmission mechanism documented in Section 1.4.3 should be interpreted as responses mainly originated by changes in government spending in the own region, whereas cross-regional spillovers contribute only to a very small extent to the detected induced dynamics.

Overall, these results reveal relatively small fiscal spillovers for the Eurozone and thus reinforce the existing results on the U.S. economy (Serrato and Wingender, 2016; Dupor and Guerrero, 2017; Auerbach, Gorodnichenko, and Murphy, 2020a; Bernardini, Schryder, and Peersman, 2020) and Italy (Acconcia, Corsetti, and Simonelli, 2014), but stand in some contrast to the sizeable spillovers reported by Coelho (2019) and McCrory (2020). In addition, our findings do not accord with the conventional policy narrative that government spending increases are thought to have large and positive spillover effects in the Eurozone (In't Veld, 2016). Relatedly,

33. Results are very similar when only considering the top 10% trade partners or when restricting to regions within the same country.

our insights imply that recommendations to jump-start the European economy by increasing public spending in regions with fiscal capacity should be interpreted with caution since the positive spillover effects might be limited despite the European single market.

1.4.6 State Dependent Multipliers

As a final exercise, we investigate whether regional fiscal multipliers in the Eurozone are characterized by significant state dependencies. In particular, we test whether fiscal multipliers depend on the state of the business cycle, on the sign of the fiscal intervention (consolidation versus expansion), and if they differ between core and periphery countries of the Eurozone.

There is an ongoing debate in the literature concerning business cycle-dependent effects of fiscal policy. While some studies indeed provide evidence that fiscal multipliers are larger in economic recessions than economic booms (Auerbach and Gorodnichenko, 2012; Nakamura and Steinsson, 2014), others do not find that fiscal multipliers vary across states of the business cycle (Ramey and Zubairy, 2018). Concerning the sign of the fiscal intervention, Barnichon, Debortoli, and Matthes (2020) show that, at the aggregate U.S. level, a reduction in government spending is associated with a larger fiscal multiplier when compared to an increase in government spending. Born, D'Ascanio, et al. (2019) find similar results for a panel of advanced and emerging market economies. Finally, the significant fiscal consolidation measures implemented in several European countries in the aftermath of the Great Recession and the dismal growth performances that followed have raised questions about the detrimental effects of austerity programs (Blanchard and Leigh, 2013). Thus, testing for a potential non-linearity between core and periphery countries is intended to provide information about significant country heterogeneities within the Eurozone.

To test for potential state dependencies, we extend our baseline specification (2.D.1). For each horizon $h = 0, \dots, 4$, we estimate the regression:

$$\begin{aligned} \sum_{m=0}^{h} z_{i,t+m} =& I_{i,t}\left[\beta_h^A \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h^A(L)X_{i,t-k}\right] \\ &+ (1 - I_{i,t})\left[\beta_h^B \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h^B(L)X_{i,t-k}\right] \\ &+ \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+m}, \end{aligned} \tag{1.4.3}$$

where $I_{i,t}$ is an indicator variable for the defined state in period t. We now instrument spending changes with the Bartik instrument but interacted with the state indicator. β_h^A and β_h^B directly yield, for each horizon h and states A and B, the fiscal output or employment multiplier, respectively. Here, we use Driscoll and Kraay

(1998) standard errors, and compute the Anderson and Rubin (1949) test and the heteroskedasticity and autocorrelation consistent (HAC) test to test for statistical differences in multipliers across states.

To investigate potential state dependencies across the business cycle, we closely follow Nakamura and Steinsson (2014) and define the indicator variable, $I_{i,t}$, based on regional unemployment fluctuations. More precisely, we define that a region is in an economic expansion (recession) in t if the unemployment rate in $t-1$ is below (above) the region's median. We define the state based on lagged unemployment to minimize contemporaneous correlations between fiscal shocks and the state of the business cycle.

Panel B in Table 1.4.2 presents the results, where the upper part reports our baseline (state-independent) estimates to allow for a direct comparison. For all years, the multiplier is estimated to be larger when the region experiences a recession compared to an economic boom. This is true for the output and employment multiplier alike. For the employment multiplier, the difference across business cycle states is also estimated to be significant, while for the output multiplier, the difference is borderline insignificant (especially at longer horizons). Thus, our evidence broadly supports the view that fiscal interventions have a larger effect on the economy during periods of economic slack, in line with the empirical evidence by Auerbach and Gorodnichenko (2012) and Nakamura and Steinsson (2014).

Next, we study whether the sign of the fiscal intervention affects the size of the fiscal multiplier. To differentiate between fiscal consolidations and fiscal expansions, we allow for different effects depending on the sign of our Bartik instrument. Whenever the change in national spending takes on a positive value, we treat the fiscal intervention as a spending expansion ($I_{i,t} = 1$), and whenever the instrument takes on a negative value, we assign a fiscal consolidation ($I_{i,t} = 0$).[34]

Panel C of Table 1.4.2 shows the estimated fiscal multipliers.[35] For the output multiplier, we do not find clear evidence that the sign of the fiscal intervention considerably influences the size of the multiplier. While for some years the output multiplier associated with a fiscal expansion is larger than the one associated with a fiscal consolidation, the picture flips in other years. For most years of the forecast horizon, the employment multiplier brought by a fiscal consolidation is larger than the one brought by a fiscal expansion. However, the differences are small such that multipliers do not significantly depend on the sign of the fiscal intervention.

Finally, we test for differences in fiscal multipliers between core and periphery countries. Greece, Ireland, Italy, Portugal, and Spain are considered periphery

34. This procedure implies that out of the 2,621 regional shocks considered, 2,207 shocks, or 84%, are treated as fiscal expansions, while the remaining 414 or 16% are treated as consolidations.

35. The multipliers are positive in both states because a fiscal consolidation is associated with a fall in government spending and a reduction in output (employment), whereas a fiscal expansion leads to an increase in government spending and a rise in output (employment).

Table 1.4.2. Output and Employment State Dependent Multipliers

	Output Multiplier					Employment Multiplier				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline Specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Business Cycle Recessions versus Expansions										
Recessions	2.57***	2.69***	2.76***	2.74***	2.64***	1.44***	1.77***	1.92***	1.97***	1.92***
	(0.56)	(0.34)	(0.25)	(0.21)	(0.15)	(0.33)	(0.15)	(0.11)	(0.18)	(0.20)
Expansions	2.17***	2.45***	2.41***	2.35***	2.33***	0.94***	1.29***	1.38***	1.38***	1.33***
	(0.26)	(0.29)	(0.22)	(0.20)	(0.17)	(0.19)	(0.21)	(0.22)	(0.22)	(0.23)
HAC Test	0.33	0.36	0.16	0.10	0.14	0.01	0.04	0.05	0.10	0.09
AR Test	0.26	0.32	0.11	0.11	0.16	0.01	0.03	0.04	0.09	0.10
# Obs	2428	2266	2104	1943	1783	2428	2266	2104	1943	1783
Panel C: Fiscal Consolidation versus Fiscal Stimulus										
Consolidation	2.16***	2.55***	2.42***	2.33***	2.29***	1.09***	1.47***	1.37***	1.36***	1.32***
	(0.47)	(0.39)	(0.30)	(0.25)	(0.22)	(0.26)	(0.12)	(0.06)	(0.09)	(0.12)
Stimulus	2.33***	2.33***	2.45***	2.26***	2.36***	0.97**	1.25***	1.43***	1.18***	1.27***
	(0.68)	(0.59)	(0.51)	(0.40)	(0.29)	(0.44)	(0.40)	(0.44)	(0.29)	(0.27)
HAC Test	0.77	0.61	0.93	0.79	0.64	0.78	0.57	0.90	0.45	0.83
AR Test	0.78	0.60	0.93	0.79	0.67	0.78	0.57	0.90	0.46	0.82
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel D: Core versus Periphery										
Core	2.63***	2.66***	2.73***	2.92***	2.90***	1.34***	1.68***	1.80***	2.20***	2.28***
	(0.59)	(0.42)	(0.27)	(0.23)	(0.21)	(0.40)	(0.31)	(0.24)	(0.17)	(0.18)
Periphery	1.79***	2.06***	2.10***	2.01***	1.99***	1.04***	1.35***	1.43***	1.34***	1.32***
	(0.28)	(0.29)	(0.27)	(0.25)	(0.20)	(0.20)	(0.13)	(0.13)	(0.13)	(0.16)
HAC Test	0.11	0.09	0.02	0.00	0.00	0.29	0.23	0.13	0.00	0.00
AR Test	0.11	0.14	0.12	0.06	0.09	0.29	0.25	0.21	0.06	0.11
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963

Notes: In Panel B, we show the results for expansions and recessions. A given region is in the low unemployment state (expansion) if in the previous period the unemployment rate was below the region's median, and it is in high unemployment state (recession) if the rate was above or equal to the region's median. In Panel C, we show state dependencies for fiscal consolidations and stimuli. Precisely, we define fiscal consolidations (stimuli) whenever the Bartik instrument is negative (positive). In Panel D, we study differences between the core and periphery Eurozone countries. The PIIGS countries (Portugal, Ireland, Italy, Greece, and Spain) are considered periphery countries, while Austria, Belgium, Finland, France, Germany, Luxembourg, and the Netherlands belong to the core group. The AR Test presents the p-value of the difference between states using the Anderson and Rubin (1949) test, while the HAC Test indicates the HAC-robust p-values.

$(I_{i,t} = 1 \ \forall t)$, while Austria, Belgium, Finland, France, Germany, Luxembourg, and the Netherlands are treated as core countries $(I_{i,t} = 0 \ \forall t)$. In this case, the indicator

variable is time invariant. Panel D of Table 1.4.2 shows that fiscal multipliers in the Eurozone display significant country heterogeneity. Both output and employment multipliers are considerably larger in core countries than in the periphery. Moreover, for most horizons considered, the difference between the multipliers is also estimated to be significant. Thus, specific country characteristics in the periphery seem to reduce the impact of fiscal interventions, whereas the opposite describes the situation in the core countries. The political and legal system, the labor market and pricing frictions or financial developments are all potentially responsible for differences in fiscal multipliers between core and periphery countries. As shown earlier, to a significant amount, fiscal policy in the Eurozone operates via a productivity channel through which higher government spending increases productivity and private investment. Because labor productivity and TFP are, on average, lower in the periphery than in the core countries, productivity differences across member states might rationalize differences in fiscal multipliers. However, understanding in more detail what drives these country heterogeneities could be an interesting avenue for future research.

1.5 Conclusion

The effectiveness of fiscal policy in the Eurozone is a central topic of ongoing debates among economists and policymakers alike. Using a newly assembled dataset at the regional level, this paper investigates the impact of fiscal policy in the Eurozone and provides new evidence on its transmission mechanism. In particular, our baseline estimates reveal a fiscal spending output (employment) multiplier of 2.2 (1.4). Moreover, the regional fiscal stimulus leads to a significant increase in private investment together with a rise in labor productivity and TFP. Furthermore, an increase in government spending causes higher wages and durable consumption expenditure and a rise (fall) in the labor share (markup). Concerning labor margins, we find that higher government spending raises total hours worked, which is driven by changes in the extensive margin (total employment), whereas the intensive margin (hours per worker) barely reacts. Our estimates imply a cost per job created of about €30,000.

We also detect significant sectoral heterogeneity, with the industry and services sectors contributing a disproportionate amount to the aggregate increase in private economic activity. The paper provides further evidence that there are small and mostly insignificant regional fiscal spillovers which stands in contrast to a common view of positive and sizeable fiscal spillovers shared in policy discussions. Finally, we detect notable state-dependencies in regional fiscal multipliers. They are larger in economic recessions and in the core countries of the Eurozone but do not significantly depend on the sign of the fiscal intervention (stimulus versus consolidation).

Our new evidence should contribute to discussions among academics and policymakers about the gains and limitations of fiscal policy in the Eurozone. In particular, our results suggest that fiscal policy is an effective tool to stimulate regional employment, investment, and productivity. Furthermore, despite the deep regional integration within the Eurozone, increased public spending in regions with ample fiscal capacity might have only small spillover effects. Finally, heterogeneous effects across industries, states of the economy, and member states should be taken into account when designing adequate stabilization measures.

Appendix 1.A Data Description

Table 1.A.1. NUTS Structure

NUTS 0	NUTS 1	#	NUTS 2	#	NUTS 3	#
Austria	Groups of states	3	States (Länder)	9	Groups of districts	35
Belgium	Regions	3	Provinces and Brussels (Verviers split in 2)	11	Arrondissements	44
Finland	Mainland, Åland	2	Large areas (Suuralueet / Storområden)	5	Regions (Maakunnat / Landskap)	19
France	ZEAT Overseas Regions	9	Regions	27	Departments	101
Germany	States (Bundesland)	16	Government regions (Regierungbezirk)	39	Districts Kreis	429
Greece	Groups of regions	4	Regions	13	Prefectures	51
Ireland	-	1	Regional Assemblies	3	Regional Authorities	8
Italy	Groups of regions	5	Regions (Trentino-Alto Adige split in 2)	21	Provinces	110
Luxembourg	-	1	-	1	-	1
Netherlands	Groups of provinces	4	Provinces	12	COROP regions	40
Portugal	Mainland and 2 autonomous regions	3	5 Coordination regions 2 autonomous regions	7	Groups of Municipalities	25
Spain	Groups of communities	7	17 Autonomous communities 2 autonomous cities	19	Provinces, Islands Ceuta, Melilla	59
Total		58		167		922

Table 1.A.2. Variables Description

Variable Name	Computation	Definition [Source]
GDP*pc*	GDP / Population	Regional gross domestic product per capita [ARDECO]
Gov. Spending *pc*	(1+Int. Cons)*Non-Market GVA / Population	Regional proxy for government spending per capita [ARDECO]
Employment		Total employment [ARDECO]
Employment Rate	Employment / Population	Total employment per capita [ARDECO]
Hours		Total hours worked [ARDECO]
Hourly Wage	Compensation / Hours	Regional average compensation per hour (all sectors) [ARDECO]
Investment *pc*	Private GFCF/ Population	Total private (all sectors excluding non-market) investment per capita (fixed gross capital formation) [ARDECO]
Labor Share	Private Compensation / private GVA	Private (all sectors excluding non-market) compensation as a share of private GDP [ARDECO]
Productivity	GVA / Hours	Labor productivity, value added per hour (all sectors) [ARDECO]
TFP	Check 1.A.5 for details	Total factor productivity (private sectors) [ARDECO and Gardiner, Fingleton, and Martin (2020)]
Motor Vehicles	# motor vehicles / Population	Stock of all motor vehicles (except trailers and motorcycles) per capita [Eurostat]
Inflation	Growth rate of regional CPI	Austria [statistik], Finland [stat], Germany [destatis], Italy [istat], Portugal [ine], Spain [ine]

1.A.1 ARDECO - Regional European Data

ARDECO is the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy, maintained and updated by the Joint Research Centre. It is a highly disaggregated dataset across both sectoral and subregional dimensions. The databasebuilds on the previous Cambridge Econometrics regional dataset and contains a set of long time-series indicators for EU regions at various statistical scales (NUTS 0, 1, 2, and 3 level) using the NUTS 2016 regional classification. The dataset includes data on demography, labor markets, capital formation and domestic product by six sectors. The six sectors are (1) agriculture, forestry and fishing, (2) industry excluding construction, (3) construction, (4) wholesale, retail, transport, accommodation, and food services, information and communication, (5) financial and business services, and (6) non-market services.

ARDECO data is an annual unbalanced panel covering the period of 1980–2017 for the European Union (EU) and some European Free Trade Association (EFTA) and candidate countries. Its main data source is Eurostat (the Statistical Office of the European Commission), complemented, where necessary, by other appropriate national and international sources. ARDECO is constructed in such a way that the country aggregates its various time series equal to the corresponding time series in the AMECO dataset referring to the National Accounts. Starting from 2002, Eurozone countries publish national series in EUR. National currency data for all years prior to the switch of the country to EUR have been converted using the irrevocably fixed EUR conversion rate. Cross-country comparisons and aggregations should continue to be based only on historical series established in ECU up to 1998 and their statistical continuation in EUR from 1999 onward. Exchange rates and purchasing power parities have been converted in the same manner. We thus use the series with real variables expressed in 2015 constant price in ECU/EUR.

1.A.2 Regional government spending measure

We now explain in detail why our regional measure (GVA plus intermediate consumption of the non-market sector) is indeed a valid proxy for government spending.

First, as previously mentioned, ARDECO's regional data is consistent with the national accounts data by construction. By definition, there exists a close link between government spending and the GVA of the non-market sector, however, they differ in two dimensions: actors and composition. Regarding the first, even though the non-market sector includes other institutional units, the general government is the main actor responsible for changes in non-market GVA.

In particular, the non-market sector consists of six sub-sectors: "Public administration and defense", "Education", "Human health and social work", "Arts, entertainment and recreation", "Other service activities," and "Activities of household

and extra-territorial organizations and bodies." The first sub-sector, "Public administration and defense," refers to activities by the general government, but not all government bodies are automatically classified under this sub-sector. For example, a secondary school administered by the central or local government is classified as "Education," and a public hospital is allocated to "Human health and social work." Thus, the two sub-sectors "Education" and "Human health and social work" are also closely linked to the general government in the national accounts, while the last three sub-sectors are linked only loosely.

Relying on Finnish data, we indeed find that 100% of the GVA in the sub-sector "Public administration and defense" is booked as government expenditure in the national accounts. For the second and third sub-sectors, this number is 88% and 75%, respectively.[36] Moreover, for the countries in our sample, these first three sub-sectors, which are most closely linked to activities by the general government, make up the lion's share of the non-market GVA, accounting for 84%.[37] Consequently, almost the entire variation in GVA of the non-market sector refers to activities by the general government.

Concerning the second dimension, we now describe the compositional differences between non-market GVA and government spending. In the national accounts, government spending is defined as follows:

Final consumption expenditure of the general government
=Gross value added of the general government
+Intermediate inputs of the general government
+Social transfers in kind purchased market production
-Market output and output for own final use
-Payments for non-market output

GVA of the general government is the major component of government spending and fully accounted in the GVA of the non-market sector. Country level data show that GVA of the general government accounts for almost 70% of government spend-

36. In our sample, with the exception of Finland, cross-classification tables between NACE and institutional sectors are not publicly available. Statistics Finland's series can be consulted here.

37. According to data collected from Eurostat and for the sample comprising the first twelve Eurozone countries between 1999 and 2017.

ing.[38] Thus, our proxy measures the single-most dominant source of government expenditures. However, the main difference between government spending and the GVA of the general government is due to intermediate inputs and social transfers in kind. When again looking at country level data, we find that GVA and intermediate consumption account for about 97% of government spending. To include intermediate consumption in our government spending measure, we use input-output tables from the PBL EUREGIO database that provide estimates for intermediate consumption of the non-market sector at the NUTS 2 level from 2000–2010. We find that, on average, intermediate consumption accounts for around 30% of total expenditure of the non-market sector at the regional level, which is very similar to the corresponding number when looking at expenditures of the general government at the national level (27%). Moreover, the variation in this ratio for a given region is rather stable over time.[39] Thus, we adjust regional GVA of the non-market sector by a region-specific time-invariant scaling factor to include intermediate consumption in our government spending measure to obtain our proxy for regional government spending.

Second, to quantitatively assess the quality of our proxy, we study its time series properties comparing them to the actual measure of government spending at the national level.[40] In particular, we use intermediate consumption adjusted GVA of the non-market sector from the ARDECO and EUREGIO datasets at the NUTS 0 (country) level and the series on final consumption expenditures of the general government from the OECD and AMECO. The pooled correlation coefficients between the GVA and the government spending series (both in levels and logs) are about 0.99 and highly significant. Such strong positive correlations also hold at the individual country level as can be seen in Table 1.A.3. With the exceptions of Italy and Portugal, the correlation coefficients are around 0.99. Moreover, Table 1.A.4 shows the estimation results from regressing government spending on our proxy in log level with and without country and year fixed effects. All regressions indicate a significant and strong relationship between the two variables with coefficients very close to 1.

So far, the analysis was conducted at the national (NUTS 0) level. We go one step further and compare our regional (NUTS 2) proxy for government spending to the government final consumption expenditure series from the PBL EUREGIO database, which is discussed in more detail in Appendix 1.A.3. The EUREGIO database provides estimates of regional government spending but only for a subset of our sample

38. According to data collected from Eurostat and for the sample comprising the first twelve Eurozone countries between 1999 and 2017.

39. When calculating time-varying intermediate consumption ratios for each region, the average standard deviation is 0.018.

40. Remember that, at the national level, GVA of the non-market sector, intermediate consumption, and government spending are available, whereas at the regional level only GVA of the non-market sector and intermediate consumption are available from national accounts data.

(2000 to 2010). Notwithstanding, when doing this comparison, we find that both series are highly significantly correlated. The correlation coefficient between the two series in logs is close to 1. Table 1.A.5 presents the same regressions as before but now at the regional level. There is a strong and significant relationship between the EUREGIO estimated government spending series and our government spending proxy given that the coefficients are estimated to be close to 1.

In sum, we conclude that regional GVA of the non-market sector is a valid proxy for regional government spending. It is closely linked to government spending in the national accounts, and both series share remarkably similar time series properties.

Table 1.A.3. Correlation Between Government Spending and our proxy by Country

	Correlation w/ OECD Series		Correlation w/ AMECO Series	
Country	Levels	Logs	Levels	Logs
Austria	0.9899	0.9886	0.9876	0.9859
Belgium	0.9762	0.9786	0.9917	0.9917
Finland	0.9698	0.9728	0.9906	0.9910
France	0.9965	0.9967	0.9931	0.9931
Germany	0.9905	0.9907	0.9848	0.9837
Greece	0.9755	0.9751	0.9851	0.9846
Ireland	0.9581	0.9660	0.9967	0.9972
Italy	0.8335	0.8412	0.8928	0.8976
Luxembourg	0.9950	0.9968	0.9946	0.9961
Netherlands	0.9826	0.9845	0.9912	0.9918
Portugal	0.9753	0.9757	0.9143	0.9100
Spain	0.9905	0.9924	0.9869	0.9904
All	0.9976	0.9977	0.9975	0.9988

Notes: This shows, by country, the correlation in levels and logs between our proxy for government spending (from ARDECO) with actual government spending (from OECD and AMECO). Whenever possible, we use data from 1999 to 2017, with the exception of Greece, for which we use the period 2001–2017.

1.A.3 PBL EUREGIO database

To include intermediate consumption in our government spending proxy and for the fiscal spillover analysis in Section 1.4.5, we use the PBL EUREGIO database. This is the first time-series (annual, 2000–2010) of global IO tables with regional detail for the entire large trading bloc of the European Union. This database allows for a regional analysis at the NUTS 2 level consistent with our baseline method. The tables merge data from WIOD (the 2013 release) with regional economic accounts and inter-regional trade estimates developed by PBL Netherlands Environmental Assessment Agency and complemented with survey-based regional input-output data for a limited number of countries. All data used are survey data, and only non-behavioral assumptions have been made to estimate the EUREGIO dataset. These two general rules of data construction allow empirical analyses focused on impacts of changes in behavior without endogenously having this behavior embedded already by construction. More detailed information can be found in Thissen et al. (2018).

Table 1.A.6 shows an example of the type of information provided by the IO tables from Thissen et al. (2018). For each pair of sector-region we have information about how much a specific sector in a specific region imported from each individual sector from each individual region, all measured in million dollars. Given this infor-

Table 1.A.4. Proxy for Government Spending at the National Level

	log *proxy*		
	(1)	(2)	(3)
Panel A: OECD			
log *GovSpend*	0.920***	0.860***	0.840***
	(0.038)	(0.063)	(0.072)
# Obs	223	223	223
Panel B: AMECO			
log *GovSpend*	1.049***	1.113***	1.111***
	(0.031)	(0.053)	(0.082)
# Obs	212	212	212
Country FE	No	Yes	Yes
Time FE	No	No	Yes

Notes: Columns (1) to (3) show the results from regressing the log of the government spending series from OECD and AMECO on the log of our proxy for government spending at the national level (NUTS 0). We use data from 1999 to 2017 and display robust standard errors clustered at the country level in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 1.A.5. Proxy for Government Spending at the Regional Level

	log *proxy*		
	(1)	(2)	(3)
log *GovSpend*	1.020***	1.032***	0.666***
	(0.045)	(0.113)	(0.199)
Regional FE	No	Yes	Yes
Time FE	No	No	Yes
# Obs	1604	1604	1604

Notes: Columns (1) to (3) show the results from regressing the log of the regional government spending series from EUREGIO on the log of our proxy for government spending from ARDECO at the regional level (NUTS 2). Data from 2000 to 2010. Robust standard errors clustered at the region level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

mation, we aggregate all sectors within a given region so that we have an estimate of the most likely trade flows between regions in the Eurozone. This means that we have an estimate of how much million dollars worth of goods and services a specific

region imported from all other individual regions. Finally, we convert this measure into euros using a yearly average of the euro-dollar exchange rate.

Table 1.A.6. Example of IO table from Thissen et al. (2018)

			Burgenland (AT11)													
			ss1	ss2	ss3	ss4	ss5	ss6	ss8	ss9	ss10	ss11	ss12	ss13	ss14	ss15
Burgenland (AT11)	ss1	Agriculture	44.4	0.1	59.0	1.3	0.6	0.2	13.2	1.2	0.8	5.2	0.3	0.1	0.5	0.7
	ss2	Mining quarrying and energy supply	2.8	47.8	4.2	0.8	7.1	2.2	14.3	9.6	5.3	3.9	3.6	1.4	8.7	17.6
	ss3	Food beverages and tobacco	5.9	0.2	18.9	0.9	1.1	0.7	1.7	0.8	2.3	12.0	0.8	0.4	0.6	5.6
	ss4	Textiles and leather	0.1	0.0	0.1	1.0	0.2	0.2	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.1
	ss5	Coke refined petroleum nuclear fuel and chemicals etc	2.4	0.8	2.5	1.0	6.8	5.4	9.0	5.2	4.8	0.6	2.8	0.6	1.8	4.2
	ss6	Electrical and optical equipment and transport equipment	0.6	1.4	1.0	0.3	0.9	8.2	4.4	4.9	3.2	0.4	1.8	0.9	2.7	2.8
	ss8	Other manufacturing	4.8	2.4	6.8	1.1	6.5	19.8	94.0	50.4	14.3	1.4	4.2	2.9	9.0	11.7
	ss9	Construction	3.0	1.8	1.5	0.4	1.4	1.9	5.3	35.9	3.4	3.5	5.1	3.7	40.4	20.2
	ss10	Distribution	16.6	4.8	26.5	10.4	20.0	32.1	53.6	30.0	31.9	8.0	12.8	3.1	9.4	23.6
	ss11	Hotels and restaurant	0.1	0.0	0.2	0.1	0.1	0.1	0.3	0.2	0.4	0.5	5.9	0.5	0.3	0.3
	ss12	Transport storage and communication	1.6	2.9	5.6	1.4	4.7	4.0	16.6	5.3	17.0	1.5	38.0	5.4	6.2	11.4
	ss13	Financial intermediation	5.1	4.6	5.3	1.5	4.5	6.5	15.6	13.1	24.1	5.5	9.9	39.1	24.2	30.4
	ss14	Real estate renting and business activities	2.5	4.1	10.7	2.1	7.6	11.4	24.7	18.7	47.7	9.6	17.8	20.4	65.5	38.6
	ss15	Non-Market service	3.7	0.9	3.2	0.8	1.7	1.4	9.5	1.6	6.6	3.0	2.4	3.4	25.7	47.8

Notes: This Figure shows an example of an input-output table for just one region from Thissen et al. (2018) (Burgenland, Austria). Each column states the amount of inputs a sector from Burgenland receives from another sector from another (or the same in this case) region. For example, the agricultural sector in Burgenland (first row) gives as inputs 44.4 million dollars worth of goods/services to the agricultural sector in Burgenland and gives 59.0 million dollars to the Food and Beverages and Tobacco sector in Burgenland (first row, third column).

1.A.4 Military Data at the Country Level

Military expenditure data are taken from the Stockholm International Peace Research Institute (SIPRI) Military Expenditure Database 2019. SIPRI collects military spending data from several sources, including government agencies and international organizations. The military spending data include all spending on current military forces and activities such as personnel, procurement, operations, military research and development, and construction. The largest component is usually salaries to and benefits of military personnel. The data are at an annual frequency.

1.A.5 Total Factor Productivity

Contrary to the remaining dependent variables, for which we only use data from ARDECO, TFP measures make use of capital stock estimates from Gardiner, Fingleton, and Martin (2020).[41] Its construction hinges on the methodology used by Derbyshire, Gardiner, and Waights (2013), which makes use of the Perpetual Inventory Method using regional investment series from ARDECO and data from EU KLEMS for the national depreciation rate and national initial capital stock.[42]

TFP is then calculated as a residual with a labor share of two-thirds as is common in the literature. Precisely, we estimate

$$TFP_{i,t} \;=\; exp\Big(ln(GVA_{i,t}) - 1/3 \times ln(K_{i,t}) - 2/3 \times ln(L_{i,t})\Big) \qquad (1.A.1)$$

where GVA is total Gross Value-Added, K is capital stock adjusted to constant 2015 EUR using national CPI data from the World Bank, and L is total hours worked. All variables are measured at the regional level i and at year t. We use all measures in private sector terms and obtained them by subtracting the non-market sector values from their total. Hence, there is no need to remove the government spending component as in Brueckner, Valentinyi, and Pappa (2019). We take the exponential of this expression to compute TFP growth rate in the exact same way as we compute it for the remaining variables, instead of taking log differences.

41. It was necessary to adjust the regional division to be in accordance with the most recent NUTS 2016 version for France, Ireland, Poland and the United Kingdom.

42. More details on its construction can be found here.

Appendix 1.B Additional Results

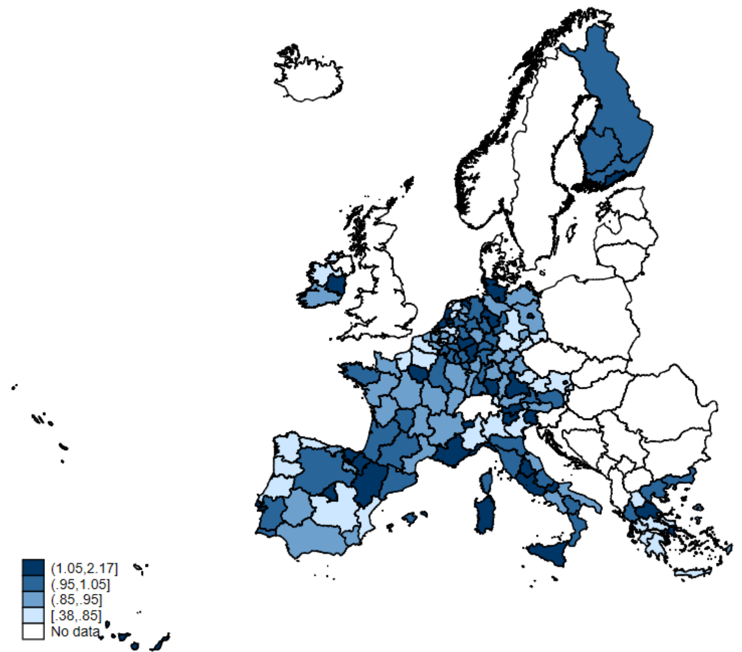


Figure 1.B.1. Sample Regions and the Share s_i. The Figure depicts the map of European NUTS 2 regions with the share s_i used in Bartik instrument construction.

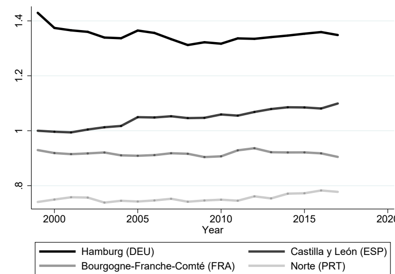
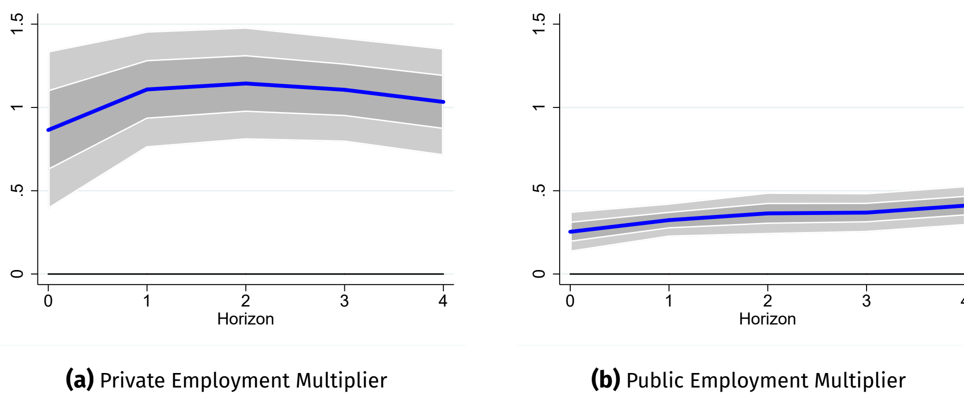


Figure 1.B.2. Ratio between Regional and National per capita Government Sending. This Figure plots the ratio between regional and national per capita government sending over time for selected regions in the sample.



(a) Private Employment Multiplier

(b) Public Employment Multiplier

Figure 1.B.3. Private and Public Employment Multipliers. Panels 1.B.3a and 1.B.3b show the cumulative employment multipliers for private and non-market sectors relative to total employment, respectively. Shaded areas are 68% (dark) and 95% (light) confidence intervals.

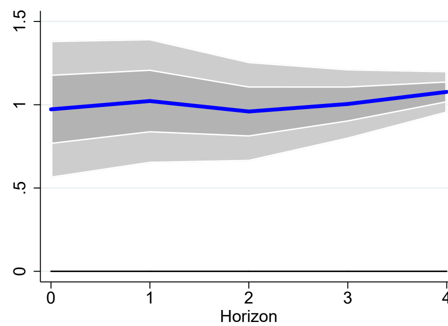


Figure 1.B.4. Investment Multiplier. This figure shows the cumulative relative private investment multiplier (using change in private investment relative to output). Shaded areas are 68% (dark) and 95% (light) confidence intervals.

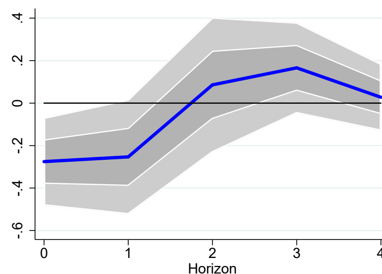


Figure 1.B.5. Impulse Response of Inflation. The figure plots the response of inflation to a one percent increase in per capita government spending relative to per capita GDP. The impulse response is expressed in percentage point changes (its differences). Shaded areas are 68% (dark) and 95% (light) confidence intervals.

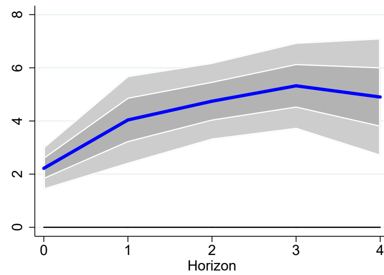
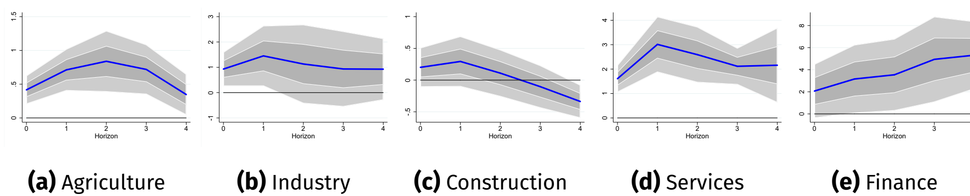
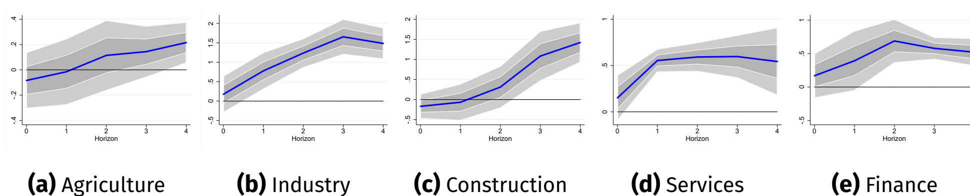


Figure 1.B.6. Impulse Response of Disposable Income. The figure plots the response of per capita disposable income to a one percent increase in per capita government spending relative to per capita GDP. The impulse response is expressed in percent changes (growth rates). Shaded areas are 68% (dark) and 95% (light) confidence intervals.



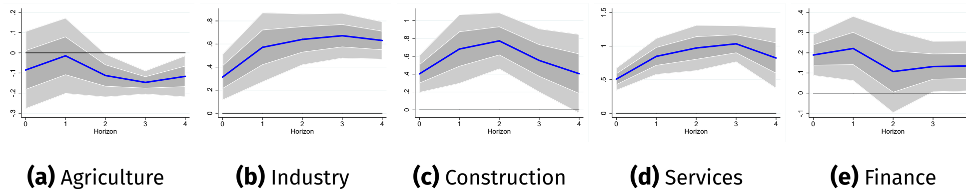
(a) Agriculture **(b)** Industry **(c)** Construction **(d)** Services **(e)** Finance

Figure 1.B.7. Impulse Responses of Investment per Sector. These figures plot the decomposition of the impulse response of private investment across private sectors. All responses are expressed in percent changes (growth rates) relative to private investment. Shaded areas are 68% (dark) and 95% (light) confidence intervals.



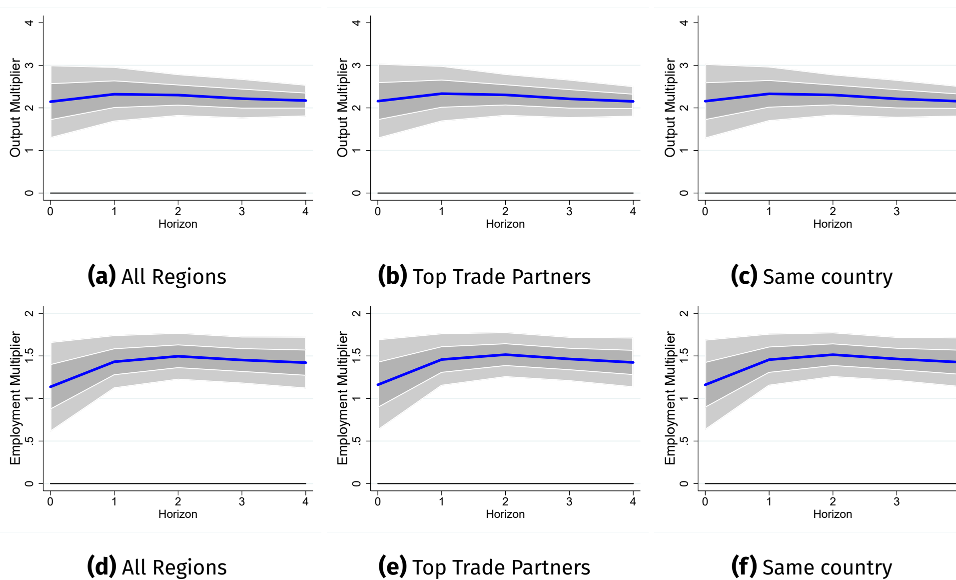
(a) Agriculture **(b)** Industry **(c)** Construction **(d)** Services **(e)** Finance

Figure 1.B.8. Impulse Responses of Hourly Wage per Sector. These figures plot the decomposition of the impulse response of compensation across private sectors. All responses are expressed in percent changes (growth rates) relative to hourly wages in the private sector. Shaded areas are 68% (dark) and 95% (light) confidence intervals.



(a) Agriculture **(b)** Industry **(c)** Construction **(d)** Services **(e)** Finance

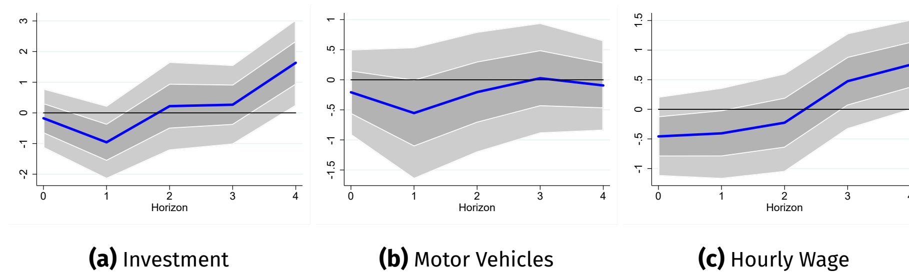
Figure 1.B.9. Impulse Responses of Total Hours per Sector. These figures plot the decomposition of the impulse response of hours worked across private sectors. All responses are expressed in percent changes (growth rates) relative to total hours in the private sector. Shaded areas are 68% (dark) and 95% (light) confidence intervals.



(a) All Regions **(b)** Top Trade Partners **(c)** Same country

(d) All Regions **(e)** Top Trade Partners **(f)** Same country

Figure 1.B.10. Output and Employment Multipliers: Spillover Analysis. Plots in the top row refer to output multipliers, while those in the bottom row refer to employment multipliers. Panels 1.B.10a and 1.B.10d show the multipliers taking into account the spillovers from all regions, Panels 1.B.10b and 1.B.10e consider only the spillovers from the main trade partners (top 10% of the weights), and Panels 1.B.10d and 1.B.10f account for the spillovers from all regions within the country. Shaded areas are 68% (dark) and 95% (light) Driscoll and Kraay (1998) confidence intervals.



(a) Investment **(b)** Motor Vehicles **(c)** Hourly Wage

Figure 1.B.11. Spillover Impulse Responses. Figures show the spillover impulse responses of private investment, registered motor vehicles, and hourly wage. Shaded areas are 68% (dark) and 95% (light) Driscoll and Kraay (1998) confidence intervals.

Appendix 1.C Robustness of the main results

In this section, we demonstrate that our main Eurozone multiplier estimates are robust to several modifications of the baseline model. The estimates change only little when applying alternative ways to construct the Bartik instrument and using different ways to extract unexpected variation in national government spending. Moreover, our findings are robust to changes in the sample and to additionally controlling for national tax policies and sovereign spreads. Finally, we also demonstrate that our results are not prone to dynamic and cross-sectional heterogeneity.

1.C.1 Instrument Construction

We start by exploring alternative ways to construct the Bartik instrument. In the baseline, we use the five years preceding the Eurozone accession to compute the regional share of government spending, s_i. However, as suggested by Nekarda and Ramey (2011), there might have been important structural changes over time that affect the regional distribution of government spending. Taking this possibility into account, we follow Nekarda and Ramey (2011) and compute the regional shares based on all years of the sample. Table 2.4.2 presents the results for the output and employment multipliers, and the first rows also report the baseline estimates. The second panel of Table 2.4.2 (Alternative s_i (I)) shows that our results barely change when using this alternative instrument construction. As a second check, we use absolute levels in regional and national government spending to construct the share s_i. In this case, the regional shares indicate scaling factors and add up to one at the national level. The second panel of Table 2.4.2 (Alternative s_i (II)) presents the results of this exercise, indicating that the multiplier estimates do not change much.

So far, we have used our proxy for government spending at both the NUTS 2 level and the national level. Although official government spending data are not available at the regional level, they are published at the national level and thus, it can be used to compute the Bartik instrument. To be precise, we measure G_I in Equation (1.3.2) as national government spending. The results from Panel B in Table 2.4.2 (National Accounts) show that the multipliers increase slightly, but the overall dynamics remain unchanged.

1.C.2 Unexpected Variation in National Spending

The baseline instrument relies on observed national government spending changes to instrument for regional changes. To account for the possibility of anticipated changes in aggregate government spending, we explore three alternative ways.

First, we rely on a timing assumption to extract unexpected changes in government spending. In particular, we follow the approach by Blanchard and Perotti

Table 1.C.1. Output and Employment Multipliers: Robustness I

	Output Multiplier					Employment Multiplier				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Alternative instrument construction										
Alternative s_i (I)	1.89***	2.05***	2.05***	1.99***	1.96***	1.10***	1.41***	1.48***	1.43***	1.39***
	(0.39)	(0.31)	(0.25)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.14)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Alternative s_i (II)	1.74***	1.90***	1.84***	1.82***	1.82***	0.99***	1.22***	1.22***	1.17***	1.02***
	(0.29)	(0.37)	(0.40)	(0.37)	(0.24)	(0.21)	(0.23)	(0.25)	(0.27)	(0.24)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
National Accounts	2.64***	2.71***	2.72***	2.63***	2.49***	1.60***	1.88***	1.96***	1.93***	1.79***
	(0.57)	(0.30)	(0.18)	(0.19)	(0.15)	(0.30)	(0.23)	(0.21)	(0.19)	(0.17)
# Obs	2627	2461	2295	2129	1963	2627	2461	2295	2129	1963
Panel C: Exogenous variation in national spending										
Fiscal Rule	2.00***	2.27***	2.34***	2.30***	2.33***	0.94***	1.32***	1.46***	1.42***	1.49***
	(0.31)	(0.36)	(0.29)	(0.28)	(0.19)	(0.21)	(0.19)	(0.20)	(0.19)	(0.21)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Military Spending	3.27***	3.22***	3.22***	2.99***	2.96***	1.63***	1.71***	1.82***	1.68***	1.76***
	(0.67)	(0.27)	(0.17)	(0.15)	(0.15)	(0.57)	(0.23)	(0.28)	(0.26)	(0.29)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Forecast Errors	3.91***	3.47***	3.03***	2.95***	2.82***	2.14***	1.97***	1.88***	1.95***	1.87***
	(1.02)	(0.34)	(0.29)	(0.19)	(0.23)	(0.77)	(0.34)	(0.29)	(0.25)	(0.27)
# Obs	2410	2258	2119	1967	1813	2410	2258	2119	1967	1813

Notes: Panel A shows the estimates for the baseline fiscal and employment multipliers. Panel B presents the estimates for alternative instrument constructions. First, following Nekarda and Ramey (2011), the share of regional spending used in the instrument is constructed as an average across the whole sample rather than predetermined as in the baseline. In the second alternative specification of s_i, we use the levels of government spending at regional and aggregate levels rather than the per capita values. Then, instead of using the aggregate government spending proxy to compute the Bartik instrument, we use the government spending from National Accounts. Panel C explores alternative identification strategies. Here, we use the residual of an estimated fiscal spending rule, national military spending, and forecast errors on government spending to obtain exogenous and unanticipated national government spending changes to construct the Bartik instrument.

(2002) that policymakers need time to decide on, approve, and implement discretionary changes in fiscal policy. We proceed by first, estimating a government expenditure rule, where we regress the growth rate of per capita national government

spending on lagged growth rates of per capita government spending, GDP, and tax revenues, time and country fixed effects. We then interpret the residual of this regression, $\hat{u}_{I,t}$, as the unexpected component of national government spending and use it to construct the Bartik instrument as follows:[43]

$$Bartik_{i,t} \; = \; s_i \times \hat{u}_{I,t},$$

Second, we use military spending as an instrument for unanticipated aggregate spending changes. Hall (2009), Barro and Redlick (2011), and Miyamoto, Nguyen, and Sheremirov (2019), among others, also use aggregate military spending data to identify government spending shocks. Changes in military spending are often large and regularly respond to foreign policy developments, suggesting that these changes are exogenous in the sense that they are less likely to be driven by domestic cyclical forces. In particular, military spending is not correlated with the state of the economy like the state of the business cycle or financial conditions of the private sector.[44] Following Miyamoto, Nguyen, and Sheremirov (2019), we use national variation in per capita military spending to compute the Bartik instrument as follows:[45]

$$Bartik_{i,t} \; = \; s_i \times \Delta M_{I,t},$$

where $\Delta M_{I,t}$ is the change in per capita national military spending.

Third, we use professional forecast errors on national government spending from the study by Born, Müller, and Pfeifer (2020). The underlying idea is that unpredicted changes in government spending by professional forecasters provide a direct measure of fiscal news that is unrelated to the state of the economy (Ramey, 2011). Similarly to the military spending procedure, we use the forecast errors directly in the Bartik instrument construction.[46] Importantly, the respective first stages are sufficiently strong. The F-Statistic varies across horizons and estimates lying between

43. While Blanchard and Perotti (2002) apply their identification strategy on quarterly data, we have to rely on annual time series. Note, though, that Born and Müller (2012) provide robust evidence that the recursive identification is appropriate for annual post-WWII U.S. time-series data. In addition, Beetsma and Giuliodori (2011) point out that budget decisions are typically made once a year, and argue that, consequently, annual data provide a more natural way to reconcile discretionary fiscal policy changes.

44. Nakamura and Steinsson (2014), Dupor and Guerrero (2017), and Auerbach, Gorodnichenko, and Murphy (2020b) use variation in regional military government spending to estimate the effect of a government spending change. However, because regional military spending data are not available for European regions, we combine the idea of unanticipated public spending changes due to military expenditures at the national level with spending changes at the regional level to construct the Bartik instrument.

45. See Appendix 1.A.4 for more details on the military data used and its source.

46. Because our analysis is conducted on annual data, we aggregate the quarterly forecast error series by Born, Müller, and Pfeifer (2020) to the annual level.

76 and 281 for the fiscal rule, 16 and 44 for the military spending, and 6 and 18 for the forecast error exercise. Thus, all instruments are sufficiently strong predictors of variations in regional government spending.

The results of the regional multiplier estimates when applying these alternative strategies to extract unexpected government spending changes at the national level are presented in Panel C of Table 2.4.2. When relying on the residual of the fiscal rule estimation, the multipliers are very similar to our baseline estimates. The four-year output multiplier becomes 2.33 and the respective employment multiplier is estimated to be 1.49. For the other two measures, the estimates are somewhat larger than the baseline results. The four-year output multiplier is 2.96 in the case of the military spending instrument and 2.82 for the forecast errors instrument; the employment multiplier is 1.76 and 1.87, respectively. However, these estimates still support our main finding: an increase in regional government spending significantly boosts regional output and employment. Importantly, our baseline results are robust to using unexpected changes in national spending for constructing the Bartik instrument instead of observed changes in national government expenditures.

1.C.3 Alternative Samples and Controlling for Financing Sources

As additional robustness checks, we test whether our results are robust to changes in the sample. First, we use NUTS 3 level data to estimate output and employment multipliers. This considerably increases the number of regions and therefore the total number of observations. At the NUTS 3 level, the sample consists of 922 regions, compared to 167 in the baseline, and the total number of observations is more than five times larger compared to the NUTS 2 level analysis. Moreover, as previously mentioned, moving to the more disaggregated NUTS 3 level should minimize the problem that individual regions have a direct influence on national government decisions since their economic and political power is further reduced when compared to the NUTS 2 level. As Panel B of Table 1.C.2 shows, the results are similar to our baseline estimates. The four-year output multiplier is now estimated to be 2.5 and the four-year employment multiplier takes a value of 1.58.

Second, we add the late Euro adopters to the sample — namely Slovenia, Malta, Slovakia, Estonia, Latvia, and Lithuania. Panel B of Table 1.C.2 shows that our results hardly change. Notwithstanding, the total number of observations increases only slightly when including the late Euro adopters.

Finally, an important difference between the Eurozone and the U.S. is that the Eurozone does not share a common fiscal authority. While the common monetary policy is conducted by the ECB, fiscal policy is conducted at the national level. In our baseline specification, regional fixed effects absorb heterogeneity across regions and countries and should therefore also capture different national fiscal reactions to the regional government spending change. However, it might be argued that additional covariates are needed to control for country-specific fiscal policies. Thus, we

Table 1.C.2. Output and Employment Multipliers: Robustness II

	Output Multiplier					Employment Multiplier				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Alternative samples										
NUTS 3 Data	2.64***	2.71***	2.64***	2.57***	2.50***	1.35***	1.61***	1.64***	1.63***	1.58***
	(0.34)	(0.27)	(0.19)	(0.17)	(0.12)	(0.29)	(0.15)	(0.11)	(0.10)	(0.10)
# Obs	14192	13303	12414	11525	10630	14192	13303	12414	11525	10630
Late Adopter	2.10***	2.28***	2.30***	2.25***	2.20***	1.09***	1.40***	1.48***	1.44***	1.43***
	(0.39)	(0.33)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2666	2494	2323	2152	1979	2666	2494	2323	2152	1979
Panel C: Controlling for financing sources										
Country homogeneity	1.95***	2.22***	2.16***	2.03***	2.04***	0.85***	1.15***	1.11***	0.92***	0.87***
	(0.30)	(0.37)	(0.32)	(0.32)	(0.22)	(0.21)	(0.20)	(0.20)	(0.19)	(0.18)
# Obs	2617	2453	2289	2125	1959	2617	2453	2289	2125	1959
Country heterogeneity	1.65***	2.06***	2.06***	1.92***	2.15***	0.75***	1.03***	0.86***	0.49**	0.52**
	(0.21)	(0.25)	(0.23)	(0.28)	(0.20)	(0.15)	(0.17)	(0.23)	(0.24)	(0.24)
# Obs	2617	2453	2289	2125	1959	2617	2453	2289	2125	1959

Notes: Panel A shows the estimates for the baseline fiscal and employment multipliers. Panel B shows the estimated multipliers using NUTS 3 level data and data for the late Euro adopters. Panel C specifications include additional controls to the baseline. The first estimates in Panel C include the contemporaneous and one-year lag of the change in the national total tax receipts per capita and sovereign spreads. The second estimates include these controls interacted with country fixed effects.

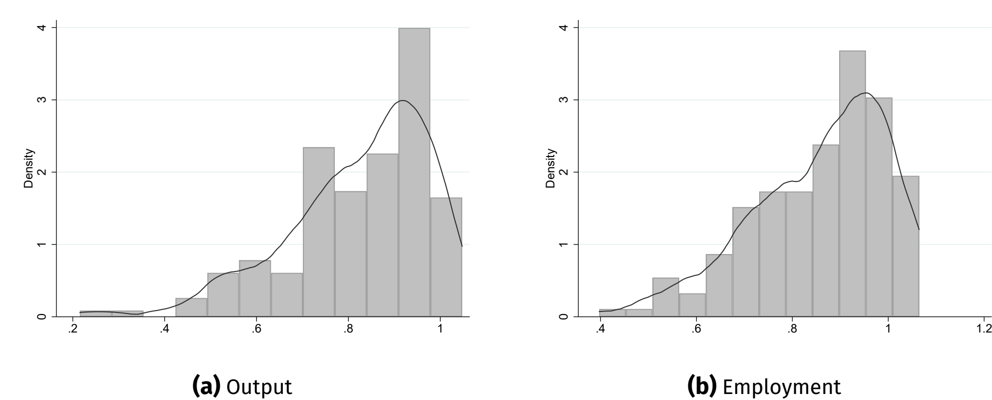
expand our baseline specification and additionally control for per capita national tax receipts and sovereign risk premia. While taxes control for the financing side of the public spending change, risk premia capture financing costs of the government. The risk premia have been shown to play a particular role in the transmission of national government spending in the Eurozone (Corsetti, Kuester, Meier, and Müller, 2013).[47] In particular, we add the contemporaneous and one-year lag of both variables to the vector of control variables. We estimate separate specifications. First, we assume homogeneity and estimate average coefficients across countries. Second, we allow for full country heterogeneity and interact both covariates with country fixed effects such that we estimate specific fiscal policy reactions for all countries of the

47. We compute sovereign spreads as the difference between the national and Germany's 10-year government bond rate. For Germany, we instead use its 10-year government bond rate as control.

sample. Panel C of Table 1.C.2 shows that the multiplier estimates slightly change when additionally controlling for the financing sources of the national governments. The impact output multiplier decreases mildly compared to the baseline estimates. However, four years after the shock, both specifications deliver very similar output multipliers relative to the baseline. The differences are somewhat larger for the employment multiplier, which becomes smaller when controlling for national fiscal policies. Nevertheless, the regional fiscal stimulus still leads to a significant increase in the employment ratio although the four-year employment multiplier drops below 1.[48]

1.C.4 Dynamic and Cross-Sectional Heterogeneity

As shown by Canova (2020) for the case of the U.S., not accounting for dynamic heterogeneity may pose a potential threat to cross-sectional multiplier estimates. As suggested by Canova (2020), we analyze the time-series properties of output and employment by estimating the AR(1) process of these series for each region in the sample. Figure 1.C.1 plots the cross-sectional distribution of the output and employment AR(1) coefficients. Because the persistence coefficients are distributed fairly homogeneously, dynamic heterogeneity does not seem as important here as in the case of the U.S. presented by Canova (2020). Yet, we re-estimate the multipliers excluding the regions with very extreme persistence coefficients, namely the top and bottom 10%. The results are presented in Panel A from Table 1.C.3 in the appendix and reassure that the baseline multipliers are robust.



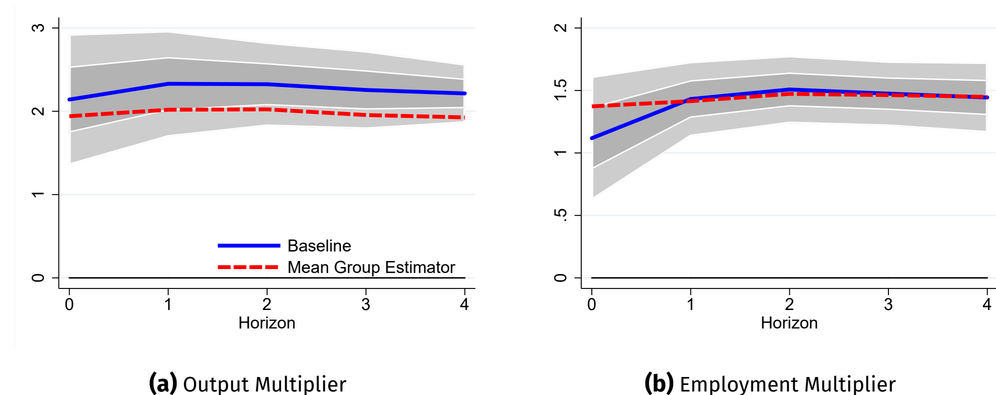
(a) Output

(b) Employment

Figure 1.C.1. Distribution of Output and Employment Persistence Parameter. This Figure plots the distribution of output and employment persistence parameter from an AR(1) process.

48. It is also important to note that, when estimating country-specific fiscal policies, the number of estimated coefficients increases significantly and the F-Statistic of the first stage decreases substantially for longer horizons, with the lowest value being 27.

Moreover, in the presence of strong cross-sectional heterogeneity, pooling observations across regions and estimating common slope coefficients might not be appropriate. To address this potential problem, we follow Bernardini, Schryder, and Peersman (2020) and estimate output and employment multipliers with a mean group approach that allows for cross-region heterogeneity in the slope coefficients. Since this mean group estimator (MGE) requires a relatively long period of time, we rely on Bayesian methods to calculate fiscal multipliers. In particular, as suggested by Canova (2020) and Miranda-Agrippino and Ricco (2021), we estimate Bayesian local projections employing a normal prior for the output and employment multiplier estimates. Motivated by the existing U.S. evidence on regional fiscal multipliers (Nakamura and Steinsson, 2014; Chodorow-Reich, 2019), the prior mean for the output multiplier is set to 1.9, the one for employment to 1.4, and both variances are set to 2.



(a) Output Multiplier

(b) Employment Multiplier

Figure 1.C.2. Output and Employment Multipliers: Baseline and Mean Group Estimator. Panels 1.C.2a and 1.C.2b show the baseline (blue solid) and the mean group estimator (red dashed) fiscal and employment multipliers using Bayesian local projections. Normal prior with variance 2 and means 1.9 and 1.4 for output and employment, respectively. Shaded areas are 68% (dark) and 95% (light) confidence intervals of the baseline (pooled) estimation .

Figure 1.C.2 shows the estimated responses for the output and employment multipliers when applying the MGE Bayesian local projections (dashed lines) together with the baseline (pooled) estimates (solid lines and shaded areas for the coefficients and confidence bands, respectively). Notably, the MGE estimates are very similar to the baseline multipliers and lie within the respective confidence bands for all periods of the forecast horizon. The employment multiplier of the MGE estimation is almost identical to the pooled estimation, while the estimated output multiplier is somewhat smaller compared to our baseline results reaching a value slightly below two four years after the fiscal stimulus. Interestingly, also the shape of the responses is similar across both estimation approaches which again supports our pooling assumption. The relatively large cross-sectional dimension and low fre-

quency of our dataset seem to limit the erratic component in the calculated impulse responses which is a more severe problem when estimating local projections on time series with a higher frequency like quarterly and monthly data (Miranda-Agrippino and Ricco, 2021). Overall, we interpret these results as evidence that cross-sectional heterogeneity is not a severe threat for our regional multiplier estimates in the Eurozone and therefore, proceed with the pooled specification in what follows.

1.C.5 Further Checks

We show results for additional robustness checks. First, the baseline multiplier estimates are robust when following closely Nakamura and Steinsson (2014) and using national military spending interacted with region fixed effects as instrument (Panel B of Table 1.C.3). Furthermore, the results do not change much when not including lagged control variables in the regressions or excluding regions that spend disproportionately more per capita than the national average (Panels C and D of Table 1.C.3). We also re-estimated the baseline model when excluding intermediate consumption from our proxy regional government spending series. Then, regional government spending is measured by the GVA of the non-market sector. As expected, the multipliers increase because the shock size (1% of GDP per capita) becomes larger relative to the baseline proxy used (Panel E of Table 1.C.3).

Secondly, to assess how important any individual country is for the results, we re-estimate the baseline regressions by sequentially dropping one country at a time. The obtained results are comparable to the baseline in every case (Table 1.C.4).

Finally, we use a Bayesian approach and estimate multipliers by means of Bayesian local projections. As shown by Miranda-Agrippino and Ricco (2021), Bayesian local projections might reduce erratic movements in impulse response computed with standard local projections. As for the mean group estimator exercise, we employ a normal prior with mean 1.9 for output and 1.4 for employment and set both variances to 2 based on recent U.S. regional multiplier estimates (Nakamura and Steinsson, 2014; Chodorow-Reich, 2019). Figure 1.C.3 in the appendix shows the estimated multipliers when using Bayesian local projections. The results are similar to our baseline estimates which implies that Bayesian local projections do not deliver a significant improvement for our analysis. As already mentioned above, the small differences in the estimated shapes of the responses might be due to the large cross section at annual frequency which already limits the erratic component in the impulse responses.

Table 1.C.3. Output and Employment Multipliers: Robustness III

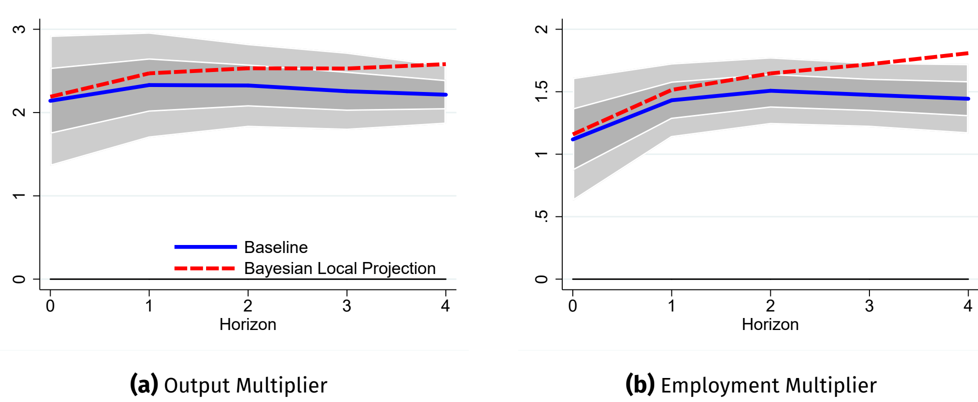
	Output Multiplier					Employment Multiplier				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel A: Excluding AR(1) outliers										
Multiplier	2.22***	2.43***	2.44***	2.40***	2.33***	1.06***	1.38***	1.47***	1.41***	1.40***
	(0.42)	(0.33)	(0.24)	(0.20)	(0.17)	(0.24)	(0.15)	(0.13)	(0.12)	(0.14)
# Obs	2112	1979	1846	1713	1579	2109	1977	1845	1713	1579
Panel B: Nakamura and Steinsson (2014) approach with military spending										
Multiplier	0.78*	1.25***	1.49***	1.59***	1.51***	0.35	0.82***	0.98***	1.03***	0.81***
	(0.47)	(0.48)	(0.33)	(0.24)	(0.18)	(0.31)	(0.27)	(0.22)	(0.17)	(0.11)
# Obs	2627	2461	2295	2129	1963	2627	2461	2295	2129	1963
Panel C: No controls										
Multiplier	2.01***	2.14***	2.11***	2.06***	2.02***	1.30***	1.49***	1.53***	1.51***	1.48***
	(0.39)	(0.31)	(0.25)	(0.21)	(0.16)	(0.25)	(0.20)	(0.16)	(0.13)	(0.09)
# Obs	2953	2789	2625	2461	2295	2953	2789	2625	2461	2295
Panel D: Excluding regions in top 10% of s_i										
Multiplier	2.22***	2.39***	2.37***	2.30***	2.27***	1.09***	1.40***	1.48***	1.47***	1.44***
	(0.40)	(0.33)	(0.25)	(0.23)	(0.16)	(0.24)	(0.16)	(0.14)	(0.14)	(0.16)
# Obs	2349	2202	2055	1908	1759	2349	2202	2055	1908	1759
Panel E: Excluding intermediate consumption										
Multiplier	2.83***	3.07***	3.06***	2.97***	2.91***	1.46***	1.87***	1.97***	1.93***	1.89***
	(0.52)	(0.41)	(0.32)	(0.30)	(0.23)	(0.33)	(0.19)	(0.18)	(0.17)	(0.19)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963

Notes: Panel A excludes regions which present very large or small (top and bottom 10%) persistence coefficient from an AR(1) regression. Panel B shows estimates for output and employment multipliers following Nakamura and Steinsson (2014) approach and using as the instrument the interaction between aggregate military spending and regional fixed effects. The results in Panel C show that the estimates are robust to excluding the controls from the baseline regression (lags of government spending and variable of interest). Panel D excludes the regions with the largest shares s_i (top 10%). Panel E shows the results when excluding intermediate consumption from our government spending proxy.

Table 1.C.4. Output and Employment Multipliers: Robustness IV

	Output Multiplier					Employment Multiplier				
	Impact	1-Year	2 Years	3 Years	4 Years	Impact	1-Year	2 Years	3 Years	4 Years
Panel A: Baseline specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Excluding individual countries iteratively										
Multiplier Austria	2.15***	2.34***	2.33***	2.24***	2.20***	1.12***	1.43***	1.50***	1.46***	1.43***
	(0.41)	(0.33)	(0.26)	(0.24)	(0.18)	(0.26)	(0.16)	(0.14)	(0.14)	(0.14)
# Obs	2477	2322	2167	2012	1855	2477	2322	2167	2012	1855
Multiplier Belgium	2.17***	2.36***	2.35***	2.27***	2.23***	1.14***	1.47***	1.54***	1.50***	1.47***
	(0.38)	(0.31)	(0.25)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.15)
# Obs	2445	2292	2139	1986	1831	2445	2292	2139	1986	1831
Multiplier Germany	1.76***	2.01***	2.06***	1.98***	1.93***	1.03***	1.32***	1.38***	1.31***	1.28***
	(0.30)	(0.26)	(0.23)	(0.22)	(0.17)	(0.17)	(0.12)	(0.14)	(0.13)	(0.16)
# Obs	2013	1887	1761	1635	1507	2013	1887	1761	1635	1507
Multiplier Greece	1.84***	1.96***	1.94***	1.77***	1.74***	1.08***	1.44***	1.54***	1.38***	1.20***
	(0.37)	(0.28)	(0.28)	(0.33)	(0.26)	(0.24)	(0.21)	(0.27)	(0.32)	(0.36)
# Obs	2439	2288	2137	1986	1833	2439	2288	2137	1986	1833
Multiplier Spain	2.28***	2.41***	2.35***	2.34***	2.29***	1.18***	1.47***	1.52***	1.60***	1.61***
	(0.40)	(0.35)	(0.28)	(0.24)	(0.18)	(0.25)	(0.15)	(0.11)	(0.08)	(0.08)
# Obs	2317	2172	2027	1882	1735	2317	2172	2027	1882	1735
Multiplier Finland	2.13***	2.33***	2.34***	2.28***	2.24***	1.12***	1.43***	1.50***	1.47***	1.43***
	(0.41)	(0.33)	(0.26)	(0.24)	(0.18)	(0.26)	(0.16)	(0.14)	(0.14)	(0.15)
# Obs	2541	2382	2223	2064	1903	2541	2382	2223	2064	1903
Multiplier France	2.19***	2.38***	2.34***	2.29***	2.26***	1.11***	1.43***	1.51***	1.48***	1.47***
	(0.43)	(0.38)	(0.31)	(0.28)	(0.22)	(0.27)	(0.18)	(0.15)	(0.13)	(0.14)
# Obs	2189	2052	1915	1778	1639	2189	2052	1915	1778	1639
Multiplier Ireland	2.27***	2.46***	2.47***	2.41***	2.35***	1.15***	1.47***	1.56***	1.53***	1.50***
	(0.41)	(0.32)	(0.23)	(0.22)	(0.19)	(0.26)	(0.15)	(0.13)	(0.13)	(0.14)
# Obs	2582	2419	2256	2093	1930	2582	2419	2256	2093	1930
Multiplier Italy	2.14***	2.32***	2.33***	2.28***	2.25***	1.08***	1.39***	1.47***	1.44***	1.43***
	(0.41)	(0.33)	(0.25)	(0.22)	(0.16)	(0.26)	(0.16)	(0.14)	(0.13)	(0.14)
# Obs	2285	2142	1999	1856	1711	2285	2142	1999	1856	1711
Multiplier Luxembourg	2.15***	2.34***	2.33***	2.26***	2.22***	1.13***	1.44***	1.52***	1.48***	1.46***
	(0.40)	(0.32)	(0.25)	(0.23)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2605	2442	2279	2116	1951	2605	2442	2279	2116	1951
Multiplier Netherlands	2.25***	2.46***	2.43***	2.32***	2.28***	1.13***	1.48***	1.57***	1.51***	1.48***
	(0.41)	(0.31)	(0.25)	(0.22)	(0.15)	(0.27)	(0.15)	(0.13)	(0.12)	(0.14)
# Obs	2429	2277	2125	1973	1819	2429	2277	2125	1973	1819
Multiplier Portugal	2.18***	2.37***	2.36***	2.30***	2.25***	1.15***	1.43***	1.50***	1.47***	1.44***
	(0.41)	(0.33)	(0.25)	(0.23)	(0.17)	(0.26)	(0.15)	(0.13)	(0.12)	(0.13)
# Obs	2509	2352	2195	2038	1879	2509	2352	2195	2038	1879

Notes: This table shows the output and employment multiplier estimates using the baseline specification but excluding individual countries iteratively from the base sample.



(a) Output Multiplier

(b) Employment Multiplier

Figure 1.C.3. Output and Employment Multipliers: Baseline and Bayesian Local Projection. Panels 1.C.2a and 1.C.2b show the baseline (blue solid) and the Bayesian local projections (red dashed) fiscal and employment multipliers. Normal prior with variance 2 and means 1.9 and 1.4 for output and employment, respectively. Shaded areas are 68% (dark) and 95% (light) confidence intervals of the baseline estimation.

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Chapter 2

The Political Costs of Austerity

Joint with Ricardo Duque Gabriel and Mathias Klein

2.1 Introduction

Anti-establishment and EU-skeptic parties have gained significant support since the Great Recession and the subsequent European Sovereign Debt Crisis. Higher vote shares for these parties have increased partisan conflict and led to more fragmented parliaments. The resultant polarized political environment is economically significant, as political tension is generally associated with higher policy uncertainty and lower economic growth (Azzimonti, 2011; Azzimonti, 2018; Funke, Schularick, and Trebesch, 2020; Carozzi, Cipullo, and Repetto, 2022). Interestingly, the rise in support for extreme parties occurred in a period of significant fiscal policy interventions. In particular, several European countries have implemented large-scale fiscal consolidation measures to reduce high levels of public debt, thereby averting the risk of sovereign default. The massive reductions in public spending faced significant opposition and resulted in an anti-austerity movement. In this paper, we empirically investigate the causal link between fiscal consolidations and rising polarization and provide new evidence on the political costs of fiscal austerity.

* We thank Niklas Amberg, Francesco Bianchi, Olivier Coibion, Thiemo Fetzer, Oskar Nordström Skans, Erik Öberg, Evgenia Passari, Romain Rancière, Paolo Surico, Ulf Söderström, Karl Walentin, Francesco Zanetti, Xin Zhang, and participants at seminars at Uppsala University, the University of Bonn, University of Naples Federico II and Sveriges Riksbank, and at the 5th International Conference on The Political Economy of Democracy and Dictatorship and The Politics of In_equality Conference for their valuable comments and discussions. We acknowledge financial support from the Fundação para a Ciência e Tecnologia [projects references SFRH/BD/144581/2019 and SFRH/BD/144820/2019] the Deutsche Forschungsgemeinschaft (German Research Foundation) under Germany's Excellence Strategy [EXC 2126/1 - 390838866] and under the RTG 2281 - The Macroeconomics of Inequality. The opinions expressed in this article are the sole responsibility of the authors and should not be interpreted as reflecting the views of Sveriges Riksbank.

To this end, we assemble a novel regional dataset on election outcomes that provides detailed voting results on regional, national, and European elections. We combine data from Schakel (2013) with information from various national and regional sources. Our final dataset covers 124 European regions from 8 countries and spans from 1980 to 2015. We collect data on more than 200 elections; roughly 20 elections per region and, on average, one election every two years. Thus, our dataset provides considerable granular variation in election outcomes for estimating the causal effect of fiscal consolidations on voting behavior. We rely on party classifications by Funke, Schularick, and Trebesch (2016) and Algan, Guriev, Papaioannou, and Passari (2017) to define parties at the far-right and far-left of the political spectrum. Our data supports the main narrative of a significant correlation between fiscal consolidations and extreme voting. First, we find a strong increase in extreme parties' vote share across European regions in the years after the Great Recession and the Sovereign Debt Crisis. Second, our data indicates a negative correlation between changes in regional government spending and patterns of extreme voting in recent years.

To test for the causal relationship between austerity and voting outcomes, we identify exogenous changes in regional public spending using a Bartik-type instrument (Bartik, 1991) that combines *regional* sensitivities to changes in *national* government expenditures with the narrative national consolidation measure proposed by Alesina, Favero, and Giavazzi (2020). The narrative series contains only those changes in the national primary balance-to-GDP ratio that are motivated by a desire to reduce budget deficits. The identified fiscal actions represent responses to past decisions and economic conditions rather than to current and prospective conditions. Therefore, there should be no systematic correlation between the identified national fiscal actions and other developments that affect economic activity in the short term. This narrative approach has been used in several studies to gauge the economic effects of fiscal consolidations at the national level (Guajardo, Leigh, and Pescatori, 2014; Jordà and Taylor, 2016; Alesina, Favero, and Giavazzi, 2019). In contrast to these approaches, we use the narrative series as the shift component in a Bartik instrument to identify exogenous reductions in government spending at the regional level. We further employ an instrumental variable local projections approach to estimate the causal effect of reductions in regional public spending on election outcomes. Importantly, our Bartik measure provides a strong instrument for regional government spending reductions, with a first-stage F-statistic well above the critical threshold, suggesting that weak instruments are unlikely to be a concern for our analysis.

Our results show that fiscal consolidations are associated with significant political costs: a 1% reduction in regional public spending leads to an increase in extreme parties' vote share of around 3 percentage points. The higher vote share captured by extreme parties can be explained by a fall in voter turnout together with an increase in the total votes for these parties. Thus, in response to fiscal consolidations,

fewer people vote and those who do exhibit a higher tendency to vote for extreme parties. In addition, austerity increases fragmentation, which, based on previous evidence on the negative economic impact of partisan conflict (Azzimonti, 2011; Funke, Schularick, and Trebesch, 2020), suggests that austerity affects economic outcomes through a more polarized political environment. We use a forecast error variance decomposition (FEVD) exercise to quantify the magnitude of regional cuts in public spending in driving more extreme voting. Our results suggest that around 10% of the variation in extreme parties' vote share is indeed due to fiscal consolidations, which further highlights the importance of austerity in understanding shifts in voters' preferences toward the more extreme ends of the political spectrum.

We conduct a battery of robustness checks to verify our findings. The results still hold for different samples and also remain unaffected when changing the construction of the national austerity measure or the share variable of the Bartik instrument. Notably, the rise in extreme parties' vote share to fiscal consolidations persists when dropping the Great Recession period and the subsequent years of the European Debt Crisis, which makes us confident that the political costs of austerity are not merely driven by the extreme events in the recent past but describe a general pattern in the data.

When differentiating between election types and far-left and far-right parties, we find only mild differences in political outcomes. While austerity leads to the largest shift toward extreme parties for European elections, the movement away from more traditional parties is also present for national and regional elections. Moreover, although both extremes gain vote shares as a result of fiscal consolidations, far-right parties experience a slightly stronger rise in voters' support. We further test for potentially important state dependencies and find that the increase in extreme parties' vote share is significantly larger when the fiscal consolidation is implemented during a recession as opposed to a period of expansion. In addition, the effects are somewhat stronger in rural and poor regions, but not statistically significantly different from the ones observed in urban and rich regions, respectively.

To rationalize our main findings on the political consequences of austerity, we also estimate the economic effects of fiscal consolidations at the regional level. Austerity leads to a significant fall in regional output, employment, investment, durable consumption, and wages. Furthermore, the reduction in public spending lowers the labor income share thereby inducing a redistribution of income away from working households. These contractionary effects of austerity support previous evidence on the economic impact of fiscal consolidations conducted at the national level (Guajardo, Leigh, and Pescatori, 2014; Jordà and Taylor, 2016). Moreover, these findings highlight the close relationship between detrimental economic developments and voters' support for extreme parties.

Finally, we try to understand whether austerity-driven recessions yield different political outcomes than general economic downturns do. We differentiate between recessions that coincide with fiscal consolidations ("austerity recessions") and those

not related to austerity ("non-austerity recessions") and estimate the response of extreme parties' vote share in both episodes of economic slack. Our estimates imply that austerity recessions lead to a significantly larger increase in the vote share for extreme parties than other recessions. In addition, in a recession that coincides with a fiscal consolidation, a reduction in regional government spending implies a larger increase in extreme voting compared to lowering public spending in non-austerity recessions. We relate this result to a potential trust channel of fiscal consolidations by showing that people's trust in the government deteriorates much more strongly during austerity recessions compared to non-austerity recessions. This might point toward a "doom loop" between distrust in the political system and more extreme voting following fiscal consolidations. In sum, austerity-driven recessions are special in the sense that they considerably amplify the political costs of economic downturns by creating more distrust in the political environment.

Related literature. Our paper is related to several strands of literature. We mainly contribute to a growing body of work on the economic drivers of populism. Guriev (2018), Guiso, Herrera, Morelli, and Sonno (2019) and Guiso, Herrera, Morelli, and Sonno (2020), Berman (2021), Baccini and Sattler (2021) and Guriev and Papaioannou (2022) provide a good overview on the causes of populism in Europe and other advanced economies by analyzing both demand- and supply-side explanations of populism and focusing on economic grievance–based explanations. Regarding right-wing populism, the usual economic explanations focus on how globalization and trade integration have generated discontent and division among citizens by making life more insecure for the working and middle classes (Colantone and Stanig, 2018; Rodrik, 2020; Pastor and Veronesi, 2021). On the other hand, left-wing populism seems to be more related to specific economic considerations coming from neoliberalism and economic policies. In particular, the left-wing rise after the Great Recession in Europe was fueled by massive anti-austerity movements in Greece (Stavrakakis and Katsambekis, 2014), Portugal (Accornero and Ramos Pinto, 2015), and other European countries (Calossi, 2016; Della Porta, Fernández, Kouki, and Mosca, 2017).

Focusing on austerity, there are several papers worth mentioning. Ponticelli and Voth (2020) use a panel dataset for 25 European countries covering the period 1919 to 2008 to show a clear link between the magnitude of expenditure cutbacks and increases in social unrest. Galofré-Vilà, Meissner, McKee, and Stuckler (2021) study the link between fiscal austerity and Nazi electoral success. Focusing on the "age of austerity" in the UK, Bray, Braakmann, and Wildman (2022) show that for each £100 loss per working age adult, racially or religiously motivated crimes rose by approximately 5-6% between 2013 and 2015. In addition, Hübscher, Sattler, and Wagner (2021b) presents survey evidence that in Germany, Spain, Portugal, and Italy a government's re-election chances greatly decrease if it proposes austerity measures with voters objecting strongly to spending cuts, while Alesina, Furceri, Ciminelli,

Saponaro, et al. (2021) argue that an austerity package worth 1% of GDP reduces the vote share of the leader's party by about 7%. These findings materialize the idea that austerity-fueled social unrest contributed to a feeling of disconnect from the established political parties and institutions and encouraged voters to support more extreme policy positions or engage in protest voting (Myatt, 2017; Panunzi, Pavoni, and Tabellini, 2020; Hübscher, Sattler, and Wagner, 2021a). The majority of these protest votes are cast in anti-establishment (or populist) parties that usually fall into two categories: far right and far left, both of which have historically benefited from poor economic conditions (Algan et al., 2017; Birch and Dennison, 2019). We add to the latter literature by focusing on finer regional level data and taking a longer time horizon perspective, which enables us to investigate whether voting for extreme parties systematically increased after austerity measures and whether economic insecurity is a possible economic channel through which austerity affects voting behavior.

We also contribute to the literature evaluating the economic effects of fiscal policy, and, in particular, the effects of narratively identified austerity episodes (Devries, Guajardo, Leigh, and Pescatori, 2011; Guajardo, Leigh, and Pescatori, 2014; Alesina, Favero, and Giavazzi, 2015; Jordà and Taylor, 2016; Alesina, Azzalini, Favero, Giavazzi, and Miano, 2018; Alesina, Favero, and Giavazzi, 2020). Our main contribution is the evaluation of the economic costs of austerity at the regional level by combining regional government spending data with narratively identified spending-based austerity measures at the national level.

The closest related work to our study is the paper by Fetzer (2019), which shows that austerity-induced welfare reforms in the UK led to a rise in support for the UK Independent Party and for Leave in the referendum on European Union membership. However, our analysis differs in several important dimensions. First, while Fetzer (2019) focuses only on the UK, we provide novel cross-country evidence on the severe political costs of austerity. The significant time and cross-sectional variation that we rely on allows further quantification of the economic significance of fiscal consolidations in explaining extreme voting. Second, our detailed election and party classifications permit us to undertake an in-depth analysis on potentially significant differences across European, national, and regional elections and between extreme parties on the left and right. Third, we also provide a thorough investigation on the economic costs of austerity and thus highlight the close relationship between economic developments and voters' support for extreme parties. Finally, we conduct a careful comparison between austerity-driven and non-austerity-driven recessions and show that the political costs of economic downturns are considerably amplified during austerity recessions.

The remainder of the paper is organized as follows. Section 2.2 describes the economic and political data used in the analysis. Section 2.3 presents the empirical methodology and discusses the identification strategy. Section 2.4 shows our empirical results. Finally, Section 2.5 concludes.

2.2 Data

In our analysis, we draw on a broad set of annual data covering the period from 1980 to 2015 for 124 regions in eight European countries: Austria, Finland, France, Germany, Italy, Portugal, Spain, and Sweden. In the following, we describe the main variables used in our analysis. Table 2.A.1 in the Appendix provides more information on the regional structure and 2.A.2 provides additional information regarding data definitions and sources.

2.2.1 Economic data

To measure regional economic developments, we rely on data from the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO), which is a highly disaggregated dataset across sectoral and regional dimensions. The database contains several long time-series indicators for European regions at different statistical scales and expands the Cambridge Econometrics Dataset used by much of the literature on European regional dynamics.

The database provides regional measures for output (gross domestic product (GDP) and gross value added (GVA)), investment, earnings, hours worked, and employment for different economic sectors like industry, construction, financial, non-financial, and non-market services. The dataset is an annual panel covering the period 1980–2017 for the European Union (EU) and some European Free Trade Association (EFTA) and candidate countries. By construction, ARDECO's regional data is consistent with the commonly used national accounts data.[1] In particular, the regional ARDECO time series are constructed in such a way that the country aggregates equal the corresponding time series in the National Accounts reported in the AMECO dataset.[2]

The data are divided into NUTS (Nomenclature of Territorial Units for Statistics) regions. NUTS is a geocode standard for referencing the subdivisions of countries for statistical purposes. The hierarchy of three NUTS levels (NUTS 1, 2, 3) is established by Eurostat in agreement with each member state, and for most countries the respective NUTS level corresponds to a specific administrative division within the country. ARDECO provides all data series at these regional disaggregation levels except for NUTS 3, for which it reports only population, employment, GDP, and GVA.

Official data on final consumption expenditure of the general government (henceforth, government spending) is not available at the European regional level.

1. See Lequiller and Blades (2014) for more details on the construction of the National Accounts data.

2. See Gabriel, Klein, and Pessoa (2021) and Appendix 2.A.1 for more information.

Hereinafter, in the spirit of Brueckner, Valentinyi, and Pappa (2019) and closely following Gabriel, Klein, and Pessoa (2021), we use the sum of GVA and intermediate consumption of the non-market sector as a proxy for government spending. GVA of the non-market sector is computed as the sum of compensation to employees (including social contributions), consumption of fixed capital (which measures the decline in the value of fixed assets owned as a result of normal wear, tear, and obsolescence), and taxes less subsidies on production. Because GVA of the non-market sector does not include intermediate consumption, which is, however, one of the main components of government spending, we use input-output (IO) tables from the PBL EUREGIO database to calculate regional intermediate consumption shares of the non-market sector, which we then add to the GVA of the non-market sector.

Our regional measure (GVA plus intermediate consumption of the non-market sector) is a valid proxy for government spending for several reasons. First, as previously mentioned, ARDECO's regional data is consistent with the national accounts data by construction. By definition, there exists a close link between government spending and the GVA of the non-market sector. Consequently, almost the entire variation in the GVA of the non-market sector refers to activities by the general government. Second, government spending and our proxy measure show very similar statistical properties. Both measures are very tightly linked at the national and regional levels. We will thus refer to our regional proxy for government spending as government spending throughout the paper. For a more detailed justification of our proxy choice, see also Gabriel, Klein, and Pessoa (2021).

2.2.2 Narrative austerity episodes

Our data for narrative fiscal consolidations comes from Alesina, Favero, and Giavazzi (2020) and spans from 1978 to 2014.[3] Building on Devries et al. (2011) and Alesina, Favero, and Giavazzi (2015), Alesina, Favero, and Giavazzi (2020) address the potential endogeneity of shifts in fiscal variables using the "narrative" approach in the spirit of Romer and Romer (2010) and carefully dividing variables into spending- and tax-based consolidations.

The measure is constructed by examining contemporaneous OECD policy documents that outline the economic situation, fiscal consolidation strategy, and major consolidation measures for each of the OECD member countries. The country notes in each report are used to identify "exogenous" consolidations as they lay out the government's rationale for pursuing fiscal adjustment. To be precise, it is possible to identify consolidation periods that were motivated by a desire for deficit reduction, meant to correct its long-run trend, or driven by other motives unrelated to the state of the business cycle, thus excluding adjustments connected to short-run, countercyclical concerns. Consolidations are measured in terms of their impact on

3. Data can be found here.

total revenue and expenditure (relative to a baseline without policy intervention) and scaled by the output level prior to the intervention announcement.

The main advantage of identifying fiscal consolidations via the narrative measure, compared to changes in the current account primary balance (CAPB) as suggested by Alesina and Ardagna (2010), is that they are exogenous to current economic developments while changes in the CAPB are correlated with the business cycle. Guajardo, Leigh, and Pescatori (2014) show that there is a significant positive correlation between GDP forecast revisions and changes in the CAPB, whereas the null hypothesis of no correlation between forecast revisions and the narrative measure cannot be rejected.

Alesina, Favero, and Giavazzi (2020) classify as spending-based consolidations all measures related to government spending and investment, including expenditure on goods and services, salaries, managing costs of state-provided services (such as education and healthcare), and government gross fixed capital formation expenditures. Regarding tax-based consolidations, they account for all direct and indirect tax changes.

Throughout the paper, the narratively identified austerity episodes at time t in country I ($\tilde{g}_{I,t}$) measure only spending-based consolidations, excluding episodes driven by significant changes in the tax system. The regional government spending proxy used in the analysis does not include tax revenues and mainly encompasses the public wage bill and, to a lesser extent, the consumption of fixed capital and intermediate consumption. Therefore, excluding consolidation episodes driven by significant changes in the tax system allows for a stronger and clearer relationship between the narrative national austerity episodes and the regional government spending measures.[4]

Following the definition in Devries et al. (2011), we construct $\tilde{g}_{I,t}$ as the sum of unanticipated shifts in government spending at time t ($g^u_{I,t}$) and changes in spending that are implemented at time t but had been announced in previous periods ($g^a_{I,t-1,t}$):

$$\tilde{g}_{I,t} = g^u_{I,t} + g^a_{I,t-1,t}. \tag{2.2.1}$$

For our sample, we observe 95 consolidation episodes, which is roughly one-third of all country-year observations. The mean (median) consolidation amounts to 0.86% (0.73%) of GDP. The largest intervention by 3.75% of GDP occurred in Portugal in 2012 during the Sovereign Debt Crisis. As described in more detail below, we combine the narrative consolidation episodes at the country level with regional sensitivities to changes in national spending to get an instrument for an exogenous fall in regional government spending that varies across time and regions. We also

4. For the identification strategy described in section 2.3, focusing on spending-based fiscal adjustments implies maximizing the link between the exogenous shift variable and the outcome variable of the first-stage regression.

show that our results are hardly affected when only considering the unexpected component of the fiscal consolidation measure ($g^u_{I,t}$).[5]

2.2.3 Election data

One main contribution of our paper consists in assembling a new comprehensive dataset on regional election outcomes. This new dataset, encompassing the years from 1980 to 2015, includes detailed information on elections to the European and national parliaments and also non-nationwide (regional or local) elections. The data is harmonized such that for each election the dataset provides the valid votes and eligible voters as well as the number of votes for each party at the NUTS 2 level.

The information on the votes cast in each election at the regional level comes from different sources. Part of our data comes from the “Regional Elections" project (Schakel, 2013). There, we collect data for European, national, and regional election results disaggregated at the NUTS 2 level for five out of the eight countries in our sample (Austria, France, Italy, Spain, and Sweden). We extend this data by collecting information from national sources to include election outcomes for the most recent years. For the remaining countries (Finland, Portugal, and Germany), the election data was collected from national sources. All sources are listed in Appendix 2.B.

Altogether, we collected information on more than 200 elections, which results in roughly 20 elections per region and, on average, one election every two years. The final dataset comprises a total of 2,890 election observations, from which 1,157 belong to national elections, 937 to regional elections, and 796 to European elections. For the baseline analysis, we use the full extent of the dataset and study the evolution of political outcomes over time and across election types. In the event of two or more elections in one year (e.g., in 2009, when all national, regional, and European elections look place in Portugal), we aggregate all elections by assigning the same weight to each individual vote. Following this approach, 2,380 election observations are used in the empirical analysis.[6]

Based on the raw election data, we then group the votes along several dimensions. The most important one relies on adding together votes for the *far-left* or the *far-right*. To categorize parties as far left or far right, we rely on the existing economic and political science literature and follow, among others, Massetti and Schakel (2015), Funke, Schularick, and Trebesch (2016), and Algan et al. (2017). In the spectrum of far-left parties, we include all parties that take up traditional Marxist-Leninist and/or communist positions, such as following an anti-capitalist ideology. On the far-right, we include parties of the “New Right" that present a moderate tone

5. When using, like Alesina, Favero, and Giavazzi (2020), long-term fiscal spending plans as the austerity measure, i.e., additionally including spending shifts announced at time t to be implemented in the future, our results only change slightly.

6. In section 2.4.1.2 below, we test for different outcomes across election types.

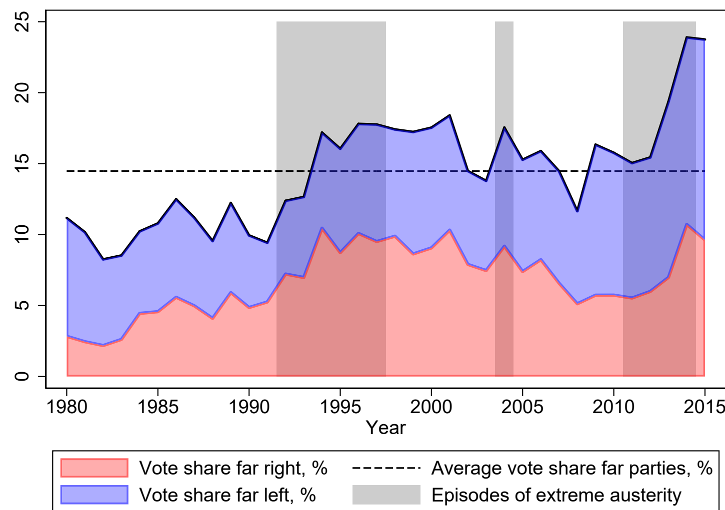


Figure 2.2.1. Vote share for extreme parties and austerity at the country level Vote shares are computed relative to total valid votes. Average vote share of extreme parties includes both far-left and far-right parties. Extreme austerity episodes are identified as above the 70th percentile after summing the shocks across countries.

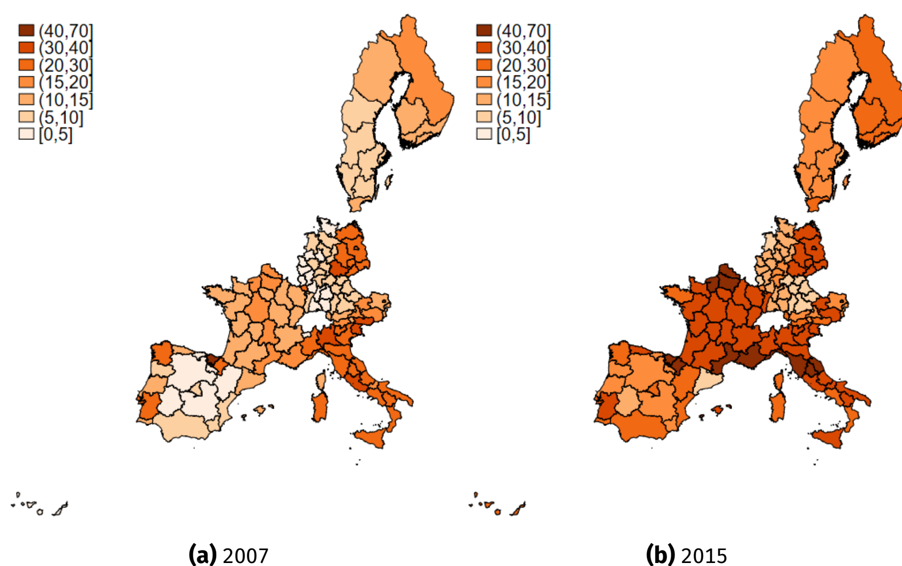
when referring to their ethnocentric and nationalistic views but nevertheless lie in the gray area between far-right extremism and right-wing populism (Funke, Schularick, and Trebesch, 2016). Importantly, we should emphasize that far-right parties are not shy about using anti-austerity narratives to capture votes (Della Porta et al., 2017). Following Massetti and Schakel (2015) and Algan et al. (2017), we also focus on populist parties that usually lie on the EU-skeptic spectrum or have strong regionalism views with suggested policies tilting to one of the extremes, with the latter being fundamental to keep some consistency between (supra-)national and regional elections. Tables 2.B.1, 2.B.2, and 2.B.3 in the Appendix provide further details and present the list of parties that are classified as either far left or far right.

2.2.4 A first look at the data

Figure 2.2.1 gives a first impression of the data and the relationship between vote shares for extreme parties and implemented fiscal consolidation programs. It shows the evolution of vote shares for far-left and far-right parties across all countries and election types in the sample together with episodes of extreme austerity indicated by the gray areas.[7] The figure highlights some important messages. First, the vote share for extreme parties is relatively volatile with an average of 15% across all years

7. Extreme austerity episodes are defined as those periods in which the narrative fiscal consolidation measure is above the 70th percentile.

and countries. Second, both extreme parties' vote shares show strong co-movement with local spikes in the mid-1990s and, most recently, in the aftermaths of the Great Recession and Sovereign Debt Crisis. Third, the share of extreme votes generally increases during large-scale austerity episodes.



(a) 2007 **(b)** 2015

Figure 2.2.2. Regional vote shares on extreme parties in 2007 and 2015. Figures 2.2.2a and 2.2.2b depict, in percent, the sum of the far-left and far-right vote shares for European regions at the NUTS 2 level in 2007 and 2015, respectively. If elections do not take place in these specific years, the map shows the outcome from the previous ballot.

Figure 2.2.2 is not only informative about the detailed regional variation that our new dataset on extreme voting captures, but also suggests a strong rise in political extremism after periods of austerity. The figure presents the regional vote shares for extreme parties for all 124 regions of the sample for the years 2007 and 2015, just before the start of the Great Recession and after the height of the Sovereign Debt Crisis. The figure shows that more extreme voting in the recent past is a shared phenomenon across countries and regions. Particularly strong increases in the vote shares of extreme parties can be observed for regions in France, Spain, and Italy. However, there are also significant differences across regions within the same country. For example, while regions in the western and southern part of Germany show lower vote shares for extreme parties, voters in the eastern part favor extreme parties more strongly. In our econometric analysis, we will make use of the large variation in voting behavior over time and across regions.

To further highlight the close connection between fiscal consolidations and extreme voting, Figure 2.2.3 presents, from 2011 onwards, the change in regional government spending and votes for extreme parties in national elections for all regions of the sample. The figure shows a clear negative correlation between government

spending and extreme voting. The correlation coefficient is −0.4 and is significant at the 1 percent level. Put differently, a reduction in public spending is associated with an increase in extreme parties' vote share. While Figures 2.2.1 and 2.2.3 are informative about the unconditional correlation between voting for extreme parties and fiscal consolidations, they do not provide a causal interpretation. In the rest of the paper, we conduct a thorough econometric analysis to investigate whether austerity causes more extreme voting.

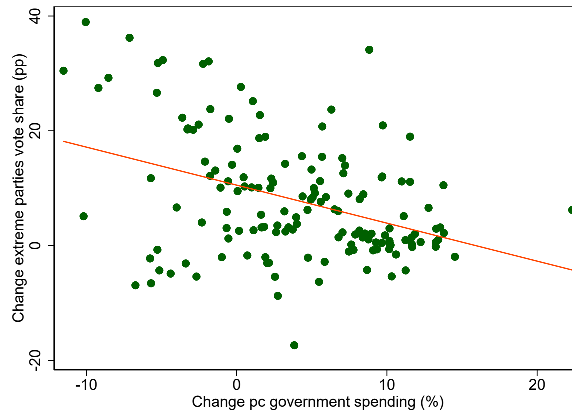


Figure 2.2.3. Extreme votes and public spending at the regional level. The y-axis plots the percentage point change in the voting share of the far-right and far-left parties between national elections. The x-axis represents the percent change in *per capita* government spending between the years of consecutive national elections. The sample includes NUTS 2 regions since 2011 and vote data for national parliament elections.

2.3 Methodology

In estimating the dynamic effects of austerity on regional political and economic outcomes, we closely follow the econometric specification by Funke, Schularick, and Trebesch (2016). To that end, we use local projections following the method pioneered by Jordà (2005) and estimate, for each horizon h = 0, ..., 4, the following equation:

$$z_{i,t+h} = \alpha_{i,h} + \beta_h \frac{G_{i,t} - G_{i,t-1}}{G_{i,t-1}} + \gamma_h(L)X_{i,t-1} + u_{i,t+h}, \tag{2.3.1}$$

where $z_{i,t+h}$ is the change in the variable of interest. More specifically, when we focus on political outcomes, $z_{i,t+h} = Z_{i,t+h} - Z_{i,t-1}$ is the percentage point change of the vote share for the far-left and far-right parties in region i between time $t-1$ and time $t+h$. The extreme parties' vote share is constructed as the number of all

votes for far-left and far-right parties divided by the number of all counted votes for a given election. $\frac{G_{i,t}-G_{i,t-1}}{G_{i,t-1}}$ is the growth rate in real per capita government spending in region i between time $t1$ and $t-1$. $(L)X_{i,t-1}$ is a vector of lagged control variables and $\alpha_{i,h}$ are region fixed-effects to control for region-specific (unobserved) characteristics. Throughout, the vector of additional control variables includes two lags of the endogenous variable and two lags of regional real per capita government spending and real per capita output growth to account for lagged dynamics in regional economic activity and public expenditures, respectively. When focusing on economic outcomes in Section 2.4.2, $z_{i,t+h}$ is the growth rate of the variable of interest, $\frac{Z_{i,t+h}-Z_{i,t-1}}{Z_{i,t-1}}$, for all variables except the labor share, for which we consider $z_{i,t+h}$ to be the difference in levels, $Z_{i,t+h}-Z_{i,t-1}$.

The main focus of our analysis consists of estimating the parameter $-\beta_h$, which directly yields at horizon h, the response of the variable of interest to a fall in regional government spending by one percent. Throughout, we cluster the standard errors at the regional level. Similar to Funke, Schularick, and Trebesch (2016), we do not include time fixed-effects in the baseline regression because they would absorb part of the variation in elections that are held by all regions in the same year (for example European elections). However, we will show below that our main findings remain when allowing for time fixed-effects.

For the identification of exogenous fiscal consolidations, we instrument the change in regional government spending with a Bartik-type instrument (Bartik, 1991) where we rely on the narratively identified spending-based austerity shocks from Alesina, Favero, and Giavazzi (2020) as described in Section 2.2.2. In particular, the Bartik instrument is computed as follows:

$$\frac{\overline{G_i}}{\overline{G_I}} \times \tilde{g}_{I,t},$$

where $\tilde{g}_{I,t}$ is the narrative national consolidation measure and $\overline{G_i}$ and $\overline{G_I}$ are averages of *per capita* government spending in region i and country I, respectively. To compute these averages, we follow Nekarda and Ramey (2011) and use data from the full sample to control for structural changes across regions over the sample period. Intuitively, if $\frac{\overline{G_i}}{\overline{G_I}}$ is above 1, region i spends more *per capita* than the national average. This implies that a disproportionate amount is spent in this region compared to other regions in the country. By interacting these regional sensitivities with narrative accounts of national fiscal consolidation programs, we assume that regions that rely more heavily on public spending cut back government expenditures more strongly when the national government implements austerity measures. Thus, the idea of the instrument is to scale national fiscal consolidation plans such that spending varies more in regions with a larger share of per capita national government spending. To be precise, we estimate the following first-stage regression:

$$\frac{G_{i,t} - G_{i,t-1}}{G_{i,t-1}} = \alpha_i + \zeta \frac{\overline{G_i}}{\overline{G_I}} \times \tilde{g}_{I,t} + \gamma(L) X_{i,t-1} + \epsilon_{i,t}. \quad (2.3.2)$$

Figure 2.C.1 in the Appendix shows a heat map depicting the share $s_i = \frac{\overline{G_i}}{\overline{G_I}}$ for the NUTS 2 regions used in the sample. There is considerable cross-sectional variation in this measure, ranging from 0.72 to 1.57. We calculate the lowest shares for Norte (Portugal, 0.72), Niederbayern (Germany, 0.74), and Niederösterreich (Austria, 0.75), and the highest shares for Lazio (Italy, 1.57), Wien (Austria, 1.52), and Área Metropolitana de Lisboa (Portugal, 1.43). There is only small variation in the shares over time. When calculating time-varying shares for each region, we find that the average standard deviation is around 0.05. This limited time variation justifies our choice of constant regional shares even though the results are robust when using a time-varying measure of the spending share.

Our identifying assumption is that central governments do not adopt austerity measures because regions that receive a disproportionate amount of government spending are experiencing certain economic and political outcomes relative to other regions. For example, the government does not cut expenses because a certain region is doing better economically or because political polarization is not rising. This is likely for two reasons. First, the data used is disaggregated at the NUTS 2 level. Intuitively, the main assumption might be violated when focusing on high aggregation levels with only few regions within a country because politically and economically important regions could directly influence central government decisions. Second, we are using narrative-identified austerity shocks that are by construction not driven by economic conditions and primarily motivated by national budgetary motives.

Another potential concern with our estimation strategy would arise if regions receiving large amounts of national spending were more cyclically sensitive than other regions and therefore might face stronger voter turnover for extreme parties. We use the standard deviation of output growth to compare the cyclical sensitivity of regions that receive large and small amounts of national spending. The standard deviations are very similar in regions with above-median national spending shares and in regions with below-median national spending shares (0.034 versus 0.031), indicating that a divergence in overall cyclical sensitivity does not bias our results. Following the same approach for the election data, we find that the standard deviation of the change in vote share of extreme parties is similar for regions with spending above and below the national median (0.050 and 0.042). As pointed out by Goldsmith-Pinkham, Sorkin, and Swift (2020), our empirical strategy using the Bartik instrument is valid even if the spending shares are correlated with the *level* of the extreme parties' vote share. Instead, our strategy asks whether differential exposure to national fiscal consolidations leads to differential *changes* in the outcome.

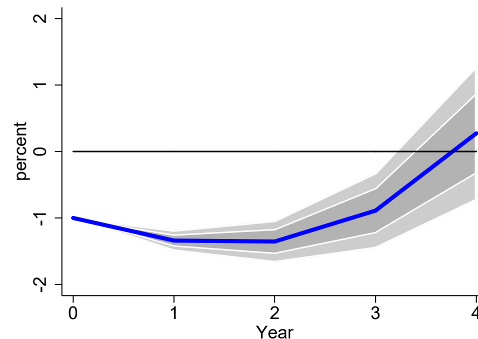


Figure 2.3.1. Government spending response to austerity. The figure plots the percent change of per capita government spending in response to an austerity induced change in government spending by one percent. Bands are 68% (dark) and 90% (light) confidence intervals.

Importantly, our instrument fulfills the relevance condition. The first-stage Olea and Pflueger (2013) F-statistic is above 70 and thus well above the threshold of 23 for a 5% critical value, implying that weak instruments are not a severe concern for our analysis. In addition, Figure 2.3.1 shows the estimated response of regional government spending to the consolidation shock. The dark and light shadings are, respectively, 68% and 90% confidence bands based on robust standard errors clustered at the regional level. The response is normalized so that spending falls by 1% in year 0. We find a significant and persistent fall in regional government spending following the austerity shock. Two years after the shock materialized, the reduction in government spending reaches its trough with around 1.25%. Thereafter, government spending converges back to its pre-shock level and the response becomes insignificant four years after the shock, which shows the transitory impact of our identified fiscal interventions. In what follows, we will use the estimated reduction in regional government spending and test whether there is a causal effect of lower public spending on voting for extreme parties.

Whereas our main analysis focuses on characterizing whether austerity shocks affect voting behavior, below we also assess the quantitative importance of this relationship. In doing so, we conduct a forecast error variance decomposition (FEVD) exercise. The local projection framework allows computing the contribution of the austerity shocks to the forecast error variance of our variables of interest. First, we consider the share of the variance in the vote shares that can be accounted for by austerity shocks from 1980 until 2014. The fraction of the variance in the vote shares at different horizons accounted for by austerity shocks can be recovered directly from the estimates of Equation (2.3.1). This measure therefore provides a metric of the extent to which austerity shocks are quantitatively important in driving voting dynamics.

We closely follow **Born2020bempty citation**, who extend the approach by Coibion, Gorodnichenko, Kueng, and Silvia (2017) and Gorodnichenko and Lee (2020) to a panel setting. In particular, we compute the variance share of the regional consolidation shock at horizon h as the R^2 of the following regression:

$$\hat{u}_{i,t+h} \;=\; \lambda_0 \hat{\epsilon}_{i,t+h} + \ldots + \lambda_h \hat{\epsilon}_{i,t} + \nu_{i,t+h}. \tag{2.3.3}$$

where $\hat{u}_{i,t+h}$ is the forecast error of the local projection (2.3.1) at horizon h and $\hat{\epsilon}_{i,t+h}$ are the (horizon-specific) predicted values of the first-stage regressions (2.3.2).

2.4 Results

In this section, we present and discuss our main empirical findings. We start by showing that an exogenous fall in regional government spending leads to a significant and persistent increase in the vote share for antiestablishment extreme parties, lower voter turnout, and more fragmentation. Moreover, we conduct a FEVD exercise to evaluate the quantitative importance of the identified consolidation episodes in explaining variation in voting for extreme parties. Then, we show that our main result is robust to several modifications of the baseline model and further decompose our baseline response across several dimensions: the increase in extreme-party voting is rather similar across election types (regional, national, European elections) and is not being driven by one side of the political spectrum with both the far-left and far-right vote shares rising in response to austerity. We also investigate the economic consequences of fiscal consolidations and show that the austerity-induced decrease in regional government spending has strong recessionary effects. Taken together, these findings are consistent with the idea that voters react to the negative economic impact of spending-based austerity episodes by shifting their vote toward more antiestablishment and extreme parties. Finally, we differentiate between economic recessions driven by fiscal consolidations and economic downturns that are unrelated to austerity and show that the political costs of economic downturns are considerably amplified when they coincide with fiscal consolidations.

2.4.1 Political Costs

Figure 2.4.1 presents our main result regarding the response of the vote share for extreme parties following a fiscal consolidation. The reduction in regional government spending leads to a significant increase in the extreme parties' vote share. A fall in public spending by 1% raises the extreme parties' vote share by more than 1.5 percentage points in the year of the fiscal policy implementation. Additionally, the vote share increase is very persistent. Two years after the shock, extreme parties have gained more than 3 percentage points. Even four years after the consolidation

was implemented, the vote share is still more than 2.5 percentage points above its pre-shock level. Thus, austerity induces large and long-lasting political costs with voters moving away from more traditional parties to extreme ones.

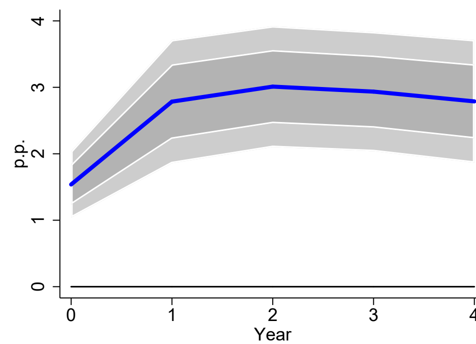


Figure 2.4.1. Response of extreme parties' vote share to austerity. The figure plots the impulse response in percentage points of the vote share for the extreme parties to an austerity-induced change in government spending by one percent. Bands are 68% (dark) and 90% (light) confidence intervals.

The documented increase in extreme voting following fiscal consolidations might be due to two different effects. First, holding turnout constant, if more people vote for extreme parties, their vote share increases. Second, austerity might discourage people from participating in the ballot and thus lower turnout. If this effect disproportionately applies for non-extreme voters, the vote share of extreme parties raises even without an increase in total votes for extreme parties. To test whether our results are driven by one of these effects or a combination of both, we re-estimate Equation (2.3.1) using either the change in turnout or total votes for extreme parties, respectively, as the dependent variable. Turnout is computed as the number of all counted votes relative to all eligible votes and total votes for extreme parties is constructed as the ratio between the number of votes for extreme parties and the number of all eligible votes.

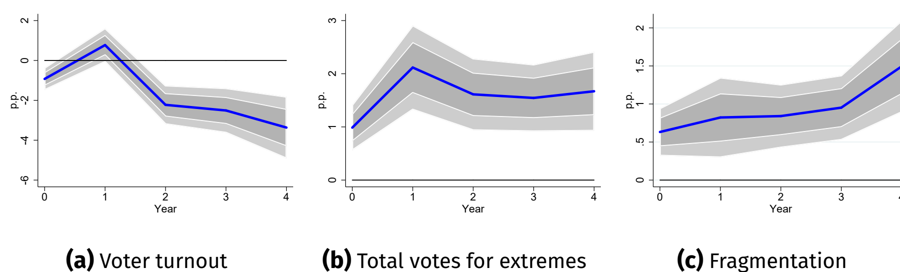
Figure 2.4.1 displays the estimation results, where the left panel shows the response of voter turnout and the middle panel presents the impact of austerity on total votes for extreme parties. Voter turnout significantly falls following a reduction in regional government spending. Four years after the fiscal intervention, turnout is reduced by almost 3.5 percentage points. In addition, the total number of votes for extreme parties significantly increases, reaching a peak of more than 2 percentage points in the year after the fiscal intervention. Therefore, the increase in extreme parties' vote share following austerity can be explained by fiscal consolidations leading to a combination of fewer people voting with higher tendency to vote for extreme parties.

We also study the impact of fiscal consolidations on fragmentation, which we construct following (Laakso and Taagepera, 1979). In particular, we rely on a measure of concentration taken from the industrial economics literature—the Herfindahl-Hirschmann concentration index—or, more precisely, its complement. This is known as the Effective Number of Parties, *ENP*, and is defined as:

$$\mathrm{ENP}_{i,t} = \sum_{j=1}^{n} p_{j,t}^{2},$$

where n is the number of parties in the election and p_j is party j's share in the total votes (between 0% and 100%). The lower the *ENP*, the higher the level of fragmentation. This measure takes two important dimensions of fragmentation into account: the number of parties involved in the decision-making process (political fragmentation) and the size inequalities between the participants (size fragmentation) (Geys, 2004). When there is more than one election per year, we use the average across elections. We estimate the same local projection but replace the extreme parties' vote share by the fragmentation variable given by $(1-\mathrm{ENP}_{i,t})$.

The right panel of Figure 2.4.1 presents the estimation results. Austerity implies a significant increase in fragmentation, which amounts to around 1.5 percentage points at the end of the forecast horizon. Based on previous evidence on negative economic consequences of higher political fragmentation (Azzimonti, 2018; Funke, Schularick, and Trebesch, 2020), this finding might suggest that, besides direct economic effects, fiscal consolidations also shape economic outcomes indirectly by leading to a more polarized political environment.



(a) Voter turnout **(b)** Total votes for extremes **(c)** Fragmentation

Figure 2.4.2. Responses of voter turnout, total votes for extreme parties, and fragmentation. The figure plots the impulse response in percentage point changes of the voter turnout, the total number of votes for extreme parties, and the political concentration to an austerity-induced change in government spending by one percent. Voter turnout is the ratio between valid votes and total eligible voters. "Total votes for extreme parties" is the sum of votes for far-left and far-right parties. Political fragmentation is measured by one minus the Herfindahl-Hirschmann concentration index, measured using the effective number of parties. Bands are 68% (dark) and 90% (light) confidence intervals.

In Table 2.4.1, we report the contribution of austerity shocks to the forecast error variance of the vote shares for a forecast horizon up to four years, where the estimates are based on Equation (2.3.3). It is evident that austerity shocks account for an economically significant part of extreme voting, and in particular in the medium run. At the four-year horizon, austerity explains 9.7% of the variation in extreme parties' vote share. We further differentiate between parties on the far left and far right. Interestingly, fiscal consolidations account for a larger part of voting for far-left parties than for far-right ones (9.1% versus 2.7% at the four-year horizon).

Table 2.4.1. Forecast error variance decomposition

Horizon	Far	Far left	Far right
1	0.6%	3.8%	1.1%
2	4.1%	5.4%	0.5%
3	7.5%	8.6%	1.7%
4	9.7%	9.1%	2.7%

Notes: Forecast error variance decomposition of far, far left, and far right vote shares based on local projections (2.3.3).

In summary, our main findings show that austerity has significant political costs. Fiscal consolidations lead to a strong and persistent increase in vote shares for extreme parties, lower voter turnout, and increased fragmentation. These findings are not only significant from an econometric point of view, but also from an economic perspective, with austerity accounting for a large share of voters favoring more extreme parties.

2.4.1.1 Robustness

In this section, we demonstrate that our main result of an increase in extreme parties' vote share following a fiscal consolidation is robust to several modifications of the baseline model. We start by modifying our aggregate narrative consolidation measure such that we only consider the unexpected component of the austerity series, i.e., $g^u_{i,t}$ from Equation 2.2.1. This rules out the hypothesis that our main finding could be driven by the anticipated component of the fiscal consolidation measure used, $g^a_{I,t-1}$. Table 2.4.2 presents the results, where the first upper panel also reports the baseline estimates. The estimated effects of a fiscal consolidation on the extreme parties' vote share are similar when only considering the unexpected component of the austerity measure. For example, four years after the consolidation was implemented, both estimations show an increase in the vote share of around 3 percentage points. Thus, our main finding is not due to strong anticipated effects of the fiscal policy change.

Jordà and Taylor (2016) suggest another way to control for significant anticipation effects in the narrative consolidation measure. They regress the austerity measure on a set of lagged macro control variables and take the residual of that regression as the new narrative consolidation series. This new measure is orthogonal to past economic developments and should thus capture only unexpected changes in fiscal policy. We follow their strategy, first regressing our narrative measure on several lagged macro covariates and then using the residual as the shift component in the construction of the Bartik instrument. Motivated by the set of regressors chosen by Jordà and Taylor (2016) and Klein (2017), the vector of control variables in the first regression includes country and time fixed-effects and lagged values of real GDP growth, real private consumption growth, the government debt-to-GDP ratio and real short-term interest rates.[8] The estimates presented in Table 2.4.2 (entry "Unpredicted austerity") show a similar finding compared to our baseline specification: austerity significantly increases extreme parties' vote share, although point estimates are larger when relying on the unpredicted austerity measure. In sum, this last result again suggests that anticipated changes in fiscal policy do not significantly drive our main findings.

Next, we verify that our result is not an artifact of the Great Recession and Sovereign Debt Crisis years by dropping the years 2008 and later and focusing on the pre-Great Recession sample. Table 2.4.2 shows that our finding is not significantly affected by this sample change. Put differently, the causal link between a reduction in regional public spending and an increase in extreme voting is by no means a result of the Great Recession and Sovereign Debt Crisis years but describes a general tendency in the data since the 1980s.

In our baseline estimation, we clustered the standard errors at the regional level. To also take into account serial correlation and heteroskedasticity among the residuals over time, we rerun the baseline model using Driscoll and Kraay (1998) standard errors. As shown in Table 2.4.2, standard errors become slightly larger when relying on the Driscoll and Kraay (1998) adjustment, but statistical significance remains.

Although Figure 2.2.1 does not indicate a clear time trend in the vote share for extreme parties, we want to ensure that our results do not capture a general movement toward more extreme parties over time. Therefore, we extend our baseline model by including time fixed-effects that should also control for common shocks across regions. Table 2.4.2 shows that the estimates are very similar to our baseline results.

As an additional check, we recalculate our Bartik instrument by using the lagged value of $s_{i,t}$ instead of the average value s_i as used in the baseline specification. Thus, we allow for a time-varying regional elasticity to national public spending changes

8. Data are taken from ARDECO, the Jordà-Schularick-Taylor Macrohistory Database (Jordà, Schularick, and Taylor, 2017), and OECD.

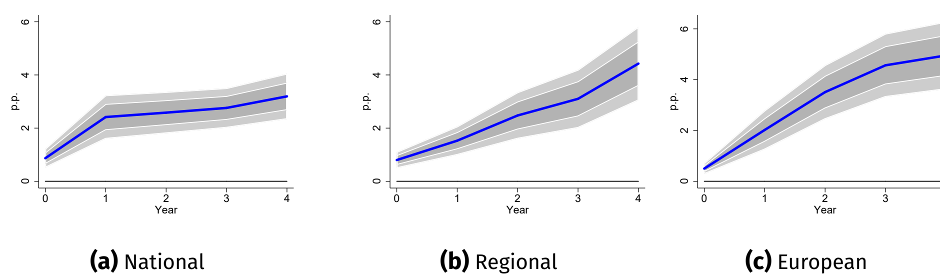
and use its lag to rule out any contemporaneous correlation between the national consolidation measure and the regional spending share. Again, as presented in Table 2.4.2, the results are very similar to the baseline estimates, indicating that our finding is robust to different ways of calculating the share measure used in the construction of the Bartik instrument.

Table 2.4.2 also presents the results when using the original Devries et al. (2011) consolidation measure, which includes both spending- and tax-based narratively identified fiscal consolidations, instead of the adjusted Alesina, Favero, and Giavazzi (2020) series. While the effect is somewhat smaller on impact, at the end of the forecast horizon both measures imply an increase in extreme parties' vote share of more than 2 percentage points.

Finally, the last two rows of Table 2.4.2 show the results when changing the sample. First, we exclude capital regions given that capitals have on average a higher government spending share. Second, we drop all regions with the top 10% highest government spending shares. It is evident that both sample changes do not significantly affect our findings. We also show in the appendix that our results are not driven by any particular country in the sample. When separately dropping one country at a time from the sample, results change only slightly (see Table 2.C.1).

Taken together, the results presented in this subsection provide confidence that the significant rise in extreme parties' vote share following a fiscal consolidation is a robust feature of the data not driven by the way we construct the national austerity measure—the share variable of the Bartik instrument—and holds for different changes in the sample.

2.4.1.2 Election types and far-left/far-right vote shares



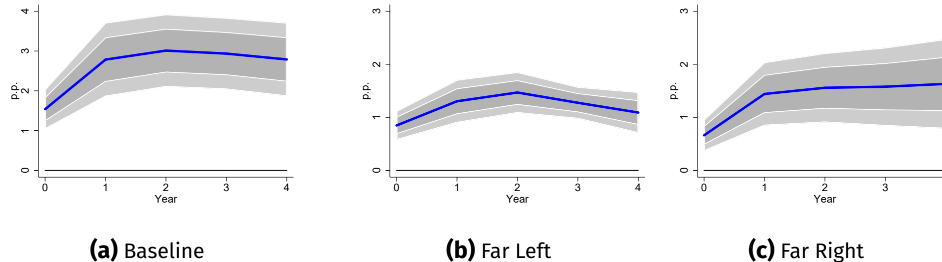
(a) National **(b)** Regional **(c)** European

Figure 2.4.3. Response of extreme parties' vote share to austerity by election type The figures plot by election type the impulse response in percentage points of the vote share for the extreme parties to an austerity-induced change in government spending by one percent. Bands are 68% (dark) and 90% (light) confidence intervals.

In the baseline estimation, we included voting results from all election types (European, national, regional). Next, we investigate whether there is significant heterogeneity across elections. In doing so, we separately restrict the sample to national,

regional, or European elections. Figure 2.4.3 presents the results of this exercise; the left panel shows the response for national elections, the middle panel for regional elections, and the right panel for European elections. The figure shows that the increase in extreme parties' vote share following a fiscal consolidation is present for all election types. The rise is most pronounced for European elections, which can be interpreted as evidence that austerity is mainly seen as implemented by European institutions; thus, they are therefore also blamed the most. However, extreme parties also significantly gain in regional elections, with an increase of larger magnitude compared to national elections.

As a further check, we study whether the increase in extreme vote shares is driven by either far-left or far-right parties. In particular, we re-estimate our baseline model but now separately focus only on the far-left or far-right parties' vote share. The obtained results are shown in Figure 2.4.4: the left panel repeats the estimates of the baseline model (the sum of far-left and far-right vote shares), the middle panel presents the vote share response for far-left parties, and the right panel for far-right parties. Austerity leads to a significant and persistent vote share increase for both extremes. The peak responses amount to around 1.5 percentage points. However, estimation uncertainty is larger for the far-right parties' vote share, whereas the far-left parties' vote share response is estimated more precisely.[9]



(a) Baseline **(b)** Far Left **(c)** Far Right

Figure 2.4.4. Response of total extreme, far-left, and far-right parties' vote share to austerity. The figures plot the impulse response in percentage points of the vote share for the total extreme, far-left, and far-right parties to an austerity-induced change in government spending by one percent. Bands are 68% (dark) and 90% (light) confidence intervals.

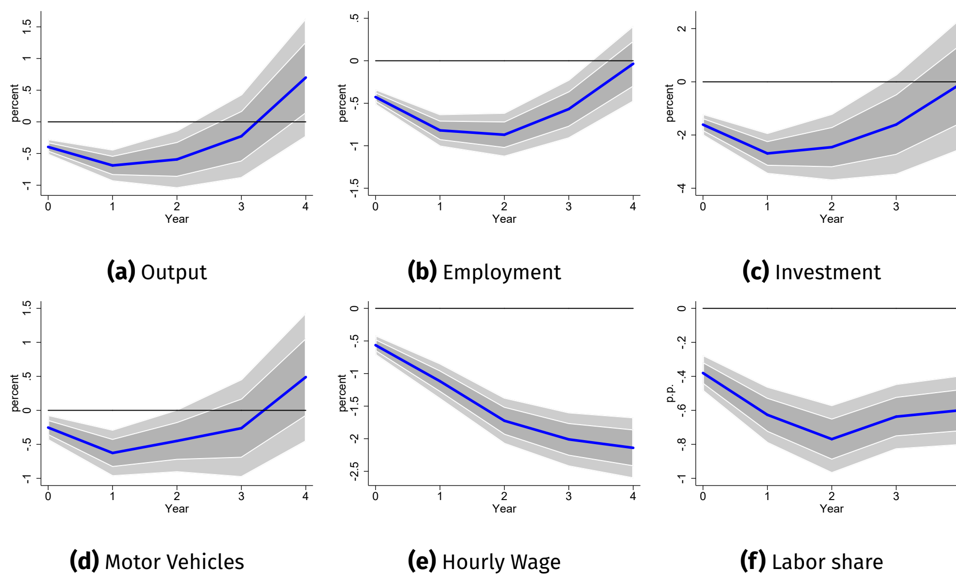
2.4.2 Economic Costs

Our main results indicate strong political costs of fiscal austerity. We have documented that a reduction in public spending leads to a significant increase in the

9. The smaller (larger) estimation uncertainty regarding the left (right) parties' vote share response might be related to the larger (smaller) variation accounted for by austerity as presented before in Table 2.4.1.

vote share for extreme parties. In the following, we try to answer what drives this voter movement away from more traditional parties toward extreme ones. A related stream of literature has shown that voter support for extreme parties is closely linked to economic developments. For example, Funke, Schularick, and Trebesch (2016) find that following a financial recession, the vote share of far-right parties rises significantly and persistently. In addition, Guriev (2018) show that higher unemployment rates during the Great Recession have considerably contributed to the recent rise of antiestablishment sentiment. To check whether the austerity-induced increased support for extreme parties is also related to a worsening of regional economies, we proceed by estimating the economic costs of fiscal consolidations. This issue is of interest on its own because studies at the aggregate (national) level provide mixed evidence. Some papers estimate that fiscal consolidations cause an economic recession (Guajardo, Leigh, and Pescatori, 2014), whereas others find only mild or even expansionary effects from austerity (Alesina, Ardagna, Perotti, and Schiantarelli, 2002).

Figure 2.4.5 presents the responses of several economic variables to the regional austerity shock based on equation (2.3.1). All of them are expressed in percent changes (growth rates), with the exception of the labor share variable, which is presented in percentage points.



(a) Output **(b)** Employment **(c)** Investment

(d) Motor Vehicles **(e)** Hourly Wage **(f)** Labor share

Figure 2.4.5. Economic responses to austerity. These figures plot the response of a one percent increase in government spending. All responses are expressed in percent changes (growth rates), with the exception of the labor share variable, which is presented as a percentage point change (its difference). Shaded areas are 68% (dark) and 90% (light) confidence intervals.

Panel 2.4.5a of Figure 2.4.5 shows the regional output response to the fiscal consolidation. We find that lower public expenditures lead to a significant fall in regional output. On impact, output is reduced by 0.4%, then declines further up to 0.7%, before slowly converging back to its equilibrium level at the end of the forecast horizon. When relating the output response to the extreme parties' vote share response shown in Figure 2.4.1, our results imply that an exogenous reduction in government spending that lowers regional GDP by 1% triggers an increase in extreme parties' vote share by around 5 percentage points.[10]

To put these results in perspective, we can compare our GDP and vote-share estimates to the ones reported in Funke, Schularick, and Trebesch (2016) and Jordà, Schularick, and Taylor (2013). Funke, Schularick, and Trebesch (2016) estimate that extreme vote shares increase by around 30% in the five years after a financial recession, and Jordà, Schularick, and Taylor (2013) show that a financial recession lowers GDP by 4%. Because our results for the vote shares are in percentage points, a direct comparison to our baseline estimates is not directly possible. So, when re-estimating the model with the vote-share variable expressed in percent changes as in Funke, Schularick, and Trebesch (2016), we find that austerity leads to an increase in the extreme parties' vote share of almost 27% four years after the shock. Thus, our results indicate that a fiscal consolidation-induced recession leads to a stronger movement toward extreme parties than a financial recession. In particular, while both economic downturns lead to an increase of extreme parties' vote share of around 30%, the reduction in GDP following austerity is much lower than the one triggered by a financial recession (0.7% versus 4%). Therefore, the political costs of economic downturns are considerably amplified when fiscal policy causes the increase in economic slack.[11] Below, we will discuss in more detail the different impact of normal (non-austerity-driven) and austerity-induced recessions on extreme voting.

As Panel 2.4.5b of Figure 2.4.5 indicates, fiscal consolidations do not only have negative real consequences, but also imply severe labor market consequences. The employment rate falls by almost 1% two years after the austerity measure was implemented. In the Appendix, we also report the corresponding output and employment government spending multipliers (see Section 2.D), where the estimation procedure closely follows Bernardini, Schryder, and Peersman (2020) and Gabriel, Klein, and Pessoa (2021). The output multiplier is estimated slightly below two, whereas the employment multiplier takes a value of slightly above two. These values are in the range of other estimates on regional government spending multipliers (Nakamura

10. Two years after the fiscal consolidation, output is lowered by 0.6% percent, whereas the vote share for extreme parties is up by 3 percentage points ($\frac{3}{0.6} = 5$).

11. It is necessary to keep in mind that the different aggregation levels in our study and Funke, Schularick, and Trebesch (2016) and Jordà, Schularick, and Taylor (2013) (regional versus national) make a direct comparison somewhat more difficult.

and Steinsson, 2014; Bernardini, Schryder, and Peersman, 2020; Gabriel, Klein, and Pessoa, 2021).

Panels 2.4.5c and 2.4.5d present the responses of private investment and the number of motor vehicles that we use as a proxy for durable consumption following Mian, Rao, and Sufi (2013) and Demyanyk, Loutskina, and Murphy (2019). Both private demand components significantly fall following the reduction in public expenditures. While the decrease in private investment is stronger than the one in output, the fall in durable consumption closely mimics the regional GDP response. Households' consumption expenditure should be closely linked to their disposable income stream in the sense that a lower income might well lead to lower (durable) consumption spending. Panel 2.4.5e indeed supports this hypothesis. Here, we report the real wage response expressed as average real compensation per hour worked. Wages fall significantly and persistently in response to the fiscal consolidation. On impact, wages decline by more than 0.5% and continue to fall until the end of the forecast horizon. Finally, Panel 2.4.5f presents the response of the labor share, which is significantly reduced by the austerity measure. Thus, the reduction in public spending induces a redistribution of income away from working households.

Taken together, these last results indicate severe economic costs of fiscal consolidations and therefore support previous evidence on the contractionary impact of austerity at the national level (Guajardo, Leigh, and Pescatori, 2014; Jordà and Taylor, 2016). Moreover, they highlight the close relationship between detrimental economic developments and voters' support for extreme parties.

2.4.3 State-Dependencies

So far, we have assumed that the political costs of fiscal consolidations are common across European regions as our baseline model is estimated as a pooled regression. However, it might well be argued that specific economic environments amplify or dampen the impact of austerity on extreme voting. In the following, we investigate how the state of the business cycle and regional characteristics like urbanization and economic development affect our estimates.

To test for potential state dependencies, we extend our baseline specification (2.3.1) and estimate for each horizon $h = 0, ..., 4$, the following regression:

$$\begin{aligned} z_{i,t+h} =& I_{i,t}\left[\beta_h^A \frac{G_{i,t} - G_{i,t-1}}{G_{i,t-1}} + \gamma_h^A(L)X_{i,t-1}\right] + (1 - I_{i,t})\left[\beta_h^B \frac{G_{i,t} - G_{i,t-1}}{G_{i,t-1}} + \gamma_h^B(L)X_{i,t-1}\right] \\ &+ \alpha_{i,h} + u_{i,t+h}. \end{aligned} \tag{2.4.1}$$

$I_{i,t}$ is an indicator variable for the defined state in period t. We now instrument spending changes with the Bartik instrument interacted with the state indicator. β_h^A

and β_h^B directly yield, for each horizon h and states A and B, the response of the extreme parties' vote share.

We start by looking at how the state of the business cycle affects the political costs of austerity. Recessions (expansions) are defined as periods in which the regional growth rate of per capita GDP is negative (positive). Panel A of Table 2.4.3 shows the results. We find that the increase in extreme parties' vote share following a fiscal consolidation is generally larger during recessions. Four years after the consolidation was implemented, extreme parties gain 4.08 (2.01) percentage points when austerity is done in a period of high (low) economic slack. As shown by the Anderson and Rubin (1949) and HAC test results, at longer horizons the difference in both states becomes statistically significant. This result is closely related to a literature documenting that economic recessions considerably amplify the negative economic consequences of austerity (Jordà and Taylor, 2016) and again shows the close relationship between the state of the economy and voting behavior.

Next, we allow for different effects between rural and urban regions. Rural and urban areas are defined according to regional density computed as the ratio between the population and total area of the region. Regions are classified as urban if density is higher than the country's median and classified as rural otherwise.[12] We find that the effects are generally larger in rural regions than urban regions, although the differences are relatively small and not statically significant.

Finally, we also compare the effects in poor and rich regions, where regions are classified as poor (rich) when their per capita GDP is below (above) the country's median. At all horizons, the increase in extreme parties' vote share is somewhat larger in poor regions than rich regions. However, we find only small differences that are estimated to be indistinguishable different from zero.

2.4.4 Austerity-recessions and non-austerity recessions

In Section 2.4.2, we have shown that there is a close link between the political and economic consequences of fiscal consolidations. Austerity leads to an increase in extreme parties' voting and lowers economic activity. A related literature has also shown that vote shares of extreme parties rise following severe economic downturns (Funke, Schularick, and Trebesch, 2016; Guriev, 2018). This might raise the question of whether our main findings are simply a reflection of economic recessions leading to higher vote shares for extreme parties. In other words, do austerity-driven recessions lead to different political outcomes than other economic downturns? In the following, we will show that the political costs of economic downturns are significantly amplified when recessions are indeed driven by fiscal consolidations.

We extend our baseline equation (2.3.1) and estimate for each horizon $h = 0, ..., 4$ the following regression:

12. Data on the regional area at NUTS 2 was retrieved from Eurostat.

$$
\begin{aligned}
z_{i,t+h} =& I^{ra}_{i,t}\left[\zeta^{ra}_h + \beta^{ra}_h \frac{G_{i,t}-G_{i,t-1}}{G_{i,t-1}} + \gamma^{ra}_h(L)X_{i,t-1}\right] \\
&+ I^{r}_{i,t}\left[\zeta^{r}_h + \beta^{r}_h \frac{G_{i,t}-G_{i,t-1}}{G_{i,t-1}} + \gamma^{r}_h(L)X_{i,t-1}\right] \\
&+ (1-I^{ra}_{i,t}-I^{r}_{i,t})\left[\zeta^{e}_h + \beta^{e}_h \frac{G_{i,t}-G_{i,t-1}}{G_{i,t-1}} + \gamma^{e}(L)X_{i,t-1}\right] + \alpha_{i,h} + u_{i,t+h}.
\end{aligned}
\tag{2.4.2}
$$

$I^{ra}_{i,t}$ is a dummy variable that takes a value of one in year t, when region i contemporaneously experiences negative per capita GDP growth and implements fiscal consolidation measures (i.e., when the Bartik instrument is larger than zero). On the other hand, $I^{r}_{i,t}$ is a dummy variable that takes a value of one when the regional per capita GDP growth rate is negative and we identify no fiscal consolidation (when our Bartik instrument is equal to zero). Thus, $I^{ra}_{i,t}$ captures recessions that coincide with austerity ("austerity-recessions") and $I^{r}_{i,t}$ measures economic downturns that are not directly related to fiscal consolidations but can be described as a combination of different negative shocks that lead to lower economic activity ("non-austerity recessions"). We also include a dummy for all remaining episodes when there is positive economic growth (economic expansions), $1-I^{ra}_{i,t}-I^{r}_{i,t}$, to use the entire variation of the sample. The coefficients ζ^{ra}_h and ζ^{r}_h capture the average impact of austerity recessions and non-austerity recessions, respectively, on the vote shares of extreme parties. In addition, β^{ra}_h and β^{r}_h indicate the marginal effect of lowering regional government spending by 1% in austerity recessions and non-austerity recessions, respectively.[13] If ζ^{ra}_h is larger (smaller) than ζ^{r}_h, this would imply that economic downturns driven by fiscal consolidations lead to a larger (smaller) increase in extreme voting than other downturns. The same logic also applies to the marginal effect coefficients β^{ra}_h and β^{a}_h.

The first row of Figure 2.4.6 presents the estimation results, where the upper left panel shows the difference between ζ^{ra}_h and ζ^{r}_h and the upper right panel shows the difference between β^{ra}_h and β^{r}_h. The difference in the average recession effect (ζ^{ra}_h-ζ^{r}_h) is positive and highly statistically significant. Thus, austerity recessions lead to a larger increase in the vote shares for extreme parties than non-austerity recessions. Furthermore, the difference in the marginal coefficients is also estimated to be positive and becomes statistically significant at longer horizons. This implies that, in recessions coinciding with fiscal consolidations, a reduction in regional government spending implies a larger increase in extreme voting compared to lowering public spending in non-austerity recessions. These results suggest that austerity recessions

13. As before, we normalize the responses such that regional government spending falls by 1% in the impact period.

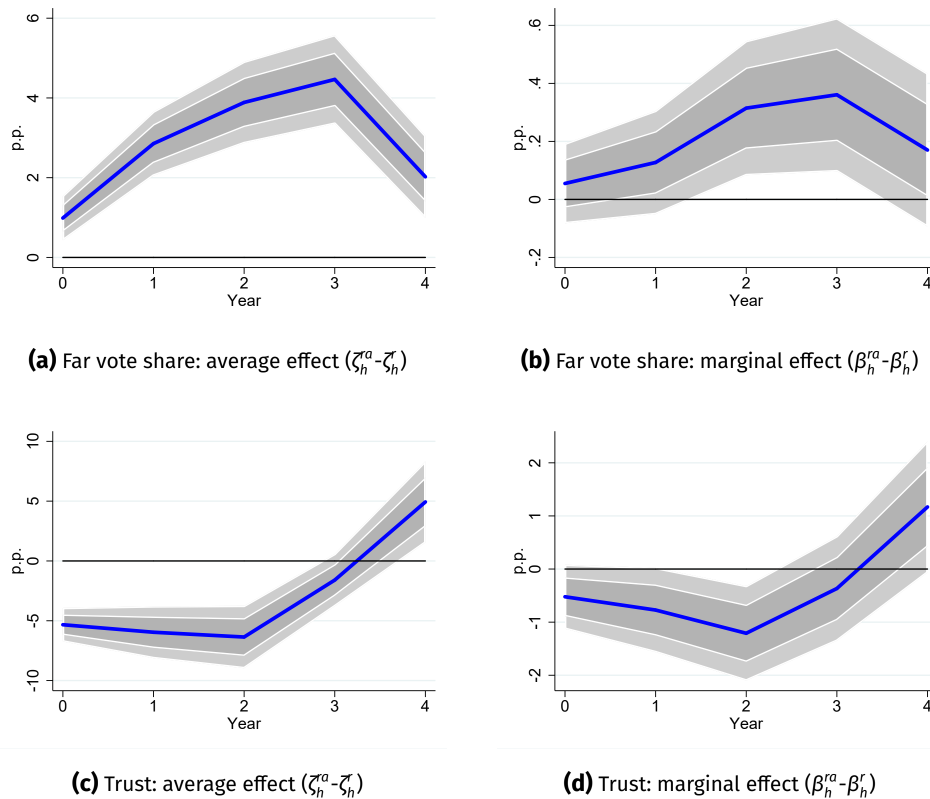


Figure 2.4.6. Difference in responses between austerity-recessions and non-austerity recessions. Panels 2.4.6a and 2.4.6b on the first row show the difference of the average and marginal effects between austerity recessions and normal recessions on the vote share of extreme parties estimated through Equation 2.4.2. Panels 2.4.6c and 2.4.6d on the second row depict the equivalent for the outcome variable trust on national parliaments. Bands are 68% (dark) and 90% (light) confidence intervals.

are special in the sense that they considerably amplify the political costs of economic downturns. Thus, our main results do not simply capture a general tendency of more voting for extreme parties during economic downturns but instead point toward a specific transmission mechanism underlying fiscal consolidations.

How could such a transmission mechanism operate? One potential channel is related to trust in the political system and the government. If voters' trust in the government falls more during austerity recessions than non-austerity recessions, the heightened skepticism about the political environment might lead to a stronger movement away from traditional parties to more extreme ones. To test this hypothesis, we use data assembled by Algan et al. (2017) and investigate the impact of austerity recessions and non-austerity recessions on voters' trust in the country's parliament. The trust index varies between zero and one and is based on micro data from the European Social Survey (ESS). People are asked to state the level of

trust in the country's parliament from zero to ten, where zero means no trust at all and ten means complete trust. The survey is conducted biennially, from 2000 until 2014, and provides data at the NUTS 2 level for most of the countries in our sample, with the exception of Finland and France. The results are presented in the second row of Figure 2.4.6. Both estimated differences are negative and significant, which implies that trust in the countries' parliament falls much more during austerity recessions than non-austerity recessions. Voters seem to become more skeptical about the political environment when the higher economic slack they experience is related to active policy interventions like fiscal consolidations. Given that voters might blame the government for part of the economic downturn, they tend to punish established parties and instead support more extreme ones.

2.5 Conclusion

While the economic consequences of fiscal consolidations are studied extensively, the political costs of austerity are less well understood. In this paper, we provide new evidence on how reductions in government spending affect election outcomes. Using a novel regional dataset on election outcomes for several European countries, we find that fiscal consolidations lead to a significant increase in vote shares of extreme parties, raise fragmentation, and lower voter turnout. A reduction in regional public spending by 1% causes a rise in extreme parties' vote share of around 3 percentage points. We highlight the close relationship between economic developments and voters' support for extreme parties by showing that austerity induces severe economic costs by lowering GDP, employment, and the labor share. Importantly, we show that austerity recessions significantly amplify the political costs of economic downturns compared to non-austerity recessions.

Table 2.4.2. Response of extreme parties' vote share to austerity: Robustness

	Impact	1 Year	2 Years	3 Years	4 Years
Baseline	1.54***	2.79***	3.01***	2.94***	2.79***
	(0.30)	(0.56)	(0.55)	(0.55)	(0.56)
(1) Unexpected component $g^u_{i,t}$	2.00***	3.39***	3.12***	3.17***	3.02***
	(0.38)	(0.77)	(0.59)	(0.57)	(0.56)
(2) Unpredicted austerity	2.12***	3.29***	2.53***	2.94***	4.48***
	(0.59)	(1.02)	(0.81)	(0.75)	(0.90)
(3) Dropping Great Recession	1.42***	2.28***	2.32***	2.38***	2.04***
	(0.20)	(0.34)	(0.44)	(0.47)	(0.45)
(4) Baseline with DK std. errors	1.54**	2.79***	3.01***	2.94***	2.79**
	(0.70)	(1.05)	(0.86)	(0.92)	(1.17)
(5) Including time fixed effects	1.38**	2.30**	2.12***	2.17**	2.73**
	(0.61)	(0.97)	(0.82)	(1.02)	(1.24)
(6) Lagged $s_{i,t}$	1.43***	2.63***	2.88***	2.82***	2.70***
	(0.27)	(0.52)	(0.52)	(0.51)	(0.53)
(7) IMF austerity shock	0.49***	2.07***	2.18***	2.59***	2.06***
	(0.12)	(0.35)	(0.33)	(0.35)	(0.32)
(8) Excluding capitals regions	1.64***	2.85***	3.03***	3.00***	2.72***
	(0.29)	(0.54)	(0.51)	(0.50)	(0.51)
(9) Excluding regions in top 10% of s_i	1.64***	2.86***	3.02***	2.92***	2.68***
	(0.31)	(0.59)	(0.56)	(0.52)	(0.53)

Notes: For regression (1), the instrument is computed using only the unexpected consolidation shock $g^u_{i,t}$ from Equation 2.2.1. Estimation (2) takes into account possible anticipation effects by using as the instrument the residuals from regressing the austerity shock on a set of macroeconomic variables, including two lags of output and consumption growth, debt-to-GDP ratio, and real short- and long-term interest rates. Regression (3) drops observations since 2008, regression (4) presents Driscoll and Kraay standard errors, and regression (5) adds time fixed-effects. In regression (6), lagged $s_{i,t}$ is used in the instrument construction instead of s_i. Regression (7) uses IMF narrative-identified austerity shocks instead of the baseline shocks. In regressions (8) and (9), the sample excludes regions with the capital cities and the regions with the largest shares s_i (top 10%). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.4.3. Response of total far vote share: state dependencies

	Total far vote share				
	Impact	1 Year	2 Years	3 Years	4 Years
Baseline	1.54***	2.79***	3.01***	2.94***	2.79***
	(0.30)	(0.56)	(0.55)	(0.55)	(0.56)
# Obs	3880	3880	3768	3692	3568
Panel A: recessions vs expansions					
Recessions	1.67***	3.03***	3.81***	3.95***	4.08***
	(0.52)	(0.81)	(0.84)	(0.85)	(1.34)
Expansions	1.57***	2.81***	2.62***	2.35***	2.01***
	(0.31)	(0.60)	(0.61)	(0.63)	(0.58)
HAC test	0.84	0.75	0.13	0.05	0.14
AR test	0.83	0.75	0.12	0.05	0.12
Panel B: urban vs rural					
Rural	1.58***	2.74***	3.06***	3.03***	2.90***
	(0.37)	(0.71)	(0.69)	(0.69)	(0.74)
Urban	1.27***	2.43***	2.50***	2.51***	2.19***
	(0.40)	(0.74)	(0.72)	(0.74)	(0.75)
HAC test	0.57	0.75	0.57	0.60	0.50
AR test	0.82	0.85	0.63	0.73	0.83
Panel C: poor vs rich					
Poor	1.55***	2.83***	3.06***	3.11***	2.83***
	(0.37)	(0.72)	(0.72)	(0.70)	(0.71)
Rich	1.52***	2.72***	2.95***	2.74***	2.68***
	(0.46)	(0.81)	(0.81)	(0.80)	(0.87)
HAC test	0.96	0.92	0.92	0.72	0.89
AR test	0.96	0.92	0.90	0.73	0.89

Notes: In panel A, recession (expansion) is the state when the growth rate of per capita output is negative (positive). In panel B, observations are classified as urban if the (lagged) population density is above the country's median for that year. Otherwise, the observations are in the rural state. In a similar fashion, for a given year, regions are labeled as poor (rich) when their per capita output is below (above) the country's median. The AR test presents the p-value of the difference between states using the Anderson and Rubin (1949) test, while the HAC test indicates the HAC-robust p-values of the difference between states. Clustered standard errors are presented between brackets. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix 2.A Data Appendix

Table 2.A.1. NUTS structure in final sample

NUTS 0	NUTS 1	#	NUTS 2	#
Austria	Groups of states	3	States (Länder)	9
Finland	Mainland	1	Large areas (Suuralueet / Storområden)	4
France	ZEAT	13	Regions	22
Germany	States (Länder)	16	Government regions (Regierungbezirke)	38
Italy	Groups of regions	5	Regions (Trentino-Alto Adige split in 2)	21
Portugal	Mainland	1	Coordination regions	5
Spain	Groups of communities	7	Autonomous communities	17
Sweden	Lands (Landsdelar)	3	National Areas (Riksområden)	8
Total		44		124

2.A.1 ARDECO - Regional European Data

ARDECO is the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy and is maintained and updated by the Joint Research Centre. It is a highly disaggregated dataset across both sectoral and sub-regional dimensions. The database contains a set of long time-series indicators for EU regions at various statistical scales (NUTS 0, 1, 2, and 3 level) using the NUTS 2016 regional classification. The dataset includes data on demography, labor markets, capital formation and domestic product by six sectors. The six sectors are (1) agriculture, forestry and fishing, (2) industry excluding construction, (3) construction, (4) wholesale, retail, transport, accommodation, and food services, information and communication, (5) financial and business services, and (6) non-market services.

ARDECO data is an annual unbalanced panel covering the period of 1980–2018 for the European Union (EU) and some European Free Trade Association (EFTA) and candidate countries. Its main data source is Eurostat (the Statistical Office of the European Commission), supplemented, where necessary, by other appropriate

Table 2.A.2. Variables Description

Variable Name	Computation	Definition [Source]
Far-left/far-right votes	Sum of all votes cast to far-left and far-right parties	Massetti and Schakel (2015), Funke, Schularick, and Trebesch (2016), and Algan et al. (2017) and their sources
GDP*pc*	GDP / population	Regional gross domestic product per capita [ARDECO]
Gov. Spending *pc*	non-market GVA / population	Regional gross value added of the non-market sector per capita [ARDECO]
Employment		Total employment [ARDECO]
Investment *pc*	private gross fixed capital formation / population	Total private (all sectors excluding non-market) Investment per capita (fixed gross capital formation) [ARDECO]
Hourly Wage	compensation of employees / total hours worked	Regional average compensation per hour (all sectors) [ARDECO]
Labor Share	private compensation / private GVA	Private (all sectors excluding non-market) compensation as a share of private GVA [ARDECO]
Motor Vehicles	# motor vehicles / population	Stock of all motor vehicles (except trailers and motorcycles) per capita [Eurostat]
Trust	Index between 0 and 1 based on micro data from the European Social Surveys (ESS).	Trust in country's parliament (Algan et al., 2017)

national and international sources. ARDECO is constructed in such a way that the country aggregates its various time series equal to the corresponding time series in the AMECO dataset referring to the National Accounts. Starting in 2002, Eurozone countries have published national series in EUR. National currency data for all years prior to the switch of the country to EUR have been converted using the irrevocably fixed EUR conversion rate. Cross-country comparisons and aggregations should continue to be based only on historical series established in ECU up to 1998 and their statistical continuation in EUR from 1999 onward. Exchange rates and purchasing power parities have been converted in the same manner. We thus use the series with real variables expressed in 2015 constant price in ECU/EUR.

Appendix 2.B Coding of Elections and their variables

Figure 2.B.1 provides a chronology of elections from 1975–2015 by country. Altogether, we identify more than 200 elections, and the final sample of coded elections includes more than 2,000 election-region observations. We include all general elections to the European parliament (eu), to the national parliament (nat), and also regional elections (reg). The latter might happen in different years for different re-

gions in Spain, Italy, and Germany. For national parliament elections, in the case of a bicameral legislative, we only consider results from the lower legislative chamber. This means that we focus on the following national elections: Austria: National Council (lower house); Germany: Bundestag (unicameral); Spain: Congress of Deputies (lower house); Finland: Eduskunta (unicameral); France: National Assembly (lower house); Italy: Chamber of Deputies (lower house); Portugal: Assembly of the Republic (unicameral); Sweden: Riksdag (unicameral). Data sources for Austria, France, Italy, Spain, and Sweden are Schakel (2013) and Schakel (2021) and his project on Regional Elections. For the other countries we relied on national sources: Finland (Statistics Finland), Germany (Federal Returning Officers), and Portugal (Pordata).

Country	Election	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Finland	eu																					
Finland	nat									2				2				2				2
Finland	reg		2				2				2				2				2			
Portugal	eu													2		2					2	
Portugal	nat		2			2	2			2		2		2				2				2
Portugal	reg		2			2			2			2				2				2		
France	eu					1					1					1					1	
France	nat				1			1					1		1					1		
France	reg												1						1			
Austria	eu																					
Austria	nat					1				1			1				1				1	1
Austria	reg			1					1					1				1				
Germany	eu					2					2					2					2	
Germany	nat						2			2				2			2				2	
Germany	reg	2	2		2	2	2		2	2	2		2	2	2		2	2	2		2	2
Italy	eu					1					1					1					1	
Italy	nat		1			1				1				1					1		1	
Italy	reg	1	1		1	1	1	1		1	1	1	1		1	1	1	1		1	1	1
Spain	eu													1		1					1	
Spain	nat					1			1				1			1				1		
Spain	reg					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sweden	eu																					1
Sweden	nat					1			1			1			1			1			1	
Sweden	reg					1			1			1			1			1			1	

Country	Election	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Finland	eu	2			2					2					2					2	
Finland	nat				2				2				2				2				2
Finland	reg	2				2				2				2				2			
Portugal	eu				2					2					2					2	
Portugal	nat				2			2			2				2		2				2
Portugal	reg		2				2				2				2				2		
France	eu				1					1					1					1	
France	nat		1					1					1					1			
France	reg			1	1					1						1					1
Austria	eu	1			1					1					1					1	
Austria	nat				1			1				1		1					1		
Austria	reg	1				1					1					1					1
Germany	eu				2					2					2					2	
Germany	nat			2				2			2				2				2		
Germany	reg	2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Italy	eu				1					1					1					1	
Italy	nat	1					1					1		1					1		
Italy	reg	1		1	1	1	1		1	1	1	1		1	1	1	1	1	1	1	1
Spain	eu				1					1					1					1	
Spain	nat	1				1				1				1			1				1
Spain	reg	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1			1
Sweden	eu				1					1					1					1	
Sweden	nat			1				1				1				1				1	
Sweden	reg			1				1				1				1				1	

Figure 2.B.1. Elections' data table. The table provides a chronology of elections from 1975–2015 by country. We include all general elections to the European parliament (eu) and to the national parliament (nat), as well as regional elections (reg). For national parliament elections, in the case of a bicameral legislative, we only consider results from the lower legislative chamber. This means that we focus on the following national elections: Austria: National Council (lower house); Germany: Bundestag (unicameral); Spain: Congress of Deputies (lower house); Finland: Eduskunta (unicameral); France: National Assembly (lower house); Italy: Chamber of Deputies (lower house); Portugal: Assembly of the Republic (unicameral); Sweden: Riksdag (unicameral). Data sources for Austria, France, Italy, Spain, and Sweden are Schakel (2013, 2021) and his project on Regional Elections [1]. For the other countries (Finland, Germany, and Portugal), we relied on national sources [2].

2.B.1 Coding of far-right and far-left parties

Table 2.B.1 shows our full list of far-left and far-right parties in the period from 1980 to 2015. We mainly follow the classification in Funke, Schularick, and Trebesch (2016) and Algan et al. (2017) and draw on their own sources such as Ignazi (1992), Ignazi (2003), March (2012), Minkenberg (2011), Mudde (2002), Mudde (2005), and Mudde (2016), Döring and Manow (2016), Bernhard and Kriesi (2019) as well as country reports by Stiftung (2010) and a large number of country-specific sources. We further supplement their classification by evaluating political parties that only contest in regional elections by Massetti and Schakel (2015). Moreover, we relied on

specific case studies to determine whether specific regionalist parties were perceived as far-winged or not, as the case of Galician Nationalist Bloc (Cachafeiro, 2009).

Table 2.B.1. List of far right (R) and far left (L) parties since 1980 by country

Country	Party	Party name (Code)
Austria	R	Alliance for the Future of Austria (BZO); Freedom Party of Austria (FPO, FPS, FPK); National Democratic Party (NDP); A Heart for Natives (Herz)
	L	Communists and Left Socialists (KB); Communist Party of Austria (KPO); Socialist Left Party (SLP); Radical Socialist Worker's Party (RSA); Marxist–Leninist Party (MLÖ); Left (LINKE)
Finland	R	Finns Party (PS); Finish Rural Party (PS); Finnish People's Blue-whites (SKS)
	L	Communist Worker's Party (KTP); Communist Party of Finland (SKP); Finnish People's Democratic League (VAS); Left Alliance (VAS)
France	R	Movement for France (MPF); National Front (FN); National Republican Movement (MNR); France Arise (DLF); Republic Arise (DLR); Alsace d'Abord (ADA); Right Radicals (RD); League of the South (LDS); Republican People's Union (UPR); Nationalist League (LIN); Anti-replacement List (AP); Party of New Forces (PFN); French Party (PDF); Extreme Right (EXD); Right Union (UDN)
	L	French Communist Party (PCF); Left Front (PG); Revolutionary Communist League (LCR); Worker's Struggle (LO); Worker's Party (MPPT); Independent Worker's Party (POI); New Anticapitalist Party (NPA); Communists (COM); Extreme Left (EXG); Union Democratic of Bretagne (UDB); Abertzaleen Batasuna (AB); Corsica Libera (CL)
Germany	R	Alternative for Germany (AfD); Freedom - Civil Rights Movement Solidarity (BFBDO); Law and Order Offensive (Schill); National Democratic Party of Germany (NPD); STATT Party; Pro Germany Citizens' Movement (ProD); The Republicans (REP); Patriots for Germany (Patrioten); German People's Union (DVU); The Right (DR); German Social Union (DSU); Bayernpartei (BP)
	L	The Left (LINKE); Party of Democratic Socialism (PDS); Communist Party of Germany (KPD); Marxist-Leninist Party of Germany (MLPD); League of West German Communists (BWK); German Communist Party; Socialist Equality Party (SGP); Spartacist Workers' Party (SpAD)
Italy	R	Brothers of Italy (FDICN); Casa Pound (CAPI); Italian Social Movement (MSIDN); National Alliance (ANA); New Force (FNU); No Euro (NEUR); Northern League (LN); Lombarda League (LLO); Veneta League (LVE);Piemont Autonomia Regionale (PIEAR); Social Alternative(ASM); The Freedomites (DF); The Right(LDES); Tricolour Flame (FT); Fronte Nazionale; Alternativa Sociale; Movimento Idea Sociale; Io Amo l'Italia; Io Sud; Wahlverband des Heimatbundes; Südtiroler Heimatbund; Freiheitliche Partei Südtirols; Union für Südtirol; Süd-Tiroler Freiheit; Valli Unite; L'Alto Adige nel Cuore; SOS Italia; Lega Padana Lombardia; Autonomie per l'Europa; Lega Padana; Destre Unite; Lega d'Azione Meridionale; Noi con Salvini; Lega Sardegna; Lega Sarda; Nello Musumeci Presidente; Sovranita
	L	Civil Revolution (RC); Communist Refoundation Party (PRC); Critical Left (SINC); Communist Worker's Party (PCDL); Party of Italian Communists (PDCI); Party of Proletarian Unity for Communism (PDUP); Five Star Movement (M5S); Anticapitalist Left (SA); Un'Altra Regione; La Sinistra della Libertà; L'Altra Europa con Tsipras; Nuova Sinistra; Democrazia Proletaria; Lega Socialista Rivoluzionaria; Lega Comunista Rivoluzionaria; Sardegna Natzione; Alleanza Lombarda Autonomia; L'Altra Europa con Tsipras; La Sinistra-L'Arcobaleno; Independentia Repubrica de Sardigna; Sinistra Ecologia Libertà; Partito di Alternativa Comunista

Notes: This classification is combines the classification from Massetti and Schakel (2015), Funke, Schularick, and Trebesch (2016), and Algan et al. (2017) and their sources.

Table 2.B.2. List of far right (R) and far left (L) parties since 1980 for Italy and Spain

Country	Party	Party name (Code)
Portugal	R	National Renovator Party (PNR); People's Monarchist Party (PPM); New Democracy Party (PND); Christian Democratic Party (PDC,PPV,CDC)
	L	Democratic Unitarian Coalition (CDU); Left Bloc (BE); Left Revolutionary Front (FER); People's Democratic Union (UDP); People's Socialist Front (FSP); Portuguese Communist Party (PCP); Portuguese Workers' Communist Party (PCTP); Revolutionary Socialist Party (PSR); United People Alliance (APU); Re-Organized Movement of the Party of the Proletariat (MRPP); Workers Party of Socialist Unity (PT, POUS, MUT); Socialist Alternative Movement (MAS); Portuguese Labour Party (PTP); Movement of the Party of the Proletariat (MRPP); Internationalist Communist League (LCI); Movement of Socialist Left (MES); Marxist–Leninist Communist Organization (OCMLP); Revolutionary Labor Party (PRT); Left-wing Union for the Socialist Democracy (UEDS)
Spain	R	Basque Nationalists (EAJ-PNV); Falange Española (FE); Vox; Fuerza Nueva; Democracia Ourensana; Democracia Nacional; Partido Familia y Vida; Identidad Española; Partido Nacionalista Cantabro; Partido Democrata Español; Plataforma per Catalunya; Movimiento Social Republicano; Grupo Independiente Liberal; Alternative Española; España 2000; Plataforma España 2000; Coalicio Valenciana; Unió Valencia; Partido Nacional de los Trabajadores; Frente Nacional-MSR; Juntas Españolas; Movimiento Catolico Español; Estado Nacional Europeo; Partido Union Nacional; Solidaridad Española

Notes: This classification combines the classification from Massetti and Schakel (2015), Funke, Schularick, and Trebesch (2016), and Algan et al. (2017) and their sources.

Table 2.B.3. List of far right (R) and far left (L) parties since 1980 for Spain

Country	Party	Party name (Code)
Spain	L	Communist Party of Spain (PCE); Communist Party of Spain (Marxist–Leninist) (PCEML); Unified Socialist Party of Catalonia (PSUC-PCE); United Left (IU); Podemos (PODEMOS); Galician Nationalistic Bloc (BNG); Workers' Party of Marxist Unification (POUM); Esquerda Galega; Partido Socialista Galego; Izquierda de los Pueblos; En Marea; Frente Popular Galego; Liga Comunista Revolucionaria; P. Comunis de Galicia Mar-Rev; Partido Socialista de los Trabajadores; Movimiento Comunista; Assembleia Do Povo Unido; Coalición por un nuevo Partido Socialista; Nós-Unidade Popular; Partido Socialista; Partido Comunista Obrero Español; Unificacion Comunista De España; Accion Republicana; Mesa Para La Unidad De Los Comunistas; Partido Comunista de los pueblos de España; Euskal Komunistak; Partido de los Trabajadores de Espana-Unidad Comunista; Nación Andaluza; Izquierda Andaluza; Recortes Cero; Adelante Andalucia; Partido Comunista Aragonés; Unidad Popular Republicana; Coalición Lucha Popular; Coalición Unión Pueblo Canario; Frente Popular De Canarias; Awañac; Más Madrid; Congreso Nacional de Canarias; Izquierda Nacionalista Canaria; Iniciativa Canaria; Coalición Canaria por la Independencia; Agrupación Electoral Izquierda Cantabria Unida; Partido Obrero Socialista Internacionalista; Izquierda Castellana; Alternativa Socialista; Coalició d'Esquerra d'Alliberament Nacional-Unitat Popular; Nacionalistes d'Esquerra; Partit Comunista Obrer de Catalunya; Coalición Unidad Comunista; Unitat Popular Socialisme; Partit Socialista Unificat de Catalunya; Candidatura d'Unitat Popular Alternativa d'Esquerres; Partido de los Obreros Revolucionarios de Espana; Partit dels Comunistes de Catalunya; Iniciativa Per Catalunya Verds; Lucha Internacionalista; Catalunya Sí que es Pot; Partido Socialista del Pueblo de Ceuta; Liga Comunista; Plataforma de Izquierdas; Agrupación Electores AUZOLAN; Euskadiko Ezkerra; Herri Batasuna; Partido Carlista; Amaiur; Union Navarra De Izquierda; Batzarre; Euskal Herritarrok; Aralar; Nafarroa Bai; Euskal Herria Bildu; Geroa Bai; Esquerra Nacionalista Valenciana; Bloque Popular Extremadura; Partit Socialista de Menorca; Partit Socialista de Mallorca; Entesa de l'Esquerra de Menorca; PSM-Nacionalistes de les Illes; Més per Menorca; Ensame Nacionalista Astur; Eusko Alkartasuna; Partido Comunista de las Tierras Vascas; Anticapitalistas; Partido Obrero Revolucionario; Organizacion Revolucionaria De Los Trabajadores; Partido de los Trabajadores de Euskadi; Movimiento Comunista; Partit Revolucionari dels Treballadors; Partido del Trabajo de España; Unidá Nacionalista Asturiana; Candidatura De Unidad Comunista; Los Pueblos Deciden; Mesa Para La Unidad De Los Comunistas; Izquierda Anticapitalista Revolucionaria
Sweden	R	New Democracy (NYD); National Democrats (ND); Sweden Democrats (SD,SVD); National Socialist Front (NSF); Progress Party (FRA,FRP); Party of the Swedes (SVP) Scania Party (SKAP,SP); Nordic Resistance Movement (NMR); European Worker's Party (EAP)
	L	Communist Party of Sweden (SKP); Communist League Marxists-Leninists (KFML); Communist League Marxist–Leninists (KPMLR); Workers' Party – The Communists (APK) Communists (KOM); National Communist Party (NKP); Socialist Justice Party (RS) The Left Party (V); Socialist Party (SOP, SOC)

Notes: This classification combines the classification from Massetti and Schakel (2015), Funke, Schularick, and Trebesch (2016), and Algan et al. (2017) and their sources.

Appendix 2.C Results Appendix

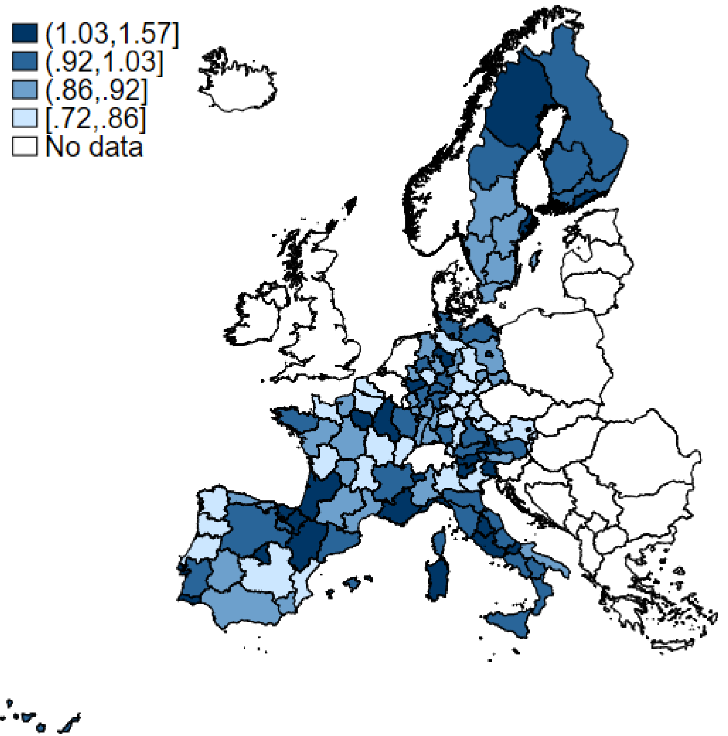


Figure 2.C.1. Sample regions and the share s_i. The figure depicts the map of European NUTS 2 regions with the share s_i used in Bartik instrument construction.

Table 2.C.1. Response of far vote share: Robustness dropping one country at the time

	Impact	1 Year	2 Years	3 Years	4 Years
Baseline	1.54***	2.79***	3.01***	2.94***	2.79***
	(0.30)	(0.56)	(0.55)	(0.55)	(0.56)
Austria	1.66***	3.02***	3.26***	3.21***	3.12***
	(0.32)	(0.59)	(0.57)	(0.57)	(0.56)
Finland	1.57***	2.84***	3.08***	3.07***	3.03***
	(0.30)	(0.56)	(0.55)	(0.54)	(0.54)
France	1.27***	2.36***	2.53***	2.34***	2.50***
	(0.28)	(0.52)	(0.48)	(0.47)	(0.55)
Germany	1.63***	2.81***	3.24***	3.23***	3.05***
	(0.33)	(0.61)	(0.62)	(0.62)	(0.63)
Italy	0.45***	0.63***	0.81***	1.14***	0.92**
	(0.16)	(0.24)	(0.25)	(0.30)	(0.47)
Portugal	1.96***	3.53***	3.67***	3.66***	3.13***
	(0.35)	(0.66)	(0.64)	(0.63)	(0.63)
Spain	2.39***	4.49***	4.59***	4.22***	4.07***
	(0.54)	(0.98)	(0.94)	(1.00)	(0.97)
Sweden	1.47***	2.70***	2.86***	2.80***	2.58***
	(0.30)	(0.56)	(0.54)	(0.53)	(0.55)
Italy and Spain	0.76*	1.25**	0.96	0.92	0.36
	(0.42)	(0.59)	(0.61)	(0.67)	(1.44)

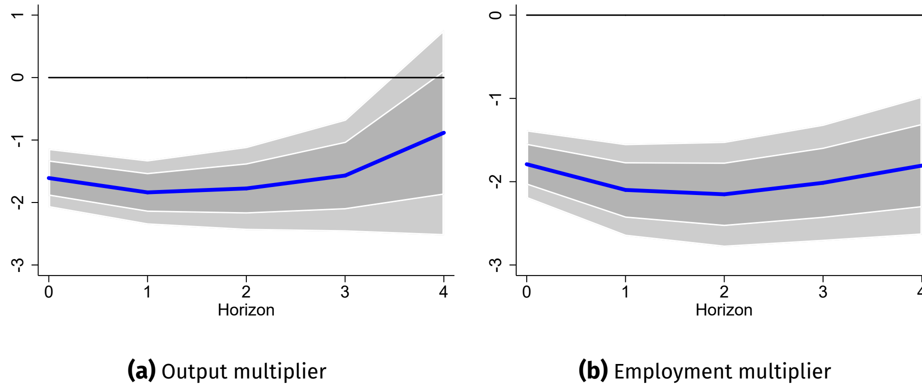
Notes: This table shows the response of extreme vote share to an austerity-induced fiscal spending shock using the baseline specification but excluding individual countries iteratively from the base sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix 2.D Output and employment multipliers

In estimating output and employment government spending multipliers, we follow Gabriel, Klein, and Pessoa (2021) but use the identification strategy from the baseline analysis described in Section 2.3. We use local projections (Jordà, 2005) and estimate for each horizon $h = 0, \ldots, 4$, the following equation:

$$\sum_{m=0}^{h} z_{i,t+m} = \beta_h \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h(L)X_{i,t-k} + \alpha_{i,h} + \varepsilon_{i,t+m}, \qquad (2.D.1)$$

where $z_{i,t+m}$ is either the change in real per capita GDP, $\frac{Y_{i,t+m}-Y_{i,t-1}}{Y_{i,t-1}}$, or the change in the employment rate, $\frac{E_{i,t+m}-E_{i,t-1}}{E_{i,t-1}}$, in region i between time $t-1$ and time $t+m$. $(L)X_{i,t-k}$ is a vector of control variables with $k = 2$, including lags of the dependent variable and of GDP and government spending growth, and $\alpha_{i,h}$ are region fixed-effects. Figure 2.D.1 depicts the cumulative GDP and employment multipliers, where the solid lines show the point estimate β_h over a horizon of four years and the dark and light shadings are 68% and 90% confidence bands, respectively. Standard errors are clustered at the regional level.



(a) Output multiplier **(b)** Employment multiplier

Figure 2.D.1. Output and employment multipliers. Panels 2.D.1a and 2.D.1b show the cumulative relative fiscal and employment multipliers estimated according to Equation (2.D.1). Shaded areas are 68% (dark) and 90% (light) confidence intervals.

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Chapter 3

Earnings Dynamics in Germany

3.1 Introduction

Earnings risk affects important decisions, including consumption, savings, and labor supply. Households can, on the one hand, self-insure against earnings shocks by adjusting savings and labor supply (of both head and spouse), but also benefit from public insurance through taxes and transfers, which can complement or replace the need to self-insure. Thus, earnings dynamics play a key role in models of household behavior which are important tools for macroeconomics research. A common approach of these models is to focus on uniform income processes so that all agents face the same income shocks. Recent empirical work with newly available micro data documents significant deviations of labor earnings changes from standard assumptions of normality and linearity for the United States (Guvenen, Karahan, Ozkan, and Song, 2021). This paper contributes to this literature by studying the distribution and dynamics of earnings shocks in Germany and the role of insurance mechanisms against them.

I start by characterizing the distribution of earnings growth at the individual level and documenting distributional measures of earnings changes, including the standard deviation, skewness, kurtosis, and persistence over the life-cycle and along

* I thank the participants and discussants at the 11th ifo Conference on Macroeconomics and Survey Data, the Workshop on Labour Economics 2021, the International Conference on Household Finance, the 2021 Meeting of SEHO for their feedback and suggestions, the Ninth ECINEQ Meeting, EEA-ESEM 2021, EALE conference 2021, and Giorgio Rota Conference 2022. I also thank the Research Data Lab of the German Federal Statistical Agency and in particular Maurice Brandt and Hannes Fauser for his continuous support to data access. I acknowledge financial support from from the Fundação para a Ciência e Tecnologia (projects references SFRH/BD/144820/2019), the CRC TR 224 (Project A03), the Deutsche Forschungsgemeinschaft (German Research Foundation) under Germany's Excellence Strategy (EXC 2126/1 - 390838866) and under the RTG 2281 - The Macroeconomics of Inequality.

the earnings distribution. Then, motivated by the importance of extreme observations for deviations from normality, I examine the contribution of hours and wages for large earnings changes as well as the role of some life-cycle and employment events in explaining large earnings fluctuations. Finally, given that for households the risk of disposable income is more relevant than the earnings risk itself, this paper also assesses whether families and the welfare system can provide any insurance against individuals' earnings risk. To examine the role of family and government insurance, I examine not only the response of household labor earnings and total income net of taxes and transfers following changes in individual earnings experienced by the head, but also study the distribution of household income, pre- and post-taxes, and transfers.

For this analysis, I use administrative data from the German Taxpayer Panel consisting of tax records from 2001 to 2016. It contains information on individual and household income, taxes, transfers, and some demographic characteristics. Given that the data is not censored, it contains the very top earners. It allows precise estimates of the dynamics of earnings shocks as well as studying the role of family and government insurance. I supplement the analysis using survey data from the German Socio-Economic Panel as, unlike the Taxpayer Panel, it contains information about total hours worked and more details on life-cycle events. Provided that the nature of the deviations from normality and linearity is difficult to anticipate, I take on a non-parametric approach to characterize the earnings dynamics in Germany.

I find strong deviations from normality and salient heterogeneities in the distribution and dynamics of earnings changes across age groups and along the earnings distribution. First, the distribution of earnings growth is more dispersed for the young and poor workers and more negatively skewed and leptokurtic for older and richer workers. Yet, when excluding the tails of the distribution and analyzing outlier robust measures for the second and third moments, the distribution becomes negatively skewed only for the 45-54 age group and more leptokurtic for the workers at the bottom half of the distribution. Furthermore, decomposing labor earnings shows that deviations from normality, such as excess kurtosis, are also present in the distributions of hours and wage changes.

Moreover, I find that there are clear asymmetries in the mean reversion of earnings shocks that are not compatible with frequent modeling choices of earnings dynamics, like AR(1) processes. For poor workers, negative shocks are transitory and positive changes are permanent. However, as we move to the top of the earnings distribution, negative shocks become more permanent and positive more transitory. The hours' growth dynamics mainly drive this non-linearity in mean reversion since wage dynamics are close to linear.

Secondly, the drivers of large earnings swings differ over the earnings distribution. The role of wage and hours changes is highly dependent on the sign of the change and earnings history of the workers. Small labor earnings changes are mainly driven by wages. Large income changes experienced by poor workers are driven by

a mix of hours and wage changes, which is consistent with unemployment spells and job switches. However, as we move up the earnings distribution, wage growth becomes considerably more relevant than hours, highlighting the job stability of the top earners.

Finally, I quantify the role of families and the welfare system in attenuating individual earnings changes across income groups. On average, spouses' labor supply remains unchanged after a change in the heads' earnings, which implies that families' ability to self-insure against income risk is solely driven by income pooling. On the other hand, the German government is able to provide considerable insurance as taxes and transfers significantly reduce the pass-through of large individual earnings shocks to the household level, especially for the bottom earners. In addition, accounting for taxes and transfers attenuates the heterogeneities and deviations from log-normality documented for the male earnings growth distribution.

This paper directly contributes to the fast-growing literature on earnings dynamics using non-parametric methods initiated by Guvenen, Karahan, et al. (2021) for the United States. The authors use a large administrative dataset to document significant deviations of earnings changes from a normal distribution and strong state-dependencies in earnings dynamics with respect to the income level and age of the workers. This approach has been followed, among others, by Pora and Wilner (2020), Halvorsen, Holter, Ozkan, and Storesletten (2020), and De Nardi, Fella, Knoef, Paz-Pardo, and Van Ooijen (2021) for European countries, who have further studied the causes and consequences of the documented earnings dynamics. Halvorsen et al. (2020) investigate the determinants of these non-normalities for Norway by dissecting earnings into wages and hours. De Nardi, Fella, Knoef, et al. (2021) have further studied the life-cycle dynamics of household earnings, pre- and post-tax income and the role of welfare systems to attenuate individual earnings changes for the Netherlands and the United States.

This study is broadly related to the literature, influenced by the seminal work by Guvenen, Ozkan, and Song (2014), that investigates the evolution of the income risk and inequality over time with special focus on the role of business cycles (Busch, Domeij, Guvenen, and Madera, 2018; Hoffmann and Malacrino, 2019; Pruitt and Turner, 2020; Friedrich, Laun, and Meghir, 2021; Drechsel-Grau, Peichl, Schmieder, Schmid, Walz, et al., 2022). Drechsel-Grau et al. (2022) provide a broad analysis of income inequality and income dynamics for Germany over the last two decades using tax and social security records. The authors find that the cross-sectional income inequality rose continuously until 2009 for both genders, but since then, has been increasing only for males. Moreover, men's earnings changes are on average smaller than women's but substantially more affected by business cycle fluctuations. Drechsel-Grau et al. (2022) also document that except for recession periods, the distribution of earnings changes is right-skewed, which goes in the direction of my results when using Kelley's skewness measure.

Using German Social Security data, Busch et al. (2018) find that the skewness of individual income growth is procyclical, while the variance is cyclical with both hours and wage margins being important. Regarding the role of the second earner and the welfare system, the authors find that household smoothing does not effectively mitigate skewness fluctuations but tax-and-transfer policies do. Evidence from survey data by Bartels and Bönke (2013) also suggests that taking into account institutions of the welfare state and risk-sharing households decreases transitory and permanent variances of net household income, even though over time both have remained fairly stable.

However, this is the first comprehensive study of the earnings income process and dynamics for Germany, which focuses not only on characterizing the distribution and persistence of labor earnings changes but also links them back to its drivers, life-cycle events, and sources of insurance against individual earnings changes by analyzing the dynamics of household income. Moreover, this paper uses German tax records which present a significant improvement relative to other available data sources for Germany. For example, these data allow not only studying the income process of the very top earners but also analyzing household dynamics of couples that file taxes together. Given the granularity of the data, this study goes beyond studying labor earnings and also analyses the role of other disposable income sources as transfers from the government.

The remainder of the paper proceeds as follows. Section 3.2 describes the data and approach. Sections 3.3, 3.4, and 3.5 present the results. Section 3.3 characterizes the distribution of earnings changes and the asymmetric mean reversion patterns of earnings dynamics, while Section 3.4 discusses the sources of the non-normalities documented. Section 3.5 investigates the role of household and government insurance in mitigating individual income risk and attenuating the deviations from normality present in male earnings changes. Finally, Section 3.6 concludes.

3.2 Data and Variable Construction

3.2.1 Data

The German Taxpayer Panel (TPP) and Socio-Economic Panel (SOEP) are the main databases used in the analysis. The TPP is an administrative dataset collected by German tax authorities, provided and administered by the German Federal Statistical Office, based on the universe of personal income tax returns. The unit of observation is the taxpayer, i.e., either a single individual or a couple filing taxes jointly.[1] It includes a detailed decomposition of income into labor earnings and asset income and

1. In the case of joint filing, income is still reported at the individual level, that is, separately for the head and spouse. It is not possible to link couples who deliver separate tax forms.

contains data on taxable income, allowances and special benefits, taxes, and transfers. Furthermore, it provides demographic information about individual taxpayers and households such as gender, year of birth, and the number of children.

Annual individual labor income is the main variable used in the analysis and it is computed as the sum of total wage income and a labor share of self-employment income. The total household labor earnings, total income, and income net of taxes and transfers are then used in Section 3.5. I use a 5% representative sample from 2001 until 2016 and employ the respective weights provided by the German Federal Statistical Office.

Given the design of the data, the measurement error is much lower than in survey data where earnings are self-reported. The TPP has nonetheless some caveats. First, given that tax filing is mostly optional, low-income taxpayers are likely to be non-filers and therefore to be misrepresented in the sample (Hauck and Wallossek, 2020). However, there are certain cases in which filing tax returns is strongly beneficial or even mandatory, for example, when taxpayers have other income sources for which taxes are not or only partially withheld. This allows good coverage of the German population with some labor market attachment, which is the primary focus of this analysis.[2] The second caveat is that the dataset does not contain information about the number of hours worked which would be important to understand the drivers of income swings. Finally, since 2005, some important social assistance transfers, like unemployment, maternity, or sickness benefits, are reported together and thus, the individual amounts from different social programs cannot be recovered.

To overcome these last limitations, I supplement the analysis with survey data from the German SOEP. This survey has been running annually since 1984 and interviewing nearly 15,000 households and about 30,000 persons. It contains detailed information about labor status, income statements, and demographics. Importantly, it also asks exhaustive questions about life events and employment experiences like job changes and unemployment.

3.2.2 Sample Selection

The base sample is a panel consisting of males with some labor market attachment and it is designed to maximize the sample size which is important for precise computation of higher-order moments in finely defined groups. The baseline sample is composed only of males between 25 and 54 to abstract from education and retirement decisions.

Moreover, an observation is included only if earnings are above a minimum income threshold defined as 5% of each year's median labor earnings. The panel for year t then selects individuals that are admissible in $t-1$ and at least in $t-2$ or $t-3$.

2. See Hauck and Wallossek (2020) for more detail on tax return (non-)filers.

This ensures consistent labor market participation and that an accurate measure of recent earnings - a variable that is described next - can be computed. [3]

3.2.3 Variable Construction

Recent Earnings

I now define “recent earnings" (RE), a term that will be used throughout the paper. For a given worker i, RE $\bar{Y}^i_{t-1}$ are computed between $t-1$ and $t-3$ as follows:

$$\bar{Y}^i_{t-1} \equiv \sum_{\{k=1\}}^{3} \frac{Y^i_{t-k,h-k}}{exp(d_{t-k,h-k})}$$

where $Y^i_{t,h}$ denotes the labor earnings of individual i who is h years old in year t. To control for age and year effects, $d_{t,h}$ denotes average earnings obtained by regressing log individual earnings on a set of age and year dummies. Next, workers are grouped by gender and age in $t-1$ and, within each group, ranked into 10 deciles with respect to their recent earnings $\bar{Y}^i_{t-1}$.

Growth Rate Measures

I compute income changes up to the five years, which is useful to distinguish between income growth over short (1-year change) and long (5-year change) horizons to study “transitory" and “persistent" earnings changes. For each $k = 1, ..., 5$, the k-year log change of earnings net of age and year effects is defined as:

$$\Delta_k \tilde{y}_{i,t} = \tilde{y}^i_{t+k,h+k} - \tilde{y}^i_{t,h} = (y^i_{t+k,h+k} - d^z_{t+k,h+k}) - (y^i_{t,h} - d^z_{t,h})$$

where $y^i_{t,h} \equiv log(Y^i_{t,h})$ is the log of labor earnings and $\tilde{y}^i_{t,h}$ is the log of earnings net of age and year effects.

3.3 Distribution of Earnings Growth

Figure 3.3.1a displays the distribution of one-year labor earnings growth for male workers in the base sample, along with Gaussian densities chosen to have the same standard deviation as in the data. The distribution features left skewness and excess kurtosis relative to a Gaussian density characterized by having no skewness and kurtosis of 3. The negative skewness indicates that there are more positive earnings changes than negative ones but while labor income increases are mostly very small, the long left-tail suggests that there are more large income drops than large rises. The excess kurtosis reveals that most changes are very small but that from time to time, there are very large ones.

3. To avoid possible outliers driven by self-reported data, the observations at the top 1% of labor earnings distribution in the SOEP are excluded.

This section studies in more detail the distribution of one-year earnings growth for German male workers by documenting its second, third, and fourth moments over the life-cycle and along the RE distribution. [4]

3.3.1 Empirical Methodology

The main goal of this section is to document heterogeneities of higher-order moments of earnings growth with respect to RE and age. To this end, for each year t, individuals are divided into three groups based on their age in year $t-1$ and then, within each age group, they are sorted into ten deciles by their RE. If these groupings are done at a sufficiently fine level, we can think of all individuals within a given age/RE group to be ex-ante identical or at least very similar. Then, for each such group, the cross-sectional moments of earnings growth between t and $t+k$ can be viewed as the properties of earnings changes that workers within that group expect to face looking ahead.

The figures that follow plot, for each age/RE group, the average moments between 2004 and $2016-k$. This approach allows computing higher-order moments precisely because each bin contains a large number of observations, especially for administrative data like the taxpayer panel. In what follows, the conventional second to fourth moments of earnings changes are reported together with outlier robust measures of skewness and kurtosis. In particular, the Kelley coefficient of skewness (Kelley, 1947) is given by:

$$\text{Kelley Skewness} = \frac{(P_{90} - P_{50}) - (P_{50} - P_{10})}{P_{90} - P_{10}}$$

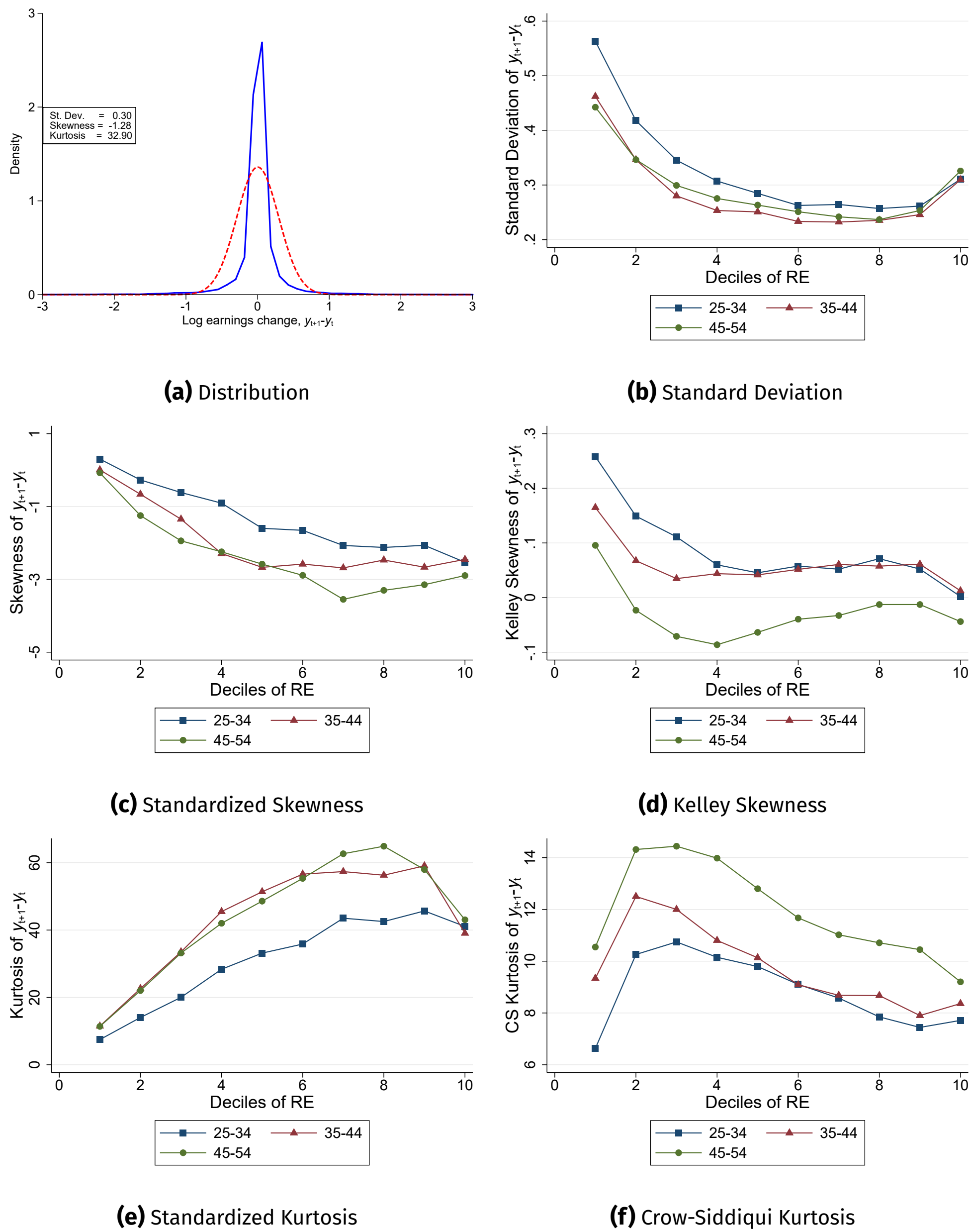
where a zero implies a symmetric distribution, positive values represent right skewness, and negative values represent left skewness.

Concerning kurtosis, Crow-Siddiqui (CS) measure (Crow and Siddiqui, 1967) is also less sensitive to outliers than the centered fourth moment and can be computed as follows:

$$\text{CS Kurtosis} = \frac{P_{97.5} - P_{2.5}}{P_{75} - P_{25}}$$

CS Kurtosis is high if $P_{97.5} - P_{2.5}$ is large relative to the probability mass that is concentrated between the 75th and the 25th percentiles, indicating the existence of heavy tails.

4. Appendix 3.B and 3.C show the results five-year earnings changes and female workers, respectively.



(a) Distribution

(b) Standard Deviation

(c) Standardized Skewness

(d) Kelley Skewness

(e) Standardized Kurtosis

(f) Crow-Siddiqui Kurtosis

Figure 3.3.1. Distribution of one-year earnings growth. Panel 3.3.1a depicts the empirical densities of one-year earnings changes along with Gaussian densities with the same standard deviation as the data. Data is from 2011 German tax records and only male workers between 25 and 54 years old are included. The remaining panels show the cross-sectional moments of one-year labor earnings growth of male workers over the life-cycle.

3.3.2 Cross-Sectional Moments of Male Earnings Growth

Second Moment: Variance

Figure 3.3.1b shows that the standard deviation of earnings changes is U-shaped along the RE distribution. Earnings changes are more than twice as dispersed for workers at the lowest percentiles of RE than for workers around the median. There are also significant differences in earnings volatility over the life cycle, especially for bottom earners, with young workers experiencing the largest volatility. This is in line with the results by Bönke, Giesecke, and Lüthen (2019) who, applying other methods and using data from the SOEP, show that younger cohorts face higher total earnings variance. Panel 3.3.1b shows this is the case up to the 90th percentile.

Despite the higher volatility, earnings changes persistence is smaller at the beginning of the working life. Figure 3.A.1 in the appendix shows that there is significant age variation in the persistence of labor earnings changes, unlike typically assumed by standard AR(1) processes. Earnings persistence starts from a value just above 0.7 at age 27, consistent with younger people switching jobs and careers frequently without a permanent impact on their labor income. It then increases fast, reaching 0.9 at age 40, where it stabilizes. This evidence indicates that shocks to labor earnings at younger ages are not as long-lived as at older ages.

Figure 3.C.2 in the appendix depicts the cross-sectional moments that characterize the distribution of one-year labor earnings changes for female workers. Relative to men, females' distribution presents even deeper life-cycle differences with changes being more dispersed for younger women. This is potentially associated with maternity as discussed later in Section 3.4.2.

Third Moment: Skewness

Figure 3.3.1c plots the centralized third moment over the life-cycle and RE distribution. Skewness starts around zero at low levels of RE but becomes negative as the income level increases, meaning that experiencing very large income declines becomes more likely than seeing a large increase. This seems to imply that the higher the RE, the more room for earnings to fall and the less room for rises. Figure 3.3.1c also shows that the distribution is more negatively skewed for older workers which supports the idea that younger workers are still climbing up the job ladder and therefore, are less likely to experience very large income drops.

The conventional centered measure of skewness can be very sensitive to the existence of long tails. Thus, Figure 3.3.1d plots the Kelley measure of skewness for labor earnings changes which is robust to outliers. It is very close to zero, slightly positive for the younger age groups and marginally negative for most deciles of the oldest group of workers. This indicates that the distribution of earnings changes is almost symmetric outside the tails of the distribution.

One important question is whether skewness becomes more negative over the life cycle because of compression of the upper tail (fewer opportunities for large

gains) or because of an expansion in the lower tail (higher risk of large declines). Figure 3.A.2 in the appendix plots the P90-P50 and P50-P10 for different age groups. With the exception of the top RE deciles, it shows compression of both upper and lower tails over the life cycle. However, since P90-P50 changes more between age groups than P50-P10, the upper tail compresses more strongly, implying that this result is mainly driven by fewer large gains. This figure documents an expansion of the lower tail and an increase in the risk of large declines only for top earners.

Regarding the distribution of female earnings growth, Figure 3.C.2 documents strong differences in the level and patterns of skewness for females relative to males. Life-cycle and RE heterogeneities are even more salient for women. Moreover, when excluding the tails, skewness is negative only for younger females, indicating they are more likely to experience very large negative changes than very large positive ones. This contrasts with the pattern documented for young German males and suggests that young women are more likely to experience very large earnings drops, possibly driven by periods of leave, job changes, or switches to part-time occupations related to maternity as discussed in Section 3.4.2.

Figure 3.3.1e shows that the distribution of earnings changes features excess kurtosis implying that, even though most changes are very small, there are some large income swings at the tails. Moreover, the kurtosis of earnings growth has an inverted-U shape that is especially striking for prime-aged workers. Thus, kurtosis is increasing with previous earnings up to the 7th or 8th decile indicating that changes become less frequent but larger at these percentiles of RE. Kurtosis is larger for older than for younger workers, even though this difference is more salient only for middle-class earners.

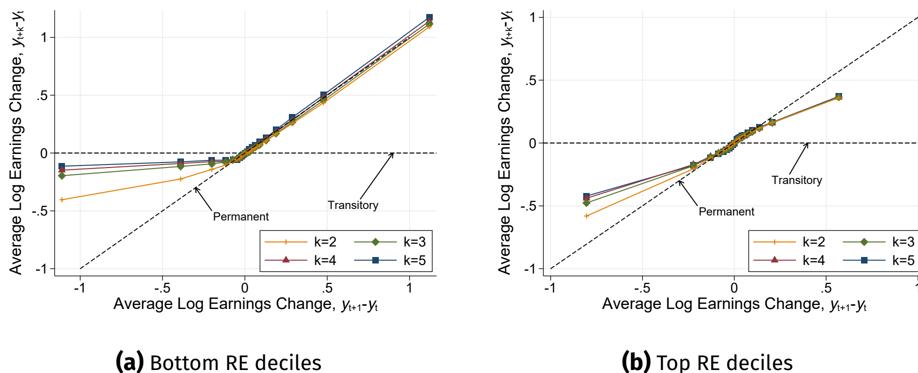
Since kurtosis can be sensitive to extreme observations, Figure 3.3.1f plots a version of kurtosis that is outlier robust and shows that indeed a considerable part of excess kurtosis can be explained by the changes at the tails. Crow-Siddiqui kurtosis is still significantly larger for older workers but it is now higher for workers at the bottom half of the distribution.

For females, the estimated kurtosis for the distribution of earnings growth varies more over the life-cycle than for males (Figure 3.C.2). These patterns are similar to the evidence provided for Norway by Halvorsen et al. (2020) but contrast with the results for the UK by De Nardi, Fella, and Paz-Pardo (2021), for which age differences are less striking. In particular, after excluding possible outliers, kurtosis remains particularly high for the group of young females between 25 and 34. This pattern differs from what panel 3.3.1f shows for young males and highlights the idea that young female workers are a particularly vulnerable group when it comes to experiencing large labor earnings swings.

3.3.3 Earnings Dynamics

Earnings dynamics are frequently modeled as simple AR(1) or low-order ARMA which impose strong assumptions on income processes as, for example, uniformity of mean reversion. This section examines the mean reversion patterns of the earnings, wages, and hours changes and their dependencies on the level of income, size and sign of the changes. In particular, to describe the mean reversion patterns of earnings growth, I estimate their non-parametric impulse responses conditional on workers' RE, size and sign of the change. In particular, within each RE group, workers are sorted by the size of their log earnings change between t and $t+1$ and grouped into twenty equally-sized quantiles. Hence, all individuals within a group have similar earnings history and experience a similar earnings change from t to $t+1$ and thus, such finely defined group can be treated as homogeneous. [5]

Figure 3.3.2 shows the response of positive and negative earnings changes of different sizes conditional on the workers RE. In particular, it plots the average earnings change after up to five years against the initial change in labor earnings. The x-axis represents the initial average log change $y^i_{t+1} - y^i_t$ for each RE group of workers, sorted by the size of their earnings shock. The y-axis plots the average log change of earnings from t to $t+k$, where $k = 2, ..., 5$.



(a) Bottom RE deciles

(b) Top RE deciles

Figure 3.3.2. Persistence of labor earnings changes by RE decile. The figure displays the k-year average log change of annual labor earnings for 20 different groups of male workers in the bottom (first and second) and top (ninth and tenth) RE deciles, plotted against their contemporaneous one-year average log change in annual labor earnings. Figure 3.A.5 in the appendix shows the results for the median RE deciles.

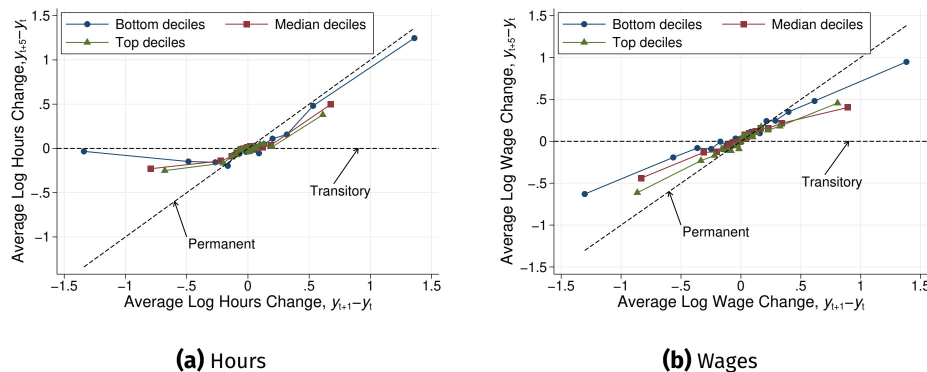
Importantly, Figure 3.3.2 indicates that there are strong asymmetries depending on the sign of the change and along the distribution of RE. Positive earnings changes are close to permanent, especially for bottom earners. Earnings drops are

5. For this analysis, the entire baseline sample is used but Appendix 3.D presents the results for a sub-sample of prime-aged workers (between 35 and 54 years old).

almost completely transitory for the bottom workers, but more permanent when experienced by those at the top. The results for the median RE deciles are an intermediate case between the bottom and the top earners (Figure 3.A.5).

Figure 3.3.2 also shows that labor earnings shocks are partially reversible within the first two years after the change takes place. Nevertheless, for some cases, a non-negligible fraction of these changes is still present after five years, suggesting a very persistent component in earnings growth. This is particularity true for top earners. Panel 3.3.2b indicates that top RE workers with earnings drops of almost 80 log points recover, on average, less than 50% of the earnings loss in the following five years. This contrasts with the figure for bottom earners - those who experience very large drops recover about 60% of their income within the next year and more than 90% over the next four.

To understand what explains the asymmetric mean reversion pattern of earnings, it is important to study the persistence of hours and wage changes separately. In line with the strategy for labor earnings, conditional on their RE, workers are grouped with respect to their hours or wage growth between t and $t+1$. Using data from the SOEP, Figure 3.3.3 presents, for each group, the average change in hours and wages from t to $t+5$ against their average initial changes.[6] Figure 3.3.3 shows significant differences between hours and wage dynamics.



(a) Hours

(b) Wages

Figure 3.3.3. Persistence of hours and wages changes. The figure displays the five-year average change in hours and wages for 20 different groups of male workers in the bottom (first and second), median (fifth and sixth), and top (ninth and tenth) RE deciles, plotted against their respective one-year average change.

Figure 3.3.3a shows that large increases in hours are persistent but large negative changes are more transitory. This indicates that employment tends to last much longer than the duration of unemployment spells. Unlike hours, wage changes are

6. Figure 3.A.6 shows that the patterns documented using the TPP and the SOEP for earnings are very similar, reassuring confidence on the SOEP.

more symmetric and both drops and rises are only partially transitory or persistent (Figure 3.3.3b). This indicates that the non-linear persistence of labor earnings documented in Figure 3.3.2 is mainly driven by the non-linearity of hours changes.

There are also some noticeable differences in the persistence of hours and wage changes across RE groups. As one moves to higher RE deciles, increases in hours and wages become slightly more transitory, while declines become somewhat more persistent. For hours, this evidence is consistent with transitions between unemployment and employment being one of the main drivers of income fluctuations for workers at the bottom of the income distribution. This contrasts with the hours and wage fluctuations for other RE groups which are possibly related to more flexible occupations, overtime work, accumulation of tasks, or complex compensation packages which tend to be cyclical and performance related (Parker, Vissing-Jorgensen, et al., 2011).

Overall, these findings suggest that earnings changes in Germany exhibit strong deviations from the assumptions of the canonical income process used in many macroeconomic applications. First, it is commonly assumed that the shocks are normally distributed and age-independent. However, the distribution deviates strongly from normality, varying also over the life-cycle as suggested by high-order moments. Second, the persistence component is assumed to follow a linear process which is at odds with the evidence that the third and fourth moments are dependent on the previous realizations of earnings.

This section provides evidence consistent with job ladder models in which most workers keep their jobs and face very small earnings changes, while few of them become unemployed and experience large earnings drops. Differences over the life-cycle indicate that younger workers are more likely to experience positive earnings changes associated with career switches up, whereas older workers (with long job tenures) are more likely to experience relatively large cuts when they find a new job after displacement. These qualitative properties are in line with findings for other countries like the United States, Norway, and the Netherlands (Halvorsen et al., 2020; De Nardi, Fella, Knoef, et al., 2021; Guvenen, Karahan, et al., 2021).

3.4 Sources of Non-normalities

So far the analysis has focused on the distribution of annual labor earnings changes, but one important question to ask is what are the sources of the deviations from normality and linearity. Motivated by the importance of extreme earnings changes for negative skewness and excess kurtosis and using data from the SOEP, this section

provides evidence on the contribution of hours and wages and the role of life events for large earnings swings experienced by male workers.[7]

3.4.1 Decomposing Earnings Changes

For many economic questions, it is not only important to understand the earnings dynamics but also its sources, that is, if they are induced by hours, wages, or both. To investigate the drivers behind the deviations from normality, this section starts by documenting whether the left skewness and excess kurtosis reported for earnings are also present in the hours and wage growth distributions. Table 3.A.1 documents the non-Gaussian features of one-year changes in earnings, hours, and wages over the life-cycle in the SOEP.[8] It shows that there are significant deviations from normality also in the distributions of both hours and wage changes, especially for older workers. Yet, the distribution of wage growth features less negative skewness and excess kurtosis than those of earnings and hours independently of the age group.

Figure 3.A.3 reports the cross-sectional moments of wage and hours changes along the RE distribution, reinforcing the deviations from normality. Kurtosis is especially higher for hours than for wages, suggesting that hours adjustments are very infrequent but that, when they happen, they tend to be of a large magnitude (plot 3.A.3c). This provides some support for models of life-cycle labor supply where workers' labor supply is inelastic and subject to unemployment shocks or only subject to adjustments of a discrete nature.

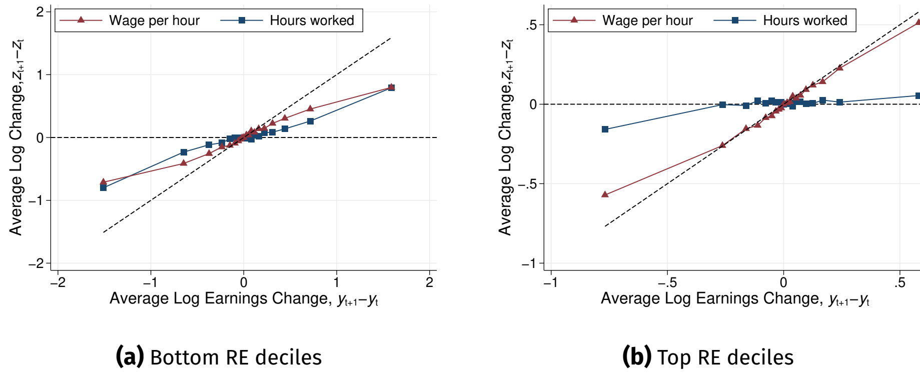
A complementary way of understanding the sources of earnings swings is to dissect them into the contribution of wage and hours changes. While most literature has focused on uniform relations between movements in wages and hours, I now investigate their co-movement for different RE levels and earnings changes of different signs and sizes. Figure 3.4.1 plots, for different groups of workers, the average growth of hours and wages on the y-axis conditional on their average labor earnings growth between t and $t+1$ on the x-axis. For this purpose, on top of conditioning on workers' recent earnings, individuals are grouped according to their earnings growth.[9] In particular, within each RE group, workers are sorted by the size of their log earnings change between t and $t+1$ and grouped into twenty equally-sized quantiles. Hence, all individuals within a group have similar earnings history and

7. Appendix 3.C and Appendix 3.D show the results for females and prime-aged workers, respectively.

8. Consistent with the taxpayer panel evidence, Table 3.A.1 indicates that the distribution of labor income changes is left-skewed and exhibits excess kurtosis, with age patterns that are also in line with those computed using administrative data.

9. Alternatively to conditioning only on the workers' RE, I consider also their age by grouping them into young and prime-age earners, 25-34 and 35-54 years old, respectively. Results remain unchanged and are documented on Figure 3.D.2 in the appendix.

experience a similar earnings change from t to $t+1$ and thus, such finely defined group can be treated as homogeneous. For simplicity, results are documented only for the bottom (first and second) and top (ninth and tenth) RE deciles.[10]



(a) Bottom RE deciles

(b) Top RE deciles

Figure 3.4.1. Contribution of hours and wages to earnings changes. The figure displays the one-year average log change of annual hours and hourly wage for 20 different groups of male workers in the bottom (first and second) and top (ninth and tenth) RE deciles, plotted against their contemporaneous one-year average log change in annual labor earnings. Figure 3.A.4 in the appendix shows the results for the median RE deciles.

Figure 3.4.1 indicates that small earnings changes are mainly driven by wage growth independently of the earnings history. However, for larger labor income swings, there is some heterogeneity with respect to the sign of the change and level of RE. Panel 3.4.1a shows that, for the bottom RE deciles, large income changes (both negative and positive) are driven by a combination of changes in wages and hours. For example, the group of bottom earners whose earnings increased around 160 log points on average experience an increase of about 80 log points in hours and an increase of 80 log points in hourly wages. For the top earners, independently of the size, earnings changes are mainly driven by changes in wage per hour rather than by changes in the number of hours worked (Figure 3.4.1b). The results for the middle deciles are somewhat an intermediate case between the bottom and the top as shown in the appendix (Figure 3.A.4).

These findings imply that, along the RE distribution, different mechanisms account for large earnings swings. Moreover, the heterogeneous role of hours suggests a large unemployment risk for the poor, but consistent job stability for the top earners independently of the earnings change experienced.

10. To control for differences in mean reversion between different groups of workers, the changes on both the x- and y-axes such that their values at the median quantile of $y_{t+1} - y_t$ cross at zero.

3.4.2 The Role of Life Events

A natural question to ask in this context is what are the drivers of large earnings swings and whether some specific life events can account for part of the risk faced by the workers, e.g. job change, a transition to unemployment, a long-term sickness, parental or maternity leaves. Tracing changes in earnings back to the labor market or life events is not merely of interest from a positive perspective but also from a normative perspective as many changes in earnings might not constitute risk from the household perspective but could result from labor market choices (Low, Meghir, and Pistaferri, 2010; Hubmer, 2018).

The analysis starts by splitting, according to their magnitude, one-year earnings changes computed from the administrative data into six groups. Then, Table 3.A.2 documents the share of workers who experience certain life events contemporaneously to these income changes. In particular, with the TPP, it is possible to trace some life and work events as workers having one more child, receiving social assistance, unemployment benefits, and being covered by short-time work schemes. Table 3.A.2 shows that, on the one hand, many workers with large earnings drops experience a contemporaneous increase in social assistance received by the government (which includes unemployment, sickness, and maternity/parental benefits). The opposite is true for workers whose income rises, i.e., their total welfare benefits received decrease on average when labor earnings increase. On the other hand, becoming handicapped or having more children are only marginally relevant in accounting for the earnings changes experienced by male workers in Germany.

To shed more light on the role of specific life and employment events for which the TPP does not provide sufficient detail, the German SOEP is used in analogous way. In particular, the SOEP contains detailed data about job changes and labor status transitions. Similar to the evidence from the administrative data, Tables 3.4.1 and 3.4.2 present the share of workers who experienced certain events contemporaneously to large, medium, and small negative or positive income changes, respectively.

Job changes are the main driver of earnings decreases for male workers in Germany - more than 26% of the workers who experience large income drops, change their job (column (1) of Table 3.4.1). Compared to the workers with small earnings changes represented in the third column of the table, they are four times more likely to transition between jobs. Moreover, 15% of the workers with large earnings cuts were forced to change their job either because the employment contract was terminated by the employer, the company closed down or the temporary employment tie was not renovated. Halvorsen et al. (2020) and Guvenen, Karahan, et al. (2021) find for Norway and the U.S. significant differences in the distribution of earnings changes for job stayers and job switchers. While for skewness their results differ, both find that annual earnings changes for switchers tend to be substantially more dispersed and less leptokurtic than those for stayers.

Table 3.4.1. Negative income shocks and life-cycle events

	One-year earnings change, $\Delta y \in$		
	< -1	$[-1, -0.25)$	$[-0.25, 0)$
	(1)	(2)	(3)
Into non-employment	22.80	10.65	1.82
Into unemployment	16.53	7.54	1.22
Into regular part-time	1.48	1.66	0.58
Changed job	26.54	16.71	6.66
Involuntary changes	16.46	12.15	2.83
Due to parental leave	0.25	0.28	0.09
Change no. of children	3.45	4.10	4.03
Lost second job	4.09	4.36	3.06
Into disability	4.02	1.93	1.08
Share (%)	1.90	8.41	36.14
$E\,\Delta^1_{log} y^i_t$	-1.64	-0.47	-0.07
$E\,\Delta^1_{log} w^i_t$	-0.81	-0.34	-0.07
$E\,\Delta^1_{log} h^i_t$	-0.82	-0.12	-0.01
$E\,\Delta^5_{log} y^i_t$	-0.31	-0.20	-0.04
$E\,\Delta^5_{log} w^i_t$	-0.27	-0.19	-0.01
$E\,\Delta^5_{log} h^i_t$	-0.02	-0.02	-0.03

Notes: Part-time worker accounts only for regular part-time employment. Individuals are considered unemployed if are not working and are registered unemployed and excluded those who are not working but sometimes have a second job, were working past the seven days, or have a regular second job. Individuals are considered not employed if they are not full- or part-time employed or attending vocational training. Workers experience a job change if their jobs in t and $t+1$ are not the same and a change of employer can happen either via an unemployment spell or through a direct job-to-job movement. I consider a forced job change in the following cases: the employment link was terminated by the employer, a temporary contract expired, the education or training was completed, the company transfers the employee, and the company closed down. The option of job change due to maternity/parental leave is only asked in some waves of the survey (from 1991 to 1998 and since 2011).

Another important driver of earnings losses is the transition between labor force status. 22% of the workers who suffer large income drops became non-employed, from which 16% became unemployed (column (1) of Table 3.4.1). Table 3.4.1 shows that, for the workers in this group, the average income changes are equally driven by a drop in wages and hours worked. So, this confirms the idea that unemployment risk and unstable employment play an important role in explaining earnings drops and is consistent with the evidence provided in Figure 3.4.1 for the bottom RE workers. Extensive margin events (e.g. layoffs) can also lead to large declines in hours and wages at the same time. These results underline the importance of the extensive margin for the tails of the earnings change distribution.

Similarly to drops, Table 3.4.2 shows that switching jobs and becoming employed, especially at full-time jobs, are the main reasons for positive income changes. About 10% move out of unemployment or inactivity into a full-time or a regular part-time job. Extra jobs seem relatively more important to explain intermediate than large labor income changes.

Table 3.4.2. Positive income shocks and life-cycle events

	One-year earnings change, $\Delta y \in$		
	$[0, 0.25]$	$(0.25, 1]$	> 1
	(1)	(2)	(3)
Into full-time			
from not full-time	1.20	6.00	17.18
from regular part-time	0.49	1.62	3.94
Into full- or regular part-time			
from not working	0.64	3.28	9.43
from unemployment	0.44	2.26	5.39
Changed job	5.95	13.89	25.47
Involuntary change	2.08	6.47	9.50
Extra job	2.88	4.27	4.04
Out of disability	0.49	0.76	0.33
Share (%)	42.52	9.43	1.60
$E\,\Delta^1_{log} y^i_t$	0.08	0.46	1.60
$E\,\Delta^1_{log} w^i_t$	0.07	0.35	0.91
$E\,\Delta^1_{log} h^i_t$	0.01	0.10	0.68
$E\,\Delta^5_{log} y^i_t$	0.06	0.34	1.58
$E\,\Delta^5_{log} w^i_t$	0.08	0.27	0.86
$E\,\Delta^5_{log} h^i_t$	-0.01	0.07	0.73

Notes: Part-time worker accounts only for regular part-time employment. Individuals are considered unemployed if are not working and are registered unemployed and excluded those who are not working but sometimes have a second job, were working past the seven days, or have a regular second job. Individuals are considered not employed if they are not full- or part-time employed or attending vocational training. Workers experience a job change if their jobs in t and $t+1$ are not the same and a change of employer can happen either via an unemployment spell or through a direct job-to-job movement. I consider a forced job change in the following cases: the employment link was terminated by the employer, a temporary contract expired, the education or training was completed, the company transfers the employee, and the company closed down.

In addition, large positive income changes are, on average, driven by a mix of wage and hours changes which is again consistent with evidence for the bottom RE workers documented in section 3.4.1. Tables 3.4.1 and 3.4.2 show that independently of the sign of the change, small and intermediate income changes are mainly

accounted for by wage changes, which are only mildly related to job switching.

Table 3.C.1 in the appendix provides the counterpart for female workers in Germany. Similarly to males, switching jobs and, in particular, unwanted job changes are the main reason for the income cuts. However, the share of females who claim to have been forced to change jobs because of parental leave is considerably larger than for males. Maternity seems to be an important driver of income dynamics for women in the German labor market since it is also clear that many of them experience a fall in earnings contemporaneously to an increase in the number of children or taking maternity leave. Unlike males, transitions in and out of inactivity and part-time employment are important to account for labor income fluctuations. These results are in line with evidence by Kleven, Landais, Posch, Steinhauer, and Zweimueller (2019) who find strong and persistent earnings penalties for females after the birth of their first child. For Germany, they find that the penalty is driven by both the intensive margin (hours worked) and wage-rate effects.

3.5 Household and Public Insurance

For households, the risk of disposable income can be more relevant than the earnings' risk of an individual family members. For this reason, this section discusses the extent to which German families are well insured against individual labor income risk through private and public insurances. First, I discuss the role of the second earner and document the pass-through of individual earnings changes to the household level (Section 3.5.1). Then, Section 3.5.2 studies whether accounting for family and government insurances can attenuate the deviations from normality and state dependencies of the cross-sectional moments documented before for male earnings changes.[11]

3.5.1 Household Earnings Dynamics

Income pooling within a household can potentially be a source of insurance for two reasons. First, when only the male head experiences an earnings shock, part of the family income remains unchanged, implying that, in relative terms, household income responds less than the head's earnings (the income pooling effect). Second, the second earner of the household may react to earnings changes experienced by the head by adjusting the number of hours worked (the added worker effect).

11. Whenever applicable, the analysis for five-year changes is also documented in Appendix 3.B. Even though the results presented in this section consider the whole baseline sample, the counterparts for prime-aged workers are documented in Section 3.D.

Thus, this analysis starts by investigating the spouses' reaction to the head's earnings changes. For couples that file taxes together, the TPP provides information about spouses' income. Figure 3.5.1 plots, for these couples in the sample, the two-year response of spouses' labor earnings to changes in the male heads' earnings between t and $t+1$. Conditional on their RE, male workers are grouped in twenty deciles according to their earnings change between t and $t+1$ (x axis). The y-axis represents the average spouses' labor income changes. Studying two-year windows allows for capturing changes in spousal labor supply that are not exactly contemporaneous to the head's earnings shock but that may be a delayed response to them.

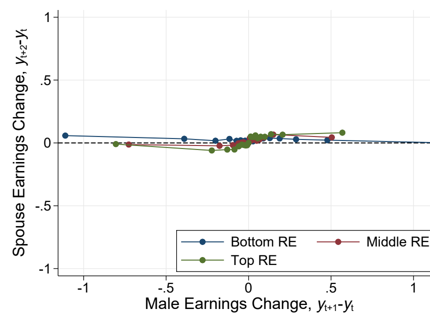


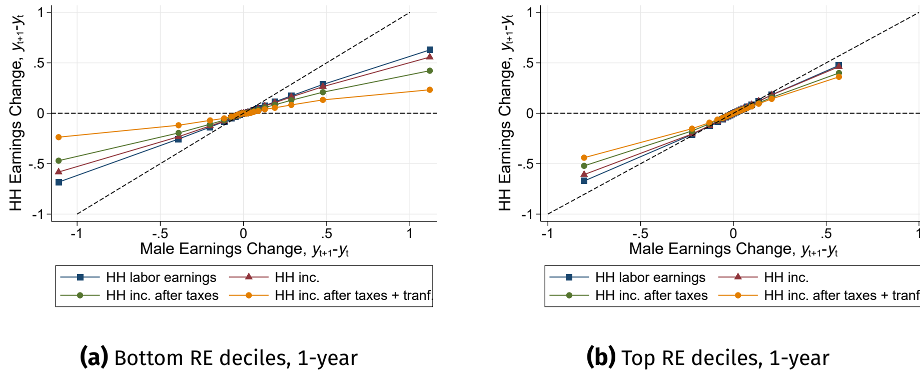
Figure 3.5.1. Two-year spouse labor earnings responses to male earnings changes. The figure displays the average two-year change of spouse labor earnings for 20 different groups of males married workers, plotted against their one-year log change in average labor earnings. The sample comprises married male workers. Results are documented only for the bottom RE deciles (first and second), median RE deciles (fifth and sixth), and top RE deciles (ninth and tenth).

Figure 3.5.1 shows that there is no apparent relation between changes in male heads' and female spouses' earnings, indicating no evidence of an added worker effect in Germany.[12] This evidence suggests that any household insurance recorded can only be driven by income pooling at the family level rather than labor supply reactions of secondary earners, which is also in line with findings for other countries (Halvorsen et al., 2020; De Nardi, Fella, Knoef, et al., 2021).

Figure 3.5.2 summarizes the roles of family and government insurance by showing the pass-through of male earnings shocks to the household level. In particular, it reports the average one-year change of household income as a response to changes in male labor earnings between t and $t+1$ for male married workers. When comparing male and household labor earnings, Figure 3.5.2 shows that there is some insurance provided by income pooling at the family level, especially for the bottom earners. For instance, for workers at the bottom, families whose head's labor income

12. Figure 3.A.7 in the appendix shows that the same results also apply to contemporaneous changes in spouses' earnings.

drops by 120 log points only experience about half this change when pooling labor earnings at the household level.



(a) Bottom RE deciles, 1-year

(b) Top RE deciles, 1-year

Figure 3.5.2. Response of household income to male earnings changes. The x axis shows the average one-year male earnings growth and the y-axis plots the average one-year growth of household labor earnings, gross income and income after taxes and transfers. . The sample used includes all male married workers between 25 and 55 years old from the baseline sample. Results are documented only for the bottom RE deciles (first and second) and top RE deciles (ninth and tenth). Figure 3.A.8 in the appendix shows the results for median RE deciles.

Comparing total household income to income net of taxes and transfers helps shed light on the role of the welfare system as a source of insurance against labor income risk. Figure 3.5.2 indicates that government insurance through taxes and transfers is not negligible, especially for bottom earners and against large income swings. Households in the first deciles of RE with a negative household income change of about 60 log points experience on average a drop of only 20 log points in household disposable income (Figure 3.5.2a). Households with a top earner head receive, as expected, less insurance from progressive taxation and transfers in case of negative shocks (the difference between the slopes in Figure 3.5.2b is smaller).

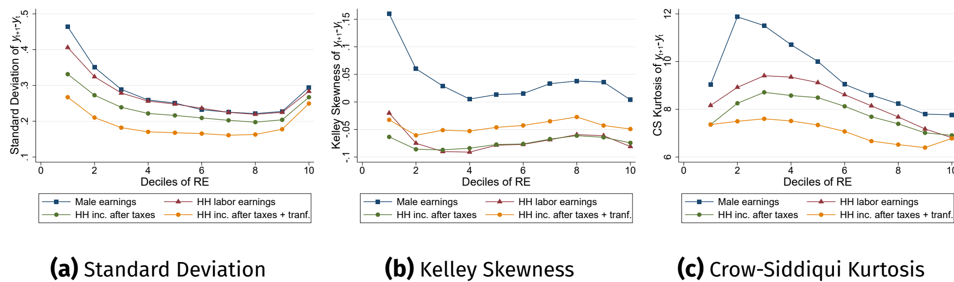
Overall, income pooling at the family level and the welfare system together provide a great source of insurance to households and can attenuate disposable income fluctuations against individual earnings swings. A household whose male experiences a very large earnings drop is, on average, insured against over 80% of the earnings loss if he is at the bottom of the distribution and almost 50% if he is a top earner. It is also worth mentioning that despite the important role of private and public insurance, household income recovers only partly even five years after the shock (see Figure 3.B.2 in the appendix).

This evidence is broadly in line with evidence from administrative datasets for other countries (Halvorsen et al., 2020; De Nardi, Fella, Knoef, et al., 2021), but also with evidence from survey data for Germany (Bartels and Bönke, 2013). Bartels and Bönke (2013) find that taking institutions of the welfare state and risk-

sharing households into account decreases transitory and permanent variances of net household income, even though over time both have remained fairly stable.

3.5.2 Cross-Sectional Moments of Household Income Growth

We now turn back to the cross-sectional moments of income changes to investigate the role of household and government insurance in attenuating the deviations from log normality documented for male labor earnings. Following the approach described in Section 3.3.1, Figure 3.5.3 reports the cross-sectional moments for household labor earnings and income net of taxes and transfers.[13] It shows that the cross-sectional moments for household earnings differ sharply from those of male earnings growth.



(a) Standard Deviation **(b)** Kelley Skewness **(c)** Crow-Siddiqui Kurtosis

Figure 3.5.3. Cross-sectional moments for one-year household earnings growth. Cross sectional moments of one-year growth of individual and household labor earnings, household gross and net income of married male workers.

Income pooling with spouse labor earnings significantly helps attenuating the differences in skewness and the kurtosis along the RE deciles (Figures 3.5.3b and 3.5.3c). However, as discussed before, this should be interpreted as a mechanical second-earner effect. Figure 3.5.3 also shows that taxes and transfers mitigate the risk experienced by individual earners, especially for those at the bottom half of the RE distribution. In particular, these sources of public insurance can attenuate the volatility, negative skewness, and excess kurtosis of income changes as depicted in the three panels of Figure 3.5.3.

For instance, at the lowest percentiles of RE, the standard deviation declines in total from about almost 0.5 to below 0.3 after considering private and public insurances. The Crow-Siddiqui kurtosis at the household level falls from a peak of 12 to below 8 for bottom deciles and skewness becomes very close to zero along all RE deciles. This means that, at the household level, income changes are relatively

13. This analysis focuses only on households whose souses file tax returns together. So, the moments reported for male heads slightly differ from those presented in Section 3.3.2 for the whole sample.

more frequent but smaller, while at the individual level changes in earnings are more infrequent but, when they happen, they are large. Even though this represents considerable mitigation of the risk, the distribution of household income after taxes and transfers is still mildly leptokurtic and features excess kurtosis compared to a normal distribution.

Figure 3.5.3 shows that family and household insurance are able to attenuate the presence of state dependencies. The amplitude of cross-sectional moments across RE groups is much smaller when accounting for these sources of insurance than for male earnings. Comparing Figure 3.5.3 to Figure 3.D.6 highlights that the age dependencies are also mitigated. Therefore, even though some deviations from log-normality are still noticeable, this section documents that accounting for government and family insurances can attenuate their magnitude and heterogeneities with respect to the income level and age of the worker.

3.6 Conclusion

This paper studies the nature of earnings changes in Germany and investigates the drivers of potential deviations from standard linear and symmetric models of labor income risk using a large dataset based on workers' tax records. First, it documents large deviations of earnings growth from a Gaussian distribution, namely negative skewness and excess kurtosis. The extent of these deviations depends on the income level and changes over the life-cycle.

Secondly, the drivers behind large earnings swings, which are important for the sharp non-normalities documented, differ across income groups. For the top earners, large labor income growth is solely explained by wage rate changes, while for the bottom earners, they are driven by a mix of changes in hours and wages which is consistent with periods of unemployment and job switches. This is coherent with evidence showing the important role of job changes and the transition between employment and unemployment in explaining earnings fluctuations of bottom workers.

Then, this paper identifies considerable asymmetries in mean reversion patterns of earnings changes, which are not compatible with frequent modeling choices of earnings dynamics, like AR(1) processes. Positive income changes are more permanent, while negative changes are transitory for the bottom earners and more permanent for the top. These non-linearities are mainly accounted for by the dynamics of hours worked since wage rate dynamics are close to linear.

Finally, I investigate the role of family and government insurance to mitigate individual earnings risk and attenuate deviations from log-normality. I find that the presence of a secondary earner in the household can smooth out earnings shocks. However, as the data does not provide evidence of an added worker effect, this is purely driven by income pooling. Moreover, government taxes and transfers in Germany mitigate the pass-through of large individual earnings swings to the household

level, especially for bottom earners. Both sources of insurance can attenuate the large deviations from log-normality of male earnings growth and its heterogeneities across income levels and age groups.

Despite all the labor institutional and welfare state differences, the moments and dynamics documented for Germany are qualitatively similar to the ones documented for other countries like the Netherlands, Norway, and the United States.

Appendix 3.A Additional Results for Male Workers

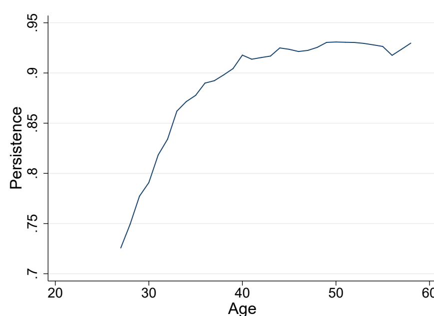
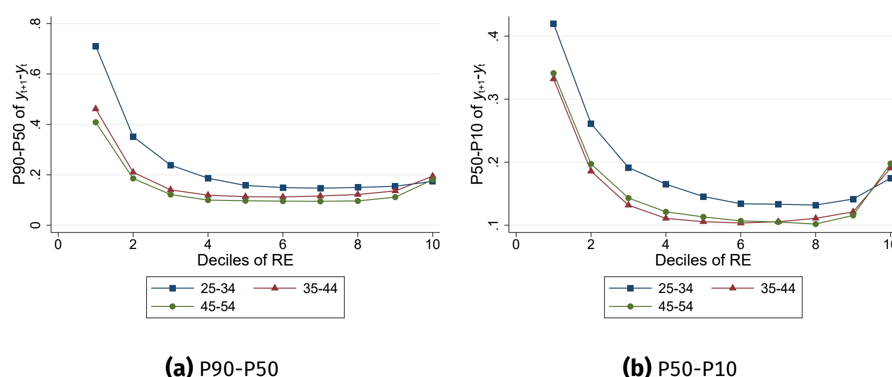


Figure 3.A.1. Persistence of earnings. Persistence of male earnings as function of age.



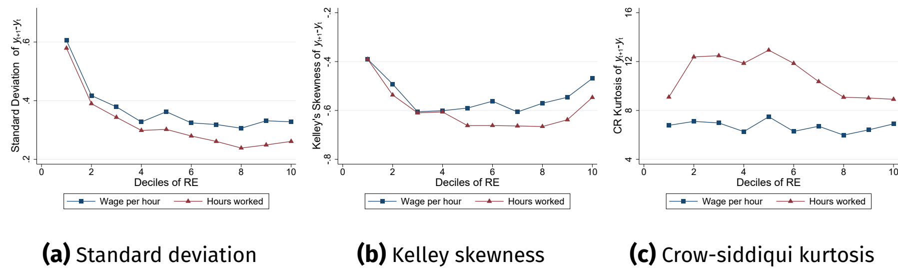
(a) P90-P50 **(b)** P50-P10

Figure 3.A.2. Skewness decomposed: P90-P50 and P50-P10. Figure 3.A.2a plots the difference between the 90th and the 50th percentiles, while Figure 3.A.2b plots the difference between the 50th and the 10th percentiles.

Table 3.A.1. Cross-sectional moments of one-year earnings, wage, and hours hrowth

	All			25-34			35-54		
	earnings	wage	hours	earnings	wage	hours	earnings	wage	hours
Variance	0.35	0.37	0.32	0.36	0.37	0.33	0.33	0.34	0.29
Kelley skewness	-0.56	-0.54	-0.60	-0.34	-0.36	-0.44	-0.52	-0.50	-0.57
CS Kurtosis	7.84	6.69	10.80	6.69	5.92	9.05	8.14	6.96	11.28

Notes: The figure plots the empirical densities of one- and five-year labor earnings change superimposed on Gaussian densities with the same standard deviation. Data is from SOEP and only male workers between 25 and 54 years of age are used. Wages are obtained by dividing annual labor earnings of male heads of households by their annual hours worked.



(a) Standard deviation **(b)** Kelley skewness **(c)** Crow-siddiqui kurtosis

Figure 3.A.3. Cross-sectional moments for one-year hours and wage growth. Cross-sectional moments of one-year growth in annual hours worked and hourly wage of male workers in the baseline sample.

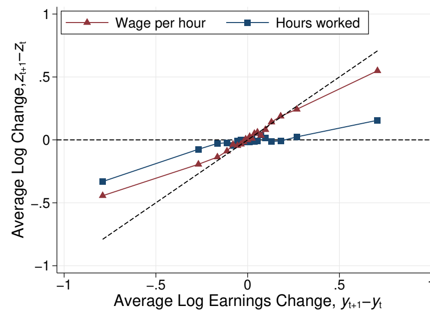


Figure 3.A.4. Contribution of Hours and Wages to Earnings Changes, median RE deciles The figure displays the one-year average log change of annual hours and hourly wage for 20 different groups of male workers in the median (5th and 6th) RE deciles, plotted against their contemporaneous one-year average log change in annual labor earnings.

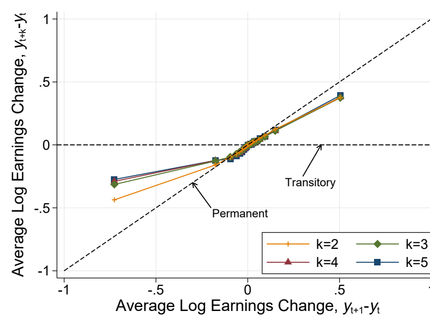
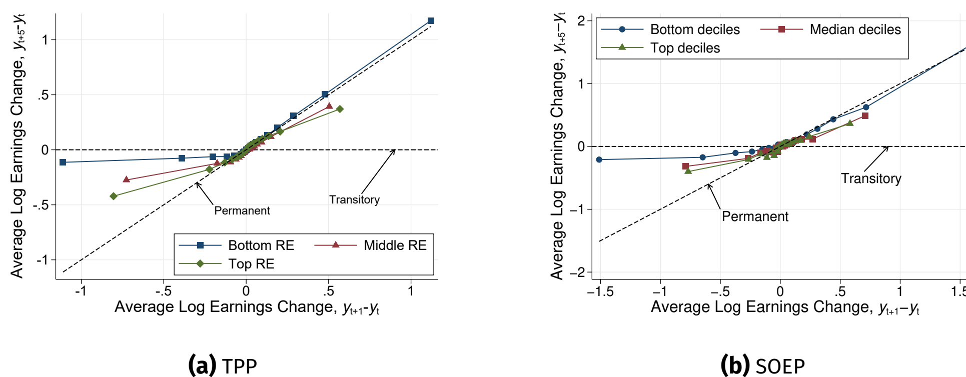


Figure 3.A.5. Persistence of labor earnings changes, median RE deciles. The figure displays the k-year average log change of annual labor earnings for 20 different groups of male workers in the median (5th and 6th) RE deciles, plotted against their contemporaneous one-year average log change in annual labor earnings.

Table 3.A.2. Important Life Cycle Events Associated with Earnings Changes

	one-year earnings change, $\Delta y \in$					
	< -1	$[-1, -0.25)$	$[-0.25, 0)$	$[0, 0.25]$	$(0.25, 1]$	> 1
Short-time work	6.9	17.2	4.1	3.3	5.1	3.9
Unemployment	64.3	44.5	7.7	5.8	40.8	59.9
Short-term allowances	5.6	15.3	5.6	4.5	6.6	4.2
Social assistance allowances	42.4	30.9	7.1	6.4	30.0	41.2
Handicapped	5.9	4.1	1.5	0.5	0.5	0.6
Change no. children	4.0	4.7	4.4	3.3	4.8	5.1

Notes: The table sorts individuals into six groups according to the size of their earnings change from t to $t + 1$ and documents the share of workers who contemporaneously experience certain life events. Short-time work (*Kurzarbeiter*) and unemployment account for the households who get in or out of these status for negative and positive income changes respectively. These are documented only until 2005. Short-term allowances include short-time work allowances/subsidies (*Kurzarbeitergeld*/*Zuschuss*), maternity benefits (*Mutterschaftsgeld*) and top-up amounts under the partial retirement law (*Aufstockungsbeträge nach dem Altersteilzeitgesetz*). Social assistance allowances account for unemployment (*Arbeitslosengeld*), sickness (*Krankengeld*), maternity (*Mutterschaftsgeld*), and parental (*Elterngeld*) benefits. Handicapped documents the share of workers who experience an increase or decrease in the handicapped allowance contemporaneously to a decrease or increase in the labor earnings, respectively. Change in the number of children accounts for workers whose number of children increased contemporaneously to the income change.



(a) TPP

(b) SOEP

Figure 3.A.6. Persistence of labor earnings changes, TPP and SOEP. The figure displays the five-year average change in labor earnings for 20 different groups of male workers in the bottom (first and second), median (fifth and sixth) and top (ninth and tenth) RE deciles, plotted against their respective one-year average change. Source: German TPP and SOEP.

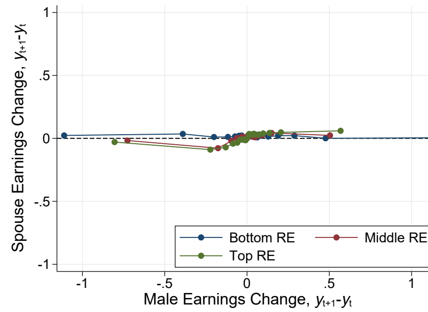


Figure 3.A.7. One-year spouse labor earnings responses to male earnings shocks. The figure displays the average one-year change of spouse labor earnings for 20 different groups of males married workers, plotted against their one-year log change in average labor earnings. The sample comprises married male workers. Results are documented only for the bottom RE deciles (first and second), Median RE deciles (fifth and sixth), and top RE deciles (ninth and tenth).

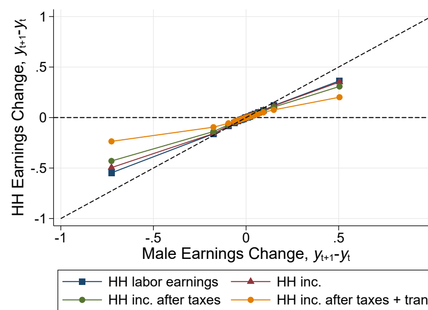
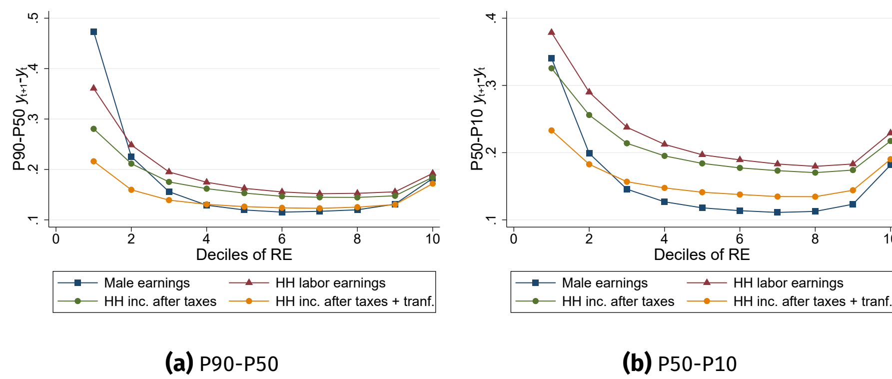
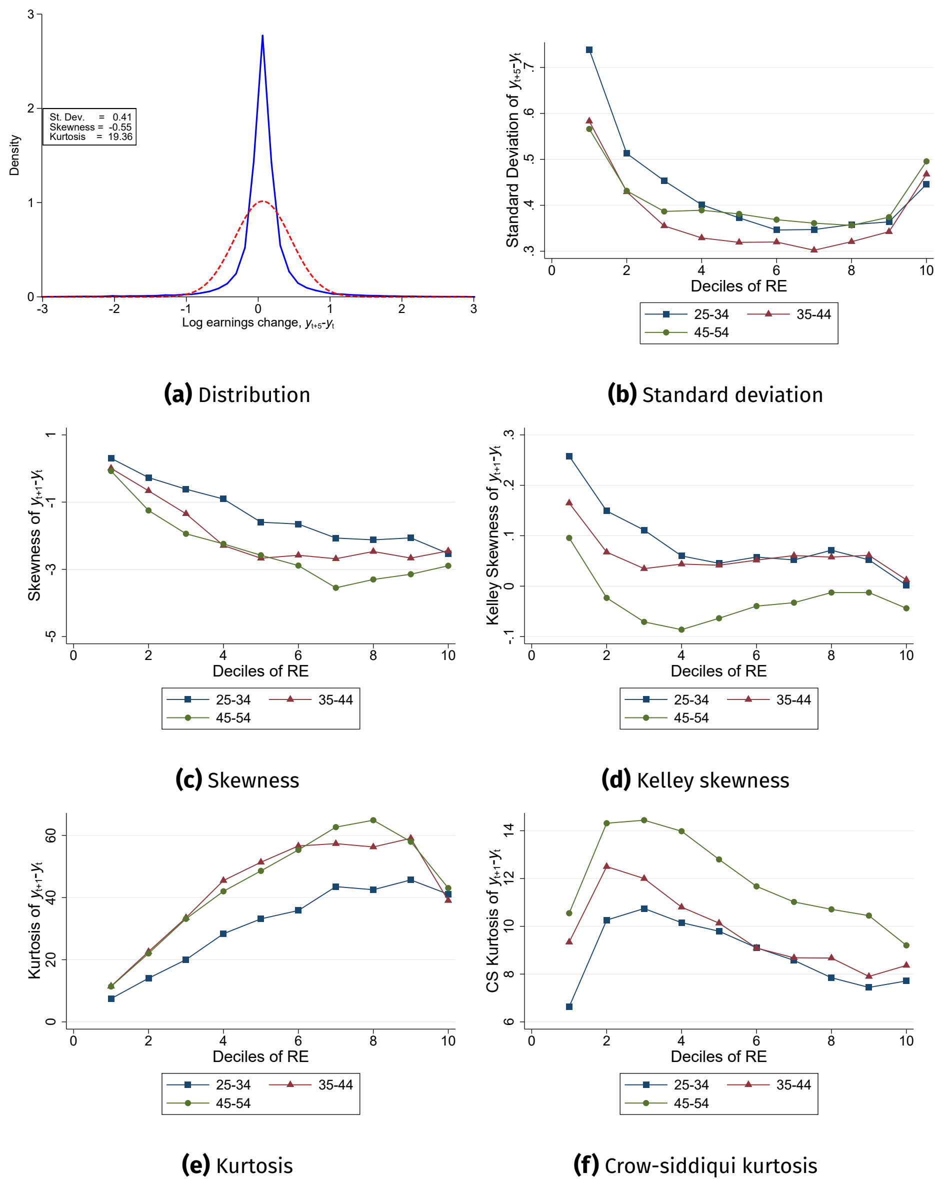


Figure 3.A.8. One-year growth of household labor earnings, gross and net income, median RE deciles. The x axis shows the average one-year male earnings growth and the y-axis plots the average one-year growth of household labor earnings, gross and net income. The sample comprises married male workers. Results are documented only for the median RE deciles (fifth and sixth) RE deciles. The sample used includes all male married workers between 25 and 55 years old from the baseline sample.



(a) P90-P50 **(b)** P50-P10

Figure 3.A.9. Skewness decomposed for household labor earnings, gross and net income. Figure 3.A.9a plots the difference between P90-P50 for older age groups and age 25–34. Figure 3.A.9b plots the same for P50-P10.



(a) Distribution

(b) Standard deviation

(c) Skewness

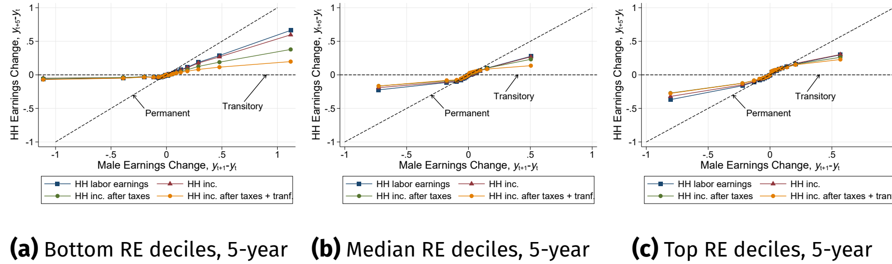
(d) Kelley skewness

(e) Kurtosis

(f) Crow-siddiqui kurtosis

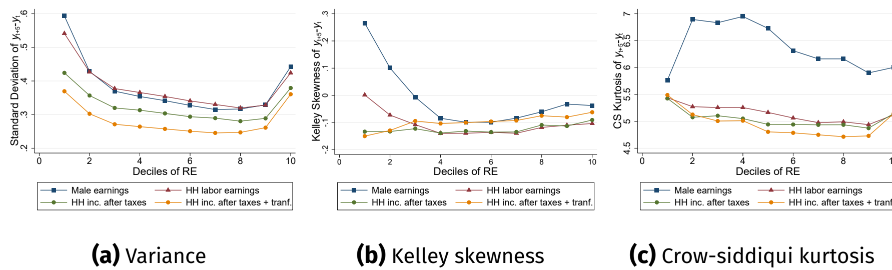
Figure 3.B.1. Distribution of five-year earnings growth. Panel 3.B.1a depicts the empirical densities of five-year earnings changes along with Gaussian densities with the same standard deviation as the data. Data is from 2007 German tax records and only male workers between 25 and 54 years old are included. The remaining panels show the cross-sectional moments of five-year labor earnings growth of male workers over the life-cycle.

Appendix 3.B Results for five-year income changes of male workers



(a) Bottom RE deciles, 5-year **(b)** Median RE deciles, 5-year **(c)** Top RE deciles, 5-year

Figure 3.B.2. Five-year growth of household income. The x axis shows the average one-year male earnings growth and the y-axis plots the average five-year growth of household labor earnings, gross and net income. The sample comprises married male workers. Results are documented only for the bottom RE deciles (first and second), Median RE deciles (fifth and sixth), and top RE deciles (ninth and tenth). The sample used includes all male married workers between 25 and 55 years old from the baseline sample.

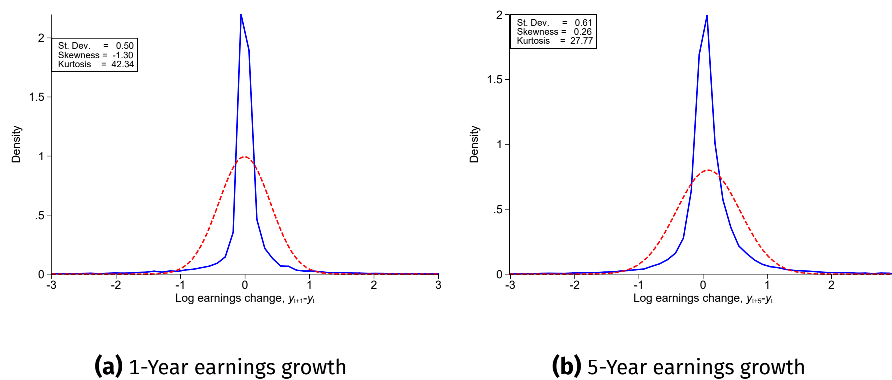


(a) Variance **(b)** Kelley skewness **(c)** Crow-siddiqui kurtosis

Figure 3.B.3. Cross-sectional moments for five-year household income growth. Cross sectional moments of five-year growth of individual and household labor earnings, household gross and net income of married male workers.

Appendix 3.C Results for Female Workers

Similarly to men, Figure 3.C.1 shows that the distributions of one- and five-year female earnings changes also comprise strong deviations from log-normality. Then, Figure 3.C.2 presents the persistence and higher-order moments of these distributions over the life-cycle and earnings distribution. Regarding the standard deviation, Figure 3.C.2b shows that, for women above 35, the distribution of earnings growth is both qualitatively and quantitatively quite similar to those of men. However, earnings changes for young females are significantly more volatile than of young males, which is likely explained by the role of maternity, leaves of absence and part-time work (as will be discussed in Section 3.4.2). Figure 3.C.2c displays the negative skewness of the earnings growth distribution for females. Relative to males, there are more differences over the life cycle and along the RE groups, however, when accounting for possible outliers, the distribution is close to symmetric (Figure 3.C.2d). For most RE deciles, the kurtosis of earnings growth is lower for young females than for young males, but higher for older females than older males (Figure 3.C.2e). Thus, the distribution of female earnings growth also displays strong deviations from normality but differences over the life-cycle are even more pronounced than for males.



(a) 1-Year earnings growth **(b)** 5-Year earnings growth

Figure 3.C.1. Histograms of one- and five-year log earnings change of females. The figure plots the empirical densities of one- and five-year labor earnings change superimposed on Gaussian densities with the same standard deviation. Data is from TPP and only female workers between 25 and 60 years of age are used.

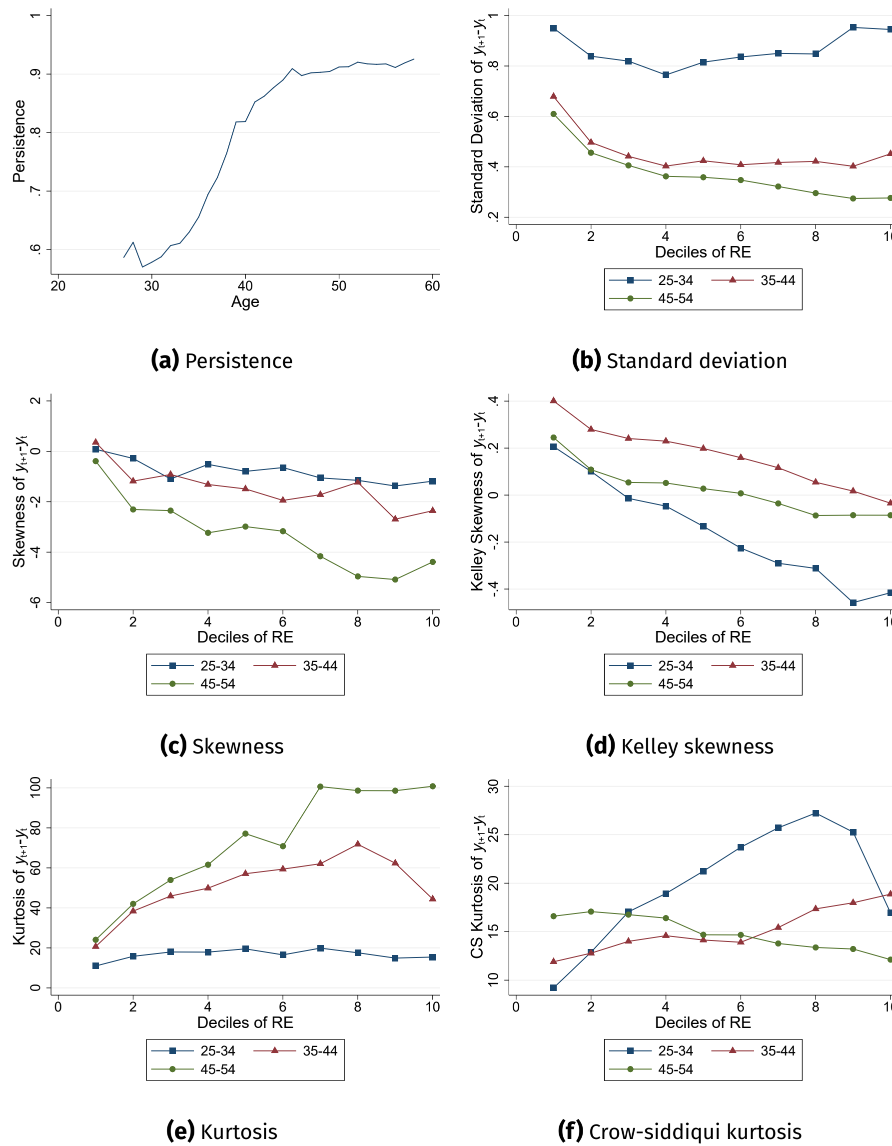
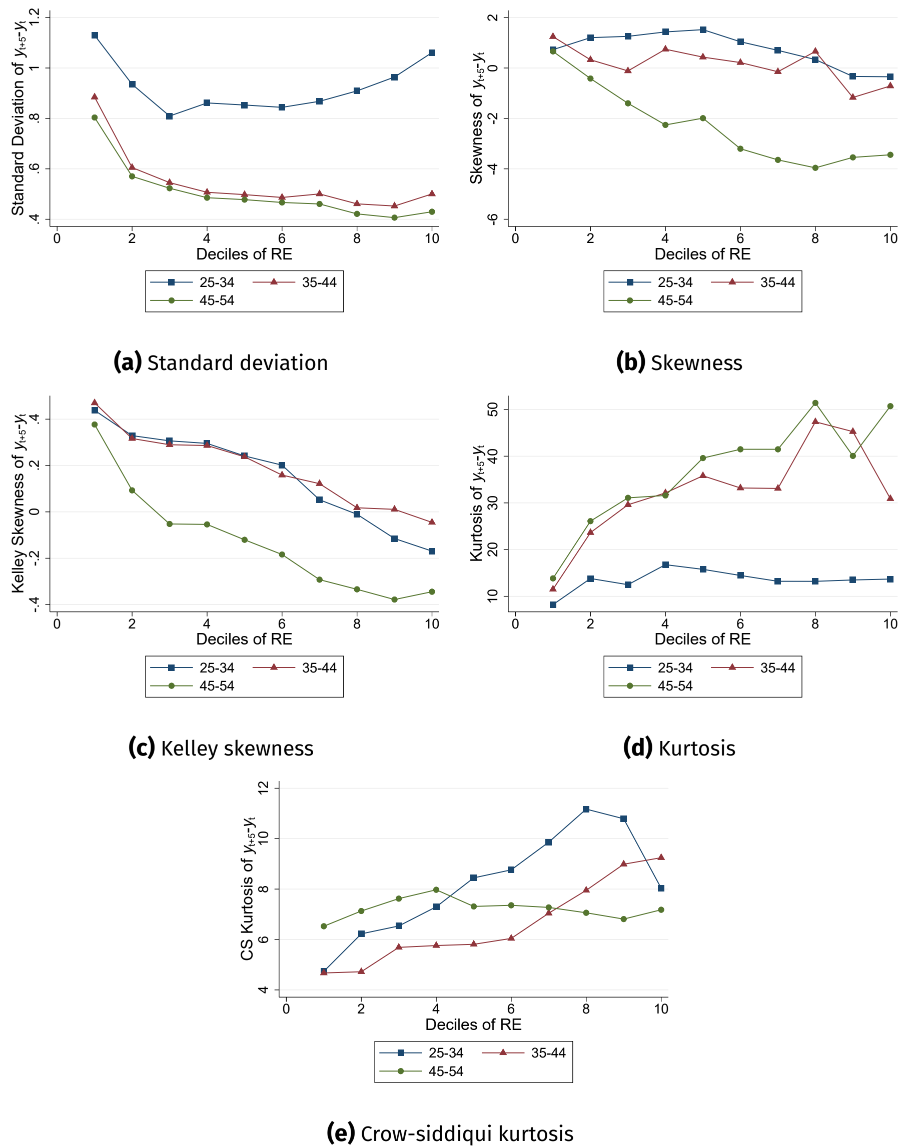


Figure 3.C.2. Persistence and cross-sectional moments for one-year earnings growth. Cross-sectional moments of one-year labor earnings growth of female workers over the life-cycle.



(a) Standard deviation

(b) Skewness

(c) Kelley skewness

(d) Kurtosis

(e) Crow-siddiqui kurtosis

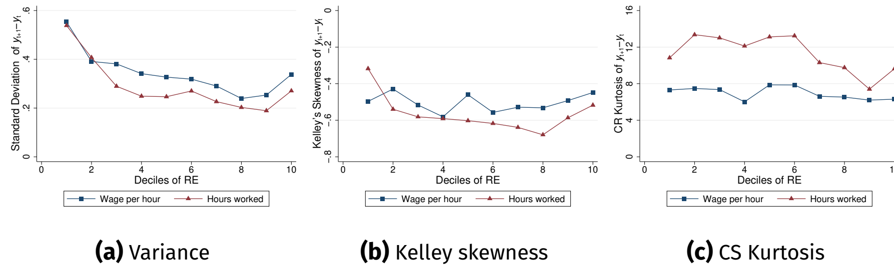
Figure 3.C.3. Cross-sectional moments for five-year earnings growth. Cross-sectional moments of one-year labor earnings growth of female workers over the life-cycle.

Table 3.C.1. Labor earnings shocks and life events for female workers

	1-Year Negative Change, $\Delta y \in$				1-Year Positive Change, $\Delta y \in$		
	< -1	$[-1, -0.25)$	$[-0.25, 0)$		> 1	$(0.25, 1]$	$[0, 0.25]$
Into non-employment	23.22	15.98	3.44	Into full-time			
Into unemployment	6.42	5.73	1.26	from not full-time	12.58	8.19	3.11
Into regular part-time	2.94	5.37	2.90	from regular part-time	5.07	5.88	2.67
Changed job	23.93	16.97	6.499	Into full- or regular part-time			
Involuntary change	10.37	9.06	2.40	from not working	9.64	3.17	0.62
Due to parental leave	6.19	4.05	0.70	form unemployed	2.39	1.17	0.23
Change no. of children	16.14	10.20	1.74	Changed job	22.22	12.92	5.49
In maternity leave	13.47	6.27	1.07	Involuntary change	5.88	4.58	1.75
Lost second job	5.50	7.00	3.52	Out of maternity leave	3.19	1.85	1.36
Into disability	1.80	1.90	1.10	Extra job	7.00	6.96	3.19
				Out of disability	0.34	0.47	0.56
Share (%)	3.98	10.88	32.83	Share (%)	3.38	12.09	36.84
$E\,\Delta^{1}_{log} y^{i}_{t}$	-1.63	-0.51	-0.07	$E\,\Delta^{1}_{log} y^{i}_{t}$	1.57	0.50	0.08
$E\,\Delta^{1}_{log} w^{i}_{t}$	-1.63	-0.51	-0.07	$E\,\Delta^{1}_{log} w^{i}_{t}$	0.88	0.33	0.07
$E\,\Delta^{1}_{log} h^{i}_{t}$	-0.90	-0.21	-0.01	$E\,\Delta^{1}_{log} h^{i}_{t}$	0.68	0.17	0.01
$E\,\Delta^{5}_{log} y^{i}_{t}$	-0.45	-0.17	-0.06	$E\,\Delta^{5}_{log} y^{i}_{t}$	1.40	0.41	0.05
$E\,\Delta^{5}_{log} w^{i}_{t}$	-0.35	-0.12	-0.01	$E\,\Delta^{5}_{log} w^{i}_{t}$	0.69	0.24	0.07
$E\,\Delta^{5}_{log} h^{i}_{t}$	-0.10	-0.04	-0.04	$E\,\Delta^{5}_{log} h^{i}_{t}$	0.71	0.17	-0.01

Notes: Part-time worker accounts only for regular part-time employment. Individuals are considered unemployed if are not working and are registered unemployed and excluded those who are not working but sometimes have a second job, were working past the 7 days, or have a regular second job. Individuals are considered not employed if they are not full- or part-time employed or attending vocational training. I consider a forced job change in the following cases: the employment link was terminated by the employer, a temporary contract expired, the education or training was completed, the company transfers the employee, the company closed down. The option of job change due to maternity/parental leave is only asked in some waves of the survey (from 1991 to 1998 and since 2011).

Appendix 3.D Results for Prime-age Workers

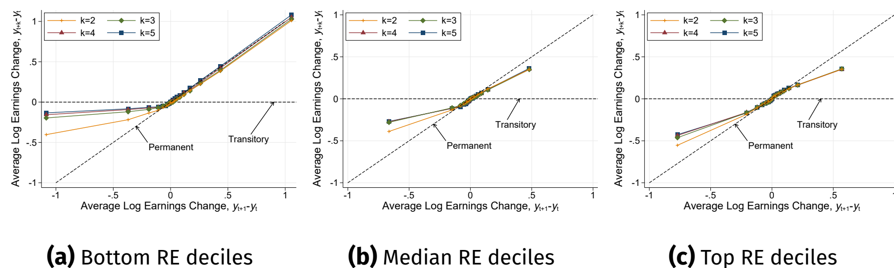


(a) Variance **(b)** Kelley skewness **(c)** CS Kurtosis

Figure 3.D.1. Cross-sectional moments of hours and wage growth. Cross-sectional moments of one-year growth in annual hours worked and hourly wage of male workers between 35 and 54 years old.

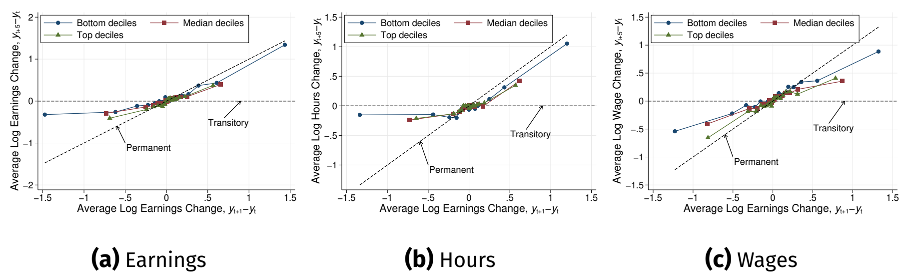
(a) Bottom RE deciles **(b)** Median RE deciles **(c)** Top RE deciles

Figure 3.D.2. Contribution of hours and wages. The figure displays the one-year average log change of annual hours and hourly wage for 20 different groups of male workers between 35 and 54 years old in the bottom (first and second), median (fifth and sixth) and top (ninth and tenth) RE deciles, plotted against their contemporaneous one-year average log change in annual labor earnings.



(a) Bottom RE deciles **(b)** Median RE deciles **(c)** Top RE deciles

Figure 3.D.3. Persistence of labor earnings changes by RE decile. The figure displays the k-year average log change of annual labor earnings for 20 different groups of male workers in the bottom (first and second), median (fifth and sixth) and top (ninth and tenth) RE deciles, plotted against their contemporaneous one-year average log change in annual labor earnings.



(a) Earnings **(b)** Hours **(c)** Wages

Figure 3.D.4. Persistence of earnings, hours, and wages changes. The figure displays the five-year average change in earnings, hours and wages for 20 different groups of male workers in the bottom (first and second), median (fifth and sixth) and top (ninth and tenth) RE deciles, plotted against their respective one-year average change.

Table 3.D.1. Labor earnings shocks and life events for prime-age male workers

	1-Year Negative Change, $\Delta y \in$				1-Year Positive Change, $\Delta y \in$		
	< -1	$[-1, -0.25)$	$[-0.25, 0)$		> 1	$(0.25, 1]$	$[0, 0.25]$
Into non-employment	21.46	10.24	1.44	Into Full-time			
into unemployment	16.66	7.68	0.98	from not full-time	17.80	4.97	1.02
Into regular part-time	1.98	1.70	0.51	from regular part-time	4.67	1.42	0.45
Changed job	28.02	14.25	5.24	Into full- or regular part-time			
involuntary change	16.85	11.49	2.37	form not working	9.96	3.12	0.53
due to parental leave	0.36	0.23	0.08	from unemployment	5.75	2.23	0.38
Change no. of children	2.87	2.66	2.55	Changed job	21.39	11.62	4.78
Lost second job	3.69	3.70	2.92	involuntary change	9.35	6.45	1.79
Into disability	4.45	2.07	1.10	Extra job	3.29	3.99	2.75
				Out of disability	0.63	0.82	0.49
Share (%)	1.65	8.05	37.04	Share (%)	1.22	8.80	43.24
E $\Delta^1_{log} y^i_t$	-1.65	-0.46	-0.07	E $\Delta^1_{log} y^i_t$	1.64	0.45	0.08
E $\Delta^1_{log} w^i_t$	-0.81	-0.35	-0.07	E $\Delta^1_{log} w^i_t$	1.03	0.35	0.07
E $\Delta^1_{log} h^i_t$	-0.83	-0.11	-0.01	E $\Delta^1_{log} h^i_t$	0.61	0.10	0.01
E $\Delta^5_{log} y^i_t$	-.39	-0.23	-0.05	E $\Delta^5_{log} y^i_t$	1.49	0.29	0.06
E $\Delta^5_{log} w^i_t$	-0.30	-0.19	-0.01	E $\Delta^5_{log} w^i_t$	0.89	0.26	0.08
E $\Delta^5_{log} h^i_t$	-0.08	-0.04	-0.04	E $\Delta^5_{log} h^i_t$	0.62	0.04	-0.02

Notes: Part-time worker accounts only for regular part-time employment. Individuals are considered unemployed if are not working and are registered unemployed and excluded those who are not working but sometimes have a second job, were working past the 7 days, or have a regular second job. Individuals are considered not employed if they are not full- or part-time employed or attending vocational training. I consider a forced job change in the following cases: the employment link was terminated by the employer, a temporary contract expired, the education or training was completed, the company transfers the employee, the company closed down. The option of job change due to maternity/parental leave is only asked in some waves of the survey (from 1991 to 1998 and since 2011).

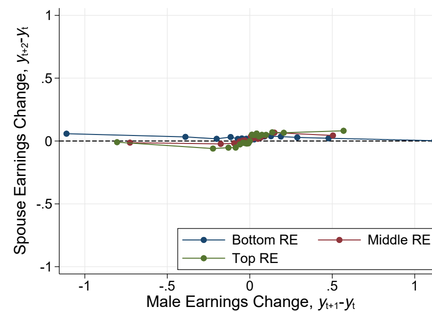
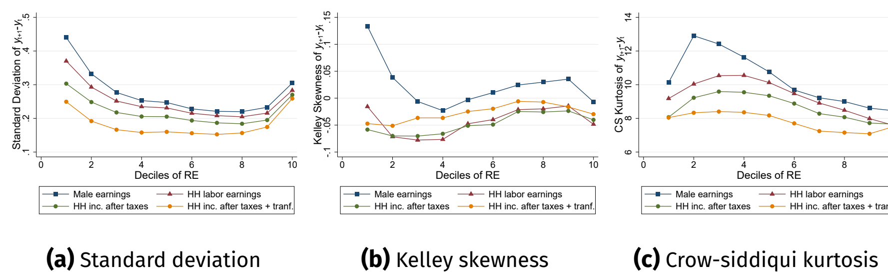


Figure 3.D.5. Two-year growth of spouses' labor earnings. The x axis shows the average one-year male earnings growth and the y-axis plots the average two-year growth of spouses earnings. The sample used includes all male married workers between 35 and 54 years old from the baseline sample.



(a) Standard deviation **(b)** Kelley skewness **(c)** Crow-siddiqui kurtosis

Figure 3.D.6. Cross-sectional moments of household income growth. Cross-sectional moments of one- and five-year growth of individual and household labor earnings, household gross and net income of married prime-aged male workers.

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