Essays on Financial Regulation

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INTRODUCTION

The financial system has undergone far-reaching changes since the global financial crisis. A new set of regulatory reforms has been introduced and their effects are still not adequately evaluated by academics and policy-makers. This dissertation takes a step to this direction. In the chapters that follow, we shed light on three questions related to the regulatory sphere that currently receive much attention by policy-makers: the leverage ratio regulation, Emerging Market Economies responses to the global financial cycle and a level playing field in financial regulation.

The repo market is crucial to the transmission of monetary policy and financial stability. It also facilitates the flow cash and securities around the financial system and contributes to the efficient allocation of capital to the real economy. However, in the wake of the financial crisis, the dynamics in the repo market changed considerably. As Durrell Duffie argued in the 2016 ECB Forum on Central Banking, the Basel III regulatory reforms, most notably the leverage ratio, played an important role in this. In Chapter 1, we exploit a novel change in how UK regulated banks had to report their leverage ratios to study the effect leverage ratio regulation has on repo markets. From January 2016 onwards the seven largest (stress-tested) UK regulated banks became formally subject to a 3 percent leverage ratio which they are required to report to the regulator on a quarterly basis. Until January 2017 these banks could report their leverage ratio based on monthly balance sheet averages, after this date reporting was based on daily

balance sheet averages. This change reduced the ability of banks to window-dress their balance sheet at month-end and therefore effectively made the leverage ratio more binding. We show that a tightening of the leverage ratio resulting from a change in reporting requirements incentivized UK dealers to reduce their repo activity, especially affecting small banks and non-bank financial institutions. However, the UK gilt repo market showed resilience with foreign, non-constrained dealers quickly stepping in to partially fill the void. These findings suggest that dealer-banks respond to tighter regulation, although they do not point to intended or unintended consequences of the Basel III regulatory reforms.

In Chapter 2, we examine the transmission channels and side effects on the real economy of capital outflow controls as a crisis management and financial stability tool. As Helene Rey in her Jackson Hole speech in 2013 argued, there is a global financial cycle that affects local credit conditions in emerging markets. After nearly a decade, as monetary policy in advanced economies begins to normalize and global financial conditions tighten, many emerging market economies either adjust their FX market operations or explicitly regulate capital outflows. While recent evidence suggests that FX market operations mitigate the vulnerability of local banks to the global financial cycle, much less is known on capital outflows regulation. Analyzing an episode of outflow controls in Greece in June 2015, we separate effects on exports arising from changes in imported inputs – the *trade* channel – and external financing conditions – the *financial* channel. We show that the lack of

imported inputs reduced exports at the intensive margin. The adjustment was not driven by changes in credit conditions as – in the run-up to outflow controls – firms were stockpiling cash reserves out of the Greek banking system and in foreign banks – sufficient to cover the variable costs of exports – insulating them from the weak local banks. However, the cash buffer abroad was only limited to cover the large upfront costs of exports that are associated with the extensive margin. We show that firms with greater dependence on external financing, regardless of their cash reserves strategy, reduced both the range of products they exported and the range of destinations they served. Overall, our findings suggest that regulating capital outflows helps to restore financial stability, but has unintended consequences on the real economy that manifest themselves through multiple channels. Identifying these channels informs on the policy responses required to mitigate the unintended consequences of capital outflow controls. Emerging markets should therefore weigh the benefits to financial stability against the costs to the real economy of capital outflow controls as a crisis management and financial stability tool.

Finally, in Chapter 3, we examine the effect financial globalization has on trade integration. Since the outburst of the global financial crisis, a large number of studies has documented that local shocks can transmit globally because of international financial linkages. However, as Maurice Obstfeld discussed in the 13th BIS Annual Conference, financial globalization can potentially be a potent source of economic benefits. However, as implied by the various theoretical frameworks

causality between financial globalization and trade integration can run both ways. We exploit quasi-natural experimental variation at the country-pair-year level that arises from the Financial Services Action Plan (FSAP) of the European Union (EU) in period 1999-2003. FSAP was a set of reforms in banking, insurance and securities markets, which harmonized EU member states' financial regulation, integrated financial markets and reduced the costs of cross-border financial intermediation. Unlike Regulations that imply immediate effect across member states, the transposition of EU Directives into national law can be slow, often beyond the EU official deadlines. The timing of the transposition of the same Directive creates variation in the regulatory harmonization of EU financial legislation within a country-pair and across years. Exploiting this variation, we first show that the harmonization of financial regulation increases de-facto financial integration. The effect is more pronounced when regulatory harmonization leaves no discretion to member states over the rules to be implemented. This novel result points to the importance of a level playing field in financial regulation. Exploiting the de-jure financial integration as an exogenous component of de-facto financial integration, we find that stronger international financial linkages do not increase bilateral trade on aggregate. Instead, industries that are more responsive to global shocks (e.g. a global demand shock or an oil production shock) trade more at higher levels of financial integration. We show that industries trade more at both margins – intensive and extensive. Overall, our findings suggest that financial globalization is a

key driver of trade integration, but the benefits are not evenly distributed across firms and industries.

Chapter 1

REPO MARKET FUNCTIONING: THE ROLE OF CAPITAL REGULATION

Joint with Neeltje van Horen

"In the context of evaluating the impact of post-crisis regulatory reforms, concerns have been raised that some of the measures introduced have had a negative impact on the functioning of repo markets. Market analysts and industry associations have argued that regulatory reforms have significantly reduced the willingness of banks to provide repo services."

Financial Stability Review, ECB, November 2017

1. Introduction

The market for repurchase agreements (repos) is a critical part of the financial system with around 12 trillion dollar of repo and reverse repo outstanding globally (CGFS, 2017).[1] The market plays a key role in facilitating the flow of cash and securities around the financial system, benefiting both financial and non-financial firms. By supporting liquidity in other markets, it contributes to the efficient allocation of capital to the real economy. And, since the Libor scandal, several

[1] A repo is essentially a secured loan. A dealer sells a debt security, usually a government bond, to another party in exchange for cash and agrees to repurchase it for an equivalent security at a specified date. Reverse repo is the same transaction but seen from the point of view of cash lender.

central banks have selected benchmark rates based on the repo market.[2] A well-functioning repo market is thus crucial for financial stability and for the efficient transmission of monetary policy.

However, in the wake of the financial crisis, the dynamics in the repo market have changed considerably. Liquidity in core repo markets has dropped, costs faced by some agents have increased and a weakening of repo market functioning has been reported (Bank of England, 2016; Duffie, 2016; CGFS, 2017). It is argued that Basel III regulatory reforms, most notably the leverage ratio, played an important role in this (Duffie, 2016; CGFS, 2017). In the words of Jerome Powell *"many point to post-crisis regulation as a key factor driving any recent decline in liquidity (...) I would agree that it is one factor driving recent changes in market making."*[3] In this paper we show that the leverage ratio indeed affects the repo market, with important heterogeneous effects.

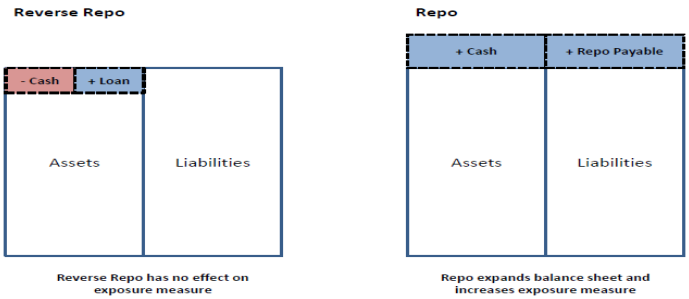
As opposed to the capital ratio, the leverage ratio is a non-risk weighted measure that requires banks to hold capital in proportion to the overall size of their balance sheet. Due to its non-risk weighted nature a binding leverage ratio makes it more costly to engage in low

[2] Recently the Federal Reserve Bank of New York launched as an alternative to the dollar-based Libor a new benchmark rate: the Secured Overnight Financing Rate (SOFR) based on transactions in the Treasury repo market. Switzerland also selected a benchmark rate based on the repo market. The Bank of England and Bank of Japan selected an unsecured rate as the benchmark alternative to sterling- and yen-based Libor.

[3] From his speech on *The Evolving Structure of U.S. Treasury Markets* at the Federal Reserve Bank of New York (October 20, 2015).

margin activities.[4] This potentially has implications for repo intermediation. The margin on repos is low but they expand a bank's balance sheet and therefore attract a capital charge under the leverage ratio (Figure 1.1). As a result, the leverage ratio makes engaging in repo activities more costly relative to engaging in activities with higher margins (but equal capital charge). Banks can hence be expected to react to this increase in costs by limiting their repo market activity.

Figure 1.1: Leverage Ratio and Repo Market



The empirical identification of the impact of the leverage ratio on repo markets is however challenging. First, one needs to find plausibly exogenous variation in the leverage ratio that affects some

[4] For example, assuming a Tier 1 risk-weighted asset (RWA) capital ratio requirement of 6 percent and a Tier 1 leverage ratio requirement of 3 percent, any asset on the firm's balance sheet that is risk-weighted below 50 percent would attract higher capital requirements under the leverage ratio than under the Tier 1 RWA capital requirements.

key participants in the repo market but not all of them. Second, the shock should not coincide with other factors affecting repo markets. Third, one needs to convincingly isolate the adjustment in supply from that driven by demand.

In this paper we address all three empirical challenges by, for the first time, exploiting a policy change that took place in the UK, one of the world's core repo markets. On January 2017, the Bank of England changed the way in which UK regulated banks had to *report* their leverage ratio (Bank of England, 2015a,b). [5] From January 2016 onwards the seven largest (stress-tested) UK regulated banks became formally subject to a 3 percent leverage ratio which they were required to report to the regulator on a quarterly basis.[6] During a transitional period of 12 months, reporting banks could measure their *on*-balance sheet assets on the last day of each month and take the average over the quarter ("monthly averaging"). From January 2017 onwards, the *on*-balance sheet assets had to be measured on each day ("daily averaging"). Both the capital measure as well as the off-balance sheet assets continued to be measured at month-end. This switch from monthly to daily averaging in relation to *on*-balance sheet assets

[5] The leverage ratio is defined as a bank's Tier 1 capital divided by its total exposure measure which consists of the bank's total on-balance sheet assets and certain off-balance sheet exposures.
[6] These are Barclays, HSBC, Nationwide, Lloyds, RBS, Santander and Standard Chartered.

reduced the ability of banks to window-dress their balance sheet at period-ends and effectively made the leverage ratio more binding.[7] [8]

The change in reporting requirement of the leverage ratio affected four dealers in the gilt repo market, but not the remaining 12 dealers, providing us with a natural treatment and control group.[9] Furthermore, the change did not coincide with any other regulatory change or adjustment in (unconventional) monetary policy in the UK potentially affecting repo markets. In addition, even though the change in reporting was already announced in November 2015, affected banks had no incentive to adjust their behaviour prior to the actual change in January 2017. Finally, all UK dealers had an incentive to adjust their repo activity even when not close to the regulatory constraint in order to avoid the market reacting to a change in their leverage ratio.

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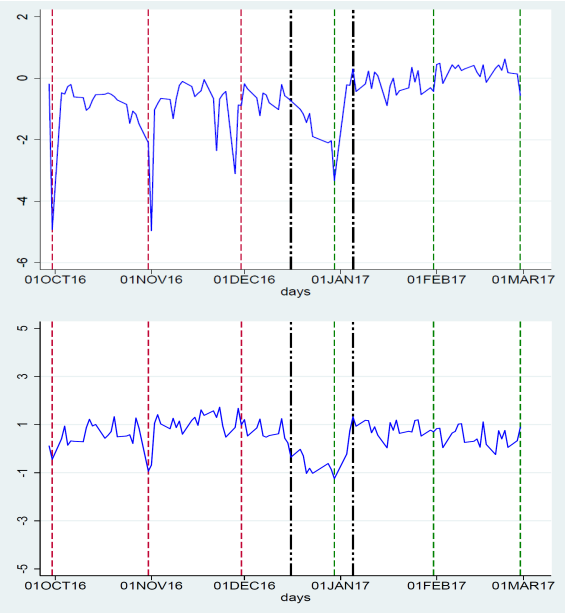
[7] Recently repo markets have been characterized by volatilities in prices and volumes over period ends (quarter-ends and year-ends) as banks are reducing the size or improving the composition of their balance sheets at these times. Regulatory constraints, such as the leverage ratio, have been identified as one of the drivers behind window-dressing behavior of European dealers (Anbil and Senyuz, 2018). Munyan (2015) shows that unlike non-US dealers, US dealers had no incentive to engage in window-dressing as they report capital ratios based on daily averaging.

[8] See also ICMA European repo and collateral council report (February 2017) which argues that daily averaging reduces overall balance sheet capacity throughout the year. In other words, the shock we exploit is expected to work through the leverage ratio constraint.

[9] The affected dealers are Barclays, HSBC, Lloyds and Santander. The unaffected dealers are Bank of America-Merrill Lynch, BNP Paribas, Citigroup, Deutsche Bank, Goldman Sachs, JP Morgan, Morgan Stanley, Nomura, RBC, Scotiabank, TD Bank and UBS.

These features make it an ideal quasi-natural experiment to study if and how capital regulation affects repo market functioning. And, as is apparent from the top panel of Figure 1.2, the four dealers affected by the regulatory change indeed reacted strongly. The graph depicts the evolution of the (standardized) total repo volume intermediated by these dealers over the period October 2016 to February 2017. During the period of "monthly averaging" they reduced repo volumes at each month-end, in line with window-dressing behaviour. After the move to "daily averaging" we do not observe such behaviour anymore, indicating that the leverage ratio effectively became more binding. As expected, the non-affected dealers did not change their behaviour (Figure 1.2, bottom panel).

Figure 1.2: Daily Repo Volume by Affected and Non-Affected Dealers



Exploiting this intensification of the leverage ratio, we assess how dealers adjusted their repo intermediation in the bilateral dealer-client repo market. We focus on this segment of the market for a number of reasons. First, it allows us to study how the leverage ratio affects the ability of end-users such as banks, insurers, pension funds, hedge funds and asset managers, to invest their cash low risk and to have access to government securities. Due to lack of detailed data, this part of the repo market has hitherto received very little attention. However it is a critical part of the market capturing almost 70 percent of total transaction volume in the UK and about 50 percent in the US.[10] As such, understanding the precise impact of capital regulation on this segment of the market is essential and complements the literature studying its impact on the US tri-party repo market (e.g. Munyan, 2015; Allahrakha, Cettina and Munyan, 2016; Anbil and Senyuz, 2018). Second, it provides us with the unique opportunity to examine how the leverage ratio affects a diverse set of repo market end-users depending on their size, relationship with the dealer and sector. Third, the impact of the leverage ratio is expected to be more pronounced in this segment as these trades are not cleared via a Central Clearing Party (CCP) which reduces the ability of banks to net out a repo with a

[10] To the best of our knowledge, the UK is the only core repo market which has data available capturing the universe of bilateral repo transactions. In 2014, the Office of Financial Research and the Federal Reserve System launched a voluntary pilot data collection focused on the US bilateral repo market, but comprehensive data is still lacking (Baklanova, Caglio, Cipriani and Copeland, 2016).

reverse repo transaction and as such avoid a capital charge.[11] Not surprisingly, there are ample signs of a reduced willingness of banks to use their balance sheet for repo especially affecting end-users in the market (CGFS, 2017).

We employ a new database, the Sterling Money Market Database (SMMD), which contains supervisory transaction-level data covering the near-universe of gilt repo transactions and it has two unique advantages. First, besides detailed information on the volume, pricing and collateral used in each transaction, the database importantly includes both the reporting dealer (the cash borrower) and the counterparty (the cash lender). This enables us to compare adjustments in repo intermediation at the *dealer-client* level allowing for a much tighter identification. Furthermore, as we know each counterparty, we are able to study whether the leverage ratio affects different clients differently. Second, the database clearly identifies each gilt repo transaction. As such, we do not have to rely on a matching algorithm along the lines of Furfine (1999) in order to isolate gilt repo transactions from other transactions and to identify both sides of the

[11] A bank can net out its repo with a reverse repo transaction when it involves transactions to the same counterparty, with the same maturity date and conducted in the same settlement system. This repo transaction then does not count towards the balance sheet anymore and therefore lowers the bank's leverage ratio. Transactions via the CCP are considered transactions to the same counterparty and therefore much more likely to be eligible for netting. In the UK the vast majority of interdealer trades are cleared by a CCP.

transaction.[12] To the best of our knowledge, this is the first paper studying the heterogeneous effects of capital regulation on repo markets.

In a standard difference-in-differences setting, we compare repo intermediation within dealer-client pairs before and after the policy shock differentiating between affected dealers (treatment group) and non-affected dealers (control group). For identification purposes, we focus on clients with at least two dealers and control for observed and unobserved heterogeneity in repo demand and credit risk by employing client fixed effects (Kwaja and Mian, 2008). In other words, for the *same* client, we compare the differential adjustment in repo volumes by affected and non-affected dealers.

Our main results are as follows. First, we find that dealers affected by the leverage ratio on average reduced repo volume (i.e. accepted less cash) from their clients relative to non-affected dealers. Critically, this result holds when controlling for changes in demand and credit risk at the client level. The economic magnitude of this change is substantial. On average, affected dealers accept 66 percentage points less repo volumes compared to non-affected dealers

[12] When using datasets such as Target2 and Fedwire, the use of algorithms is necessary so the output includes transactions that do not represent transactions that are of interest to the researcher or may discard transactions that should be included and these types of errors can be large (Armantier and Copeland, 2012).

from the same client in the period after the policy change compared to the period before. [13]

This effect, however, hides some important heterogeneous effects. Motivated by the CGFS (2017) report on repo market functioning, we first differentiate between small and large clients (as measured by their total repo activity in the period prior to the regulatory change) and find that dealer banks subject to the regulatory change reduced repo volume more to their smaller clients compared to their larger clients, relative to non-affected dealers. These results hold when controlling for demand and concurrent factors potentially affecting individual dealers. We also find that dealers tend to move away from clients with whom they have a weaker relationship; however the impact of size dominates. We do not find a differential effect for clients with more long-term repos, that tend to be cash borrowers or that are foreign.

Economic effects are large with affected dealers intermediating on average 133 percentage points lower repo volumes from their small relative to their large clients compared to non-affected dealers.[14] We show that this differential behavior is persistent, consistent with the manifestation of a permanent change in repo market intermediation. Furthermore, affected dealers were not behaving

[13] This magnitude reflects the combined effect of affected dealers reducing repo volume they accept from their clients and the non-affected dealers increasing it.

[14] This magnitude again reflects the combined effect of affected dealers reducing the repo volume they accept from their small clients relative to their large clients, while non-affected dealers are increasing theirs.

differently prior to the regulatory change reducing concerns that our results are driven by different pre-event trends between the two types of dealers.

When examining the impact on the extensive margin and other loan terms, we document a (persistent) reduction in the frequency of transactions and a reduction in repo rates that affected dealers are willing to offer to their (small) clients. We do not find an adjustment in haircuts or maturities. These findings are as expected as the intensification of the leverage ratio should only affect volumes and prices. Bigger haircuts reflect a worsening of the quality of the underlying collateral and maturities mainly relate to a client's business model, so both should not be affected by the intensification of the leverage ratio.[15]

The heterogeneous effects we document are in line with evidence gathered from market participants (CGFS, 2017) and puts rigor to the causal interpretation of our findings. As interactions with large clients are much more frequent, profit margins and franchise value tend to be higher. In addition, larger clients more likely provide ancillary business which justifies use of balance sheet and have more negotiating power over the contract terms. Finally, with larger clients it is more likely that a dealer can net out a repo with a reverse repo transaction which implies that the transaction does not count towards the balance sheet. As such, dealer banks are expected to adjust their

[15] Our non-result is in line with the notion that collateral and maturity are substitute mechanisms in mitigating agency problems (e.g. Ortiz-Molina and Penas, 2008).

repo intermediation to small relative to large clients, in line with our findings.

In the final section of the paper we investigate the aggregate effect and repo substitution. A conservative back of the envelope calculation suggests that, keeping all else equal and not allowing for the possibility of substitution, the withdrawal of affected dealers resulted in small clients being able to place 32 percent, equaling 2.9 billion pounds, less cash in the gilt repo market. However, we find evidence that this is partially offset by non-affected dealers increasing their repo activity to these clients. This was primarily done through an intensification of pre-existing relationships, rather than through the establishment of new ones. In line with this, non-affected dealers increased their market share to small clients from 39 to 49 percent after the regulatory change. These results indicate that competing, non-constrained, foreign dealers took the opportunity to capture market share when affected, UK dealers withdrew from the small end-user segment of the dealer-client market. The market therefore seems to have been resilient and adjusted quickly.

The remainder of the paper is structured as follows. The next section provides a review of the literature. In Section 3 we describe in more detail the gilt repo market and how the leverage ratio affects repo market intermediation. Section 4 outlines our empirical methodology and describes the SMM database that we exploit. Section 5 presents and discusses our empirical findings and Section 6 analyses the aggregate effect and market adjustment. Section 7 concludes and discusses the policy implications of our findings.

2. Related literature

Our paper contributes to and combines two main strands of the literature. First, it contributes to the literature that studies the repo market. Most recent studies have focused on the functioning of the US repo market around the global financial crisis (Gorton and Metrick, 2012; Krishnamurthy, Nagel, and Orlov, 2014 ; Copeland, Martin, and Walker, 2014) or the European repo market around the sovereign debt crisis (Mancini, Ranaldo and Wrampelmeyer, 2016; Boissel, Derrien, Ors and Thesmar, 2017), broadly concluding that both markets resisted the stress fairly well with no significant decline in volumes but with some increases in haircuts.

A more nascent part of this literature focuses explicitly on how regulation affects repo markets. Studying the US tri-party repo market Munyan (2015) and Anbil and Senyuz (2018) provide evidence that indicates that non-US banks reduce their repo activity around financial reporting dates to appear better capitalized.[16] Allahrakha, Cettina and Munyan (2016) document a number of changes in the US tri-party repo market after the announcement of the leverage ratio in the US, such as a reduction in borrowing, an increase in use of more

[16] A related literature studies window-dressing behavior in other markets. Du, Tepper and Verdelhan (2018) document covered interest rate parity violations at quarter-ends indicating that post-crisis regulation drives a wedge between supply and demand due to costly financial intermediation. Abbassi, Iyer, Peydro and Soto (2017) find that after the ECB's announcement of its asset quality review, reviewed banks decreased their share of riskier securities and loans and the level of overall securities and credit supply.

volatile collateral and a shift towards non-bank dealers. Using a sample of European banks, Baldo, Bucalossi and Scalia (2018) show that repo activity outside the leverage ratio reporting dates has not decreased. Focusing primarily on the interdealer segment of the gilt repo market, Bicu, Chen and Elliott (2017) find no statistically significant evidence of a reduction in repo liquidity after the announcement of the leverage ratio in the UK.

Our work extends this literature in several ways. First, we explicitly focus on the dealer-client segment of the repo market, which hitherto received very little attention due to unavailability of data. As this is a major segment of the repo market (more than 70 percent in the UK), understanding its functioning is essential. Second, in contrast to the above literature, the quasi-natural experiment that we exploit in combination with detailed transaction level data allows us to address the empirical challenges that one faces when isolating the impact of the leverage ratio from other confounding factors and to isolate demand from supply. This enables us to make a clean assessment of the causal impact of the leverage ratio on repo market functioning. Third, the data allow us to examine how capital regulation affects different clients and therefore to uncover heterogeneous effects.

Second, our paper contributes to the literature that studies the consequences of capital regulation. Not surprisingly, given its early introduction, most of this literature has focused on the impact of changes in the capital ratio, showing that an increase in capital requirements (or cost) leads banks to contract lending (see among others, Berger and Udell, 1994; Aiyar, Calomiris, Hooley, Korniyenko

and Wieladek, 2014; Jimenez, Ongena, Peydro and Saurina, 2017) with important negative real effects on firms (Gropp, Mosk, Ongena and Wix, 2018) and that it induces credit re-allocation towards non-bank financial intermediation (Irani, Iyer, Meisenzahl and Peydro, 2018).

While the leverage ratio has received a lot of press coverage and is discussed extensively in policy debates, the academic literature on its impact is still relatively scarce. However it is growing rapidly. Adrian, Boyarchenko and Shachar (2017) find evidence that indicates that leverage regulation leads to a reduction in bond liquidity. Acosta Smith, Grill and Lang (2017) and Choi, Holcomb and Morgan (2018) show that the leverage ratio incentivizes banks to shift their portfolio to riskier assets but does not increase overall bank risk. Furthermore, recent research shows that the leverage ratio discourages dealers to engage in FX trading activity (Cendese, Della Corte and Wang, 2018) reduces their willingness to clear derivatives on behalf of clients (Acosta Smith, Ferrara and Rodriguez-Tous, 2018) and to participate in spread-narrowing trades (Boyarchenko, Eisenback, Gupta, Shachar and Van Tassel, 2018). We add to this literature by showing that the leverage ratio affects repo market functioning with dealers moving away from smaller end-users when the leverage ratio becomes more binding.

3. Leverage ratio and repo market intermediation

This section describes the functioning of the gilt repo market in the UK and then discusses how the leverage ratio in general and the change in

the reporting requirement in particular affect the repo market functioning.

3.1 Gilt repo market

Formally, a repo is a "repurchase agreement": an agreement to sell securities (referred to as collateral) at a given price to a counterparty with the commitment to repurchase the same (or similar) security at a specified future date for a specified price. The difference between the price at which the security is sold and repurchased reflects an annualized interest rate known as the repo rate. From the point of view of the cash borrower the transaction is referred to as repo, while from the point of view of the cash lender it is referred to as reverse repo. A repo transaction is economically equivalent to a secured loan since the securities provide credit protection in the event that the seller (i.e. the cash borrower) is unable to complete the second leg of the transaction. Collateral haircuts and regular margin payments further protect the lender against fluctuations in the value of the collateral. The majority of repo transactions are overnight transactions; however a substantial share consists of maturities ranging from a couple of days to a number of months.

Repo markets play a key role in facilitating the flow of cash and securities around the financial system. They create and support opportunities for the low-risk investment of cash, as well as efficient management of liquidity and collateral by financial and non-financial firms. The repo market supports the smooth functioning of derivatives markets as it provides market participants with means to obtain high-

quality collateral that can be used as margin. Movements in short-term repo rates change the market-based financing conditions for banks and hence their conditions for trading with firms and households. This means that repo rates are a prime channel through which changes in the monetary policy stance are transmitted to the broader financial system and the real economy. The repo market is therefore key to the short-term liquidity needs of banks and non-bank financial institutions and a cornerstone of the transmission of monetary policy.

Although the precise structure of the repo market varies across jurisdictions, there are two segments: the dealer-to-dealer (interdealer) and the dealer-to-client segment (dealer-client). In the interdealer market, dealers transact to finance their market-making inventory, source short-term funding or invest their cash and they transact on behalf of their clients. In the dealer-client segment, end-users meet with dealers to provide collateral in return for cash (e.g. asset managers, pension funds, hedge funds and insurance companies) or to invest in cash while receiving collateral (e.g money market funds or corporate treasurers). Banks in addition use reverse repo to borrow gilts for their liquid asset buffers.

Trades can be settled in three ways: bilateral, triparty and via a Central Clearing Party (CCP). The difference between bilateral and triparty repo is that in the latter market a third party called a clearing bank acts as an intermediary and alleviates the administrative burden between two parties engaging in a repo. The clearing bank does not assume the credit risk of the counterparties in the transaction. When trades are settled through a CCP the CCP acts as the clearing bank but

also assumes the credit risk by becoming the buyer to all sellers and the seller to all buyers. Only members of the CCP can trade through the CCP. As CCP membership is expensive it is typically limited to large banks and dealers.

In the UK the vast majority of interdealer transactions are cleared by a CCP and this accounts for close to 30 percent of all repo transaction volume. The dealer-client segment is almost entirely settled bilaterally and captures almost 70 percent of total transaction volume. Only a tiny segment of the UK repo market is settled on tri-party basis (less than 5 percent). In contrast, half of the dealer-client segment of the US repo market segment is settled bilaterally and half is settled tri-party via a clearing bank, such as the Bank of New York Mellon and JP Morgan Chase (Baklanova, Dalton and Tompaidis, 2017).

The vast majority of sterling-denominated repo involves the sale and repurchase of gilts (UK government bonds) issued by the UK Debt Management Office (DMO). Around the policy shock there were 16 dealer banks active in the market. These are Bank of America-Merrill Lynch, Barclays, BNP Paribas, Citigroup, Deutsche Bank, Goldman Sachs, HSBC, JP Morgan, Lloyds, Morgan Stanley, Nomura, RBC, Santander, Scotiabank, TD Bank and UBS.[17] As of mid-2016, there was about 900 billion USD repo and reverse repo collateralized by gilts outstanding, which makes the UK the fourth largest repo market (after the Euro area, US and Japan) (CGFS, 2017).

[17] There are also two non-bank dealers active, but we do not include them in the analysis.

3.2 Leverage ratio

In the wake of the global financial crisis the Basel Committee of Banking Supervision (BCBS) undertook a significant program of reform to banking regulation known as Basel III. The reform introduced new international regulatory standards for both capitalization and liquidity risk management. One of the key regulatory reforms was the introduction of the leverage ratio. As opposed to the capital ratio, the leverage ratio is a non-risk weighted measure that requires banks to hold capital in proportion to the exposure measure (including both on-balance sheet exposures and some off-balance sheet items). The requirement constrains leverage in the banking sector and thus helps to mitigate the risk of destabilizing deleveraging processes. Furthermore, as it is independent of risk, the leverage ratio provides a safeguard against model risk and measurement error which affects the capital ratio.

However, because of its non-risk weighted nature the leverage ratio effectively makes it more costly for banks to engage in low margin activities. This potentially has implications for repo intermediation as the margin on repos is low but they expand a bank's balance sheet and therefore attract a capital charge under the leverage ratio (Figure 1). As a result, the leverage ratio makes it effectively more costly for banks to assign balance sheet to repos relative to assets with higher margins (but equal capital charge). Banks can hence be expected to react to this increase in cost by limiting their repo activity.

The BCBS first indicated that it planned to introduce a leverage ratio in a consultation document in 2009 and proposed a 3 percent target in 2010 (BCBS, 2009 and 2010). At this time it also proposed a transition path to implementation whereby banks would be required to publicly disclose their leverage ratios starting in January 2015. In 2014, the BCBS finalized the definition of the leverage ratio and reiterated that the leverage ratio would become a Pillar 1 requirement from 2018 onwards (BCBS, 2014).

The way domestic regulators have implemented the leverage ratio varies across jurisdictions. UK authorities have implemented the leverage ratio earlier than the Basel and EU timelines. The seven largest UK banks (those subject to regulatory stress-tests) have been expected to meet a 3 percent leverage ratio since January 2014 (Bank of England, 2013). End 2015 the UK leverage ratio framework was announced, stipulating a 3 percent minimum requirement for the seven banks (Barclays, HSBC, Nationwide, Lloyds, RBS, Santander and Standard Chartered) starting in January 2016 (Bank of England, 2015a,b). Other UK regulated banks (smaller domestic banks and foreign subsidiaries other than Santander) will become subject to a 3 percent minimum requirement under CRD IV to be implemented after 2019. For a detailed timeline of the implementation of the leverage ratio in the UK see Appendix Table 1. [18]

[18] For a further description of how UK authorities implemented the leverage ratio see Bicu, Chen and Elliott (2017)

4. Empirical methodology and data

In order to examine how the leverage ratio affects repo intermediation in the bilateral dealer-client market, we exploit a regulatory change in the UK which modified the way banks had to report their leverage ratio. This policy change affected some dealers in the UK sterling money market but left the other dealers unaffected and, thus, provides us with an ideal quasi-natural experiment.

As of January 2016 four dealers in the gilt repo market, Barclays, HSBC, Lloyds and Santander, became formally subject to a 3 percent leverage ratio which has to be reported on a quarterly basis. During a transitional period of 12 months the reporting banks could measure their on-balance sheet assets on the last day of each month and take the average over the quarter ("monthly averaging"). From January 2017 onwards the on-balance sheet assets had to be measured on each day ("daily averaging"). This switch from monthly to daily average reporting reduced the ability of banks to window-dress their balance sheet and effectively made the leverage ratio more binding. The remaining 12 dealers did not have to report their leverage ratio to the Bank of England and as such were not subject to the change in this requirement providing us with a natural treatment and control group.[19]

[19] These dealers are headquartered in the EU, US and Canada and therefore (also) subject to regulation in their home markets. The US implementation of the Basel III leverage ratio is the supplementary leverage ratio that requires certain banks to hold tier 1 capital equivalent to 3 percent of total exposures. US banks that are subject to the supplementary leverage ratio began disclosing and reporting their ratios in 2015, and must be in compliance by 2018. In addition, an

Figure 2 shows that the change in reporting requirements indeed affected the behavior of the UK regulated dealers. It depicts the evolution of the (standardized) total repo volume intermediated by UK regulated (top panel) and non-UK regulated (bottom panel) dealers over the period October 2016 to February 2017. As the graph shows, prior to the regulatory change the UK regulated dealers substantially reduced their repo volumes around month-ends, while non-UK regulated dealers did not. After the regulatory change the volume reductions were much less pronounced and more in line with the behavior of non-UK regulated dealers. These patterns show that "monthly averaging" incentivized UK regulated dealers to window-dress their balance sheet, which after the regulatory change was not beneficial anymore.

The change in regulatory reporting provides us with plausibly exogenous variation in the intensification of the leverage ratio in order to assess its impact on repo intermediation. Using the change in reporting requirements instead of the introduction of the leverage ratio is useful for several reasons. First, the policy shock is much cleaner compared to the introduction of the leverage ratio itself. The UK regulatory authorities announced the implementation of the leverage

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enhanced supplementary leverage ratio (eSLR) will come into effect in 2018 and requires G-SIBs and insured depository institutions of G-SIBs to meet a 5 percent and 6 percent minimum leverage ratio, respectively. Canadian banks have to maintain a leverage ratio that meets or exceeds 3 percent at all times since January 2015. European banks have to disclose their leverage ratio since 2015 but do not have to meet a 3 percent minimum as part of their Pilar 1 capital requirements.

ratio ahead of time specifically to give banks time to gradually adjust their balance sheet. Therefore it is hard to contribute changes in the repo market to the *introduction* of the leverage ratio. The change in reporting requirement that we exploit was also announced ahead of its actual implementation (at the end of 2015), however dealers did not have an incentive to change their behaviour ahead of the implementation date. The vast majority of repo transactions are very short-term, so dealers do not have to adjust their repo rates or volumes until the daily average requirement comes into effect. This makes it possible to isolate the impact of the leverage ratio on repo intermediation from other confounding factors. Furthermore, all UK dealers had an incentive to adjust their repo activity even without a binding leverage in order to avoid the market reacting to a change in their leverage ratio. Finally, and crucial for our identification, the change in regulation did not coincide with any other regulatory changes or changes in (unconventional) monetary policy in the UK that could affect repo market intermediation. As such, the reporting change provides us with a suitable exogenous policy shock that affects some dealers in the gilt repo market, while leaving others unaffected.

4.1 Identification strategy

We want to assess how the leverage ratio affects the ability of end-users such as banks, insurers, pension funds, hedge funds and asset managers, to invest their cash low risk and to have easy access to government securities. Having identified exogenous variation in the intensification of the leverage ratio allows us to perform a difference-

in-differences analysis in which we compare repo intermediation within dealer-client pair before and after the policy shock differentiating between dealers affected and not affected by the shock.

We compare the behaviour of the two types of dealers in the month before and after the regulatory change. To avoid any bias from increased volatility resulting from dealers' practices to window-dress and adjust their balance sheets at year-end, we drop the last two business weeks of December 2016 and the first business days of January 2017 (see Figure 2). [20] We ensure that both the pre and post periods have the same number of week days as to assure that results are not driven by different activity on certain days of the week. As such, our *pre* period ranges from November 21 to December 16, 2016 and the *post* period ranges from January 5 to February 1, 2017 (i.e. 4 business weeks each). We use a relatively short period of time for two reasons. One, this market is very different from the corporate loan market: it is very short term, often overnight, and clients tend to use the market repeatedly during a short time window. Second, as the market is affected by unconventional monetary policy and (changes in) other regulatory requirements (CGFS, 2017), the longer the time window around the event the more likely confounding factors will affect the estimates. However, we show that our results remain robust when we consider alternative time windows.

[20] At year end both types of dealers significantly reduce their repo volumes as banks reduce the size or improve the composition of their balance sheets because of regulatory constraints such as the leverage ratio, the G-SIB surcharge and the SRF levy, and because of commercial and taxation consideration (CGFS, 2017).

We analyse the same dealer-client pair before and after the policy shock. However, it is crucial to also control for changes in demand and risk at the client level. Therefore we focus on clients that were placing cash in the pre-period with at least 2 different dealers and continue to transact with them in the post period.[21] This allows us to saturate the specification with client fixed effects and to control for both observed and unobserved heterogeneity in client fundamentals (demand, quality and risk). In other words, for the *same* client, we compare the differential adjustment in repo intermediation by affected and non-affected dealers (Khwaja and Mian, 2008).

4.2 Data

We use a new regulatory database called the Sterling Money Market Database (SMMD). The aim of this data collection is to secure and improve information available to the Bank of England on conditions in the sterling money market to help the Bank meet its monetary policy and financial stability objectives. The database contains virtually all transactions, from overnight to one year, conducted in the secured and unsecured sterling money market as reported by the 23 most active participants in the market (this captures about 95 percent of the total market).[22] The transactions include both repos and reverse repos

[21] Clients with only one dealer represent <1 percent of total repo volume in our sample.

[22] The data that are available from 1 February 2016 contain a subset of 'early adopters', comprising roughly 80 percent of the full population. The full reporting population is contributing since 1 July 2016. This full population of reporters is chosen to cover 95 percent of the volume of activity in the sterling money market, and may be expected to

secured against gilts and known as gilt repo. The database includes transactions in both the interdealer and the dealer-client repo market, but we focus exclusively on the latter segment of the market. We have access to five months of data: October 2016 – February 2017.

The SMM database has two unique advantages. First, besides detailed information on the volume, pricing and collateral used in each transaction, the database importantly includes both the reporting dealer (the cash borrower) and the counterparty (the cash lender). This allows us to effectively compare adjustments in repo intermediation *within* dealer-client pairs and to examine in detail differential adjustments across client types. Second, as the database clearly identifies gilt repo transactions, we do not have to rely on a matching algorithm along the lines of Furfine (1999) in order to isolate the gilt repo transactions from other transactions and to identify both sides of the transaction, a procedure that is necessary when using transaction level datasets such as Target2 and Fedwire. As such we can say with certainty that all transactions we capture are indeed gilt repo transactions, that we do not wrongly exclude repo transactions from any of the reporting banks and that the party identified as the cash lender is indeed the correct counterparty.

We clean the data in a number of ways. First, while there are 23 reporting entities, only 16 of those are dealers in the repo market. As the dealers are the biggest intermediaries we capture the vast

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change over time to remain in line with this aim. For more information on the scope of and process for reporting, see www.bankofengland.co.uk/statistics/Documents/reporters/defs/instructions_smm.pdf.

majority of trades (>95% in terms of repo volumes). Second, we are only interested in clients that are banks or non-bank financial institutions, such as pension funds, hedge funds and insurance companies, and therefore we drop all repo transactions involving non-financial corporates. In addition, we drop dealer-client transactions in which the client is another dealer (interdealer transactions), a State, a Central Bank or a trust, because of different business models. Third, for most transactions counterparties are reported using either their unique legal entity identifier (LEI) or their name (for about 70 percent of the transactions the LEI is provided). However, in a few instances (<10 percent of total transactions), due to privacy laws, only the sector of the counterparty is provided. As our identification relies on changes in repo intermediation at the dealer-client level, we cannot include transactions for which the counterparty name is not available, hence we drop these.[23] We further drop transactions with variable rate, pool or multiple collateral and tri-party repo transactions.[24]

As counterparty names are provided at the legal entity level, different funds of the same asset manager are reported as different counterparties. Although a laborious task, we manually aggregate these different legal entities into a parent company and use this as the client in our model.[25] We take this approach as credit risk, reputation and size

[23] This mainly affects transactions reported from institutions based in France.

[24] Transactions with these characteristics represent less than 5 percent of total transactions.

[25] A similar consolidation procedure is applied by the Office of Financial Research in the U.S. Money Market Fund Monitor data.

of the parent company will ultimately determine to what extent a dealer will adjust its repo activity. Furthermore, focusing on the parent company avoids classifying the same legal entity as different counterparties because different dealers use different reporting conventions.

In order to control for demand and changes in credit risk we only include clients that were placing cash with at least two different dealers and who continue to transact with these dealers in the post period. Our final sample therefore contains 15 dealers, 38 clients and 126 dealer-client pairs. On average a client interacts with 3 different dealers, but the number of dealers a client interacts with ranges from 2 to 10. Over 80 percent of the dealer-client pairs involve clients that are non-bank financial institutions, with the largest groups being hedge funds and asset managers.

In the period preceding the change in reporting requirements 4,218 repo transactions worth 306 billion pounds took place between our group of dealers and clients. Of those 75 percent were overnight, 13 percent had a maturity of one week and 11 percent of more than one week. On average a dealer-client pair interacted 33 times. The affected dealers accounted for 31 percent of total repo volume accepted.

5. Empirical results

5.1 Baseline effect

In order to examine the impact of the exogenous intensification of the leverage ratio on repo intermediation we estimate the following model:

$$\Delta log\ (Volume)_{ij} = \beta_1 \times Affected\ Dealer_i + \beta_2 \times Relationship_{ij} + \mu_j + \varepsilon_{ij}$$

where $\Delta log\ (Volume)_{ij}$ is the pre-post change in the (log of) the total repo volume accepted by dealer *i* from client *j,* with pre={November 21-December 16} and post={January 05-February 01}. We aggregate the daily transactions between a dealer-client pair before and after the regulatory change because most clients do not trade every day. Also, this way we eliminate concerns of estimation bias due to serial correlation. The variable is winsorized at the 1 and 99th percentile. $Affected\ Dealer_i$ is a dummy variable equal to 1 if the dealer was subject to the UK leverage ratio at the time of the policy change, and to 0 otherwise; $Relationship_{ij}$ is defined as the pre-determined ratio of frequency of repo transactions between dealer *i* and client *j* to total number of repo transactions of dealer *i* [26]*;* μ_j is a vector of client fixed effects; and ε_{ij} is the error term. The model is estimated using OLS and, in addition, we cluster standard errors at the dealer level. We choose this level of clustering because the coefficient of interest varies at the dealer level, as well as to account for the fact that changes in repo volumes are likely correlated within dealer. Appendix Table A.2

[26] We use the definition of relationship strength put forward by Petersen and Rajan (1994). For robustness, we construct an alternative measure of relationship between dealer-client pair, defined as the pre-determined ratio of volume of repo transactions between dealer-client to total volume of repo transactions of dealer (e.g. Afonso, Kovner and Schoar, 2011). Our conclusions remain unchanged when we employ the alternative measure.

shows the definition and summary statistics of all variables used throughout the paper.

Our coefficient of interest is β_1. A negative coefficient for β_1 would imply that—all else equal—affected dealers intermediate lower repo volumes after the policy change, compared to non-affected dealers. Put differently, the numerical estimate of β_1 captures the difference in adjustment of repo market intermediation induced by switching from the control group to the treatment group. The cross-section specification in first differences eliminates any time-invariant (un)observed heterogeneity at the dealer, client and dealer-client pair level as well as shocks common to all clients and dealers. The relationship measure controls for the importance of the client in the dealer's portfolio before the regulatory change. In our preferred specification we also include client fixed effects to allow us to control for (un)observed heterogeneity in changes in client demand, quality and risk. As such, we isolate the impact of the change in the reporting requirement of the leverage ratio on repo intermediation by comparing the change in repo volumes accepted by the same client from affected vis-à-vis non-affected dealers.

Table 1.1: Leverage Ratio and Repo

	Δlog(Volume)			
	[1]	[2]	[3]	[4]
Affected Dealer	-0.404**	-0.431**	-0.446*	-0.664*
	0.179	0.174	0.231	0.312
Relationship		-0.767	-1.074	-1.705
		0.993	1.056	1.276
Constant	0.137	0.159		
	0.113	0.108		
Client's Sector FE	no	no	yes	no
Client FE	no	no	no	yes
N	126	126	126	126
R^2	0.027	0.031	0.065	0.333

Significance Levels: .01***; .05**; .1*

Note: The table presents results from OLS regressions. Daily transactions are collapsed before and after the regulatory change using a time window of one month, where Pre={November 21-December 16} and Post={January 05-February 01}. *Δlog(Volume)* is defined as the pre-post change in the (log of) the total repo volume accepted by dealer *i* from client *j* and is winsorized at 1 and 99 percentiles. *Relationship* is a (demeaned) pre-determined continuous variable, defined as the ratio of frequency of repo transactions between dealer- client pair to total number of repo transactions of the dealer. Standard errors allow for correlation at the dealer level.

The result in Table 1.1, column (1) indicates that dealers affected by the leverage ratio on average reduced the repo volume they were willing to accept from their clients relative to non-affected dealers (significant at the 5 percent level). Without controlling for demand we find that after the regulatory change affected dealers on average reduce

repo volume they accept by 27 percent, while non-affected dealers on average increase it by 14 percent. In column (2) we control for the strength of the pre-shock relationship between dealer and client. We find no evidence that the strength of the relationship has an impact on the change in repo volume accepted.

One could be concerned that some of the clients placing cash at affected banks have a lesser need to place cash or experienced and increase in credit risk after the change in reporting requirement, relative to clients from non-affected banks. If this was the case, the reduction in repo volume instead of a supply side reaction by dealers, would be driven by lower demand and/or quality of the client. To address this concern, we first add sector fixed effects to control for changes in demand that are sector driven (column 3). Controlling for demand at the sector level barely affects our coefficient of interest.

As we only study clients that interact with multiple dealers, we next include client fixed effects to control both for heterogeneity in observable and unobservable characteristics at the client level. We find that, for the *same* client, affected dealers reduce repo intermediated compared to non-affected dealers. The coefficient now increases significantly which suggests that sector fixed effects may not be enough to control for demand in this market.

The economic magnitude of the change we document is substantial. The most saturated and therefore preferred model in column (4) shows that affected dealers accept almost 66 percentage points less repo volumes compared to non-affected dealers from the same client in the period after the policy change compared to the

period before. As is evident from the results without client fixed effects, the magnitude of this effect reflects the combined effect of affected dealers reducing repo volumes and non-affecting dealers increasing it. In other words, an intensification of the leverage ratio reduces dealers' willingness to engage in repo market activity. This average effect might however hide some important heterogeneous effects. An issue we turn to next.

5.2 Heterogeneous effects: Small versus large clients

Motivated by the CGFS (2017) report on repo market functioning, we start by differentiating between small and large clients. As interactions with large clients are much more frequent, profit margins and franchise value tend to be higher. In addition, larger clients are more likely to provide ancillary business which justifies use of balance sheet and have more negotiating power over the contract terms. Finally, with larger clients it is more likely that a dealer can net out a repo with a reverse repo transaction which implies that the transaction does not count towards the balance sheet. As such, we expect that dealers adjust their repo intermediation to small relative to large clients when faced with a more binding leverage ratio.

To examine this conjecture we expand model (1) and allow the impact of the regulatory change to differ between small and large clients. Our model is as follows:

$$\Delta \log (Volume)_{ij} = \beta_1 \times Affected\ Dealer_i \times Small_j + \beta_2 \times Relationship_{ij} + \mu_j + \varphi_i + \varepsilon_{ij}$$

where $\Delta log\ (Volume)_{ij}$, $Affected\ Dealer_i$ and $Relationship_{ij}$ are defined as before; $Small_j$ is a dummy variable equal to 1 if the client is small, defined as engaging in below median volume of repo transactions in the pre period, and 0 if large; μ_j is a vector of client fixed effects; φ_i is a vector of dealer fixed effects; and ε_{ij} is the error term. $Affected\ Dealer_i$ and $Small_j$ are only included in the specification on their own in versions of Model (2) which exclude μ_j and φ_i, respectively, because otherwise the effect of the former is subsumed in the dealer fixed effects, and the effect of the latter is subsumed in the client fixed effects. The model is again estimated using OLS and standard errors are clustered at the dealer level.

A negative $\beta_1$would imply that – all else equal – affected dealers reduce the volume of repo they are willing to accept from small clients relative to large clients after the policy change, compared to dealers not affected by the tightening of the leverage ratio. Besides controlling for the pre-shock relationship strength and client fixed effects, this specification also allows us to control for dealer fixed effects. As such, our model effectively controls for concurrent factors that potentially influence affected dealers differently from non-affected dealers, such as a regulatory change or (unconventional) monetary policy shocks in the home country of the non-affected dealer.

In terms of raw statistics we see that small and large clients differ substantially. In the month prior to the regulatory change large clients on average transact 183 times and place on average 14 billion pounds cash, while small clients transact 13 times and place on average

557 million pounds. In this period, the affected dealers accounted for 31 and 61 percent of total repo volume accepted from large and small clients respectively.

As in Table 1.1 we first show results without any controls (Table 1.2, column 1). We find that dealers subject to the regulatory change reduced repo volume to their smaller clients while dealers not affected by the change increased it. We do not find a differential effect for large clients. On average, affected dealers reduce repo volume accepted from their smaller clients by 53 percent, while non-affected dealers increase it by 51 percent with the difference being statistically significant. For large clients, affected dealers also reduce repo volume accepted, but by 12 percent, so the adjustment is much more subdued. On the other hand, non-affected dealers slightly increased it by 2 percent. The difference between the two groups of dealers in this case is however not significant.

Controlling for relationship strength (column 2) and sector fixed effects (column 3) barely affects the coefficients. When we next control for client fixed effects and thus control for demand and changes in quality and credit risk at the client level in column (4) the differential effect becomes even more pronounced. In column (5) we also include dealer fixed effects. This means that we effectively control for concurrent factors that potentially influence the affected dealers differently from the non-affected dealers. Using this very restrictive specification we confirm the previous results. The estimate of the interaction term remains statistically significant at the one percent level

and the magnitude remains relatively unchanged compared to the specification with only client fixed effects.

Table 1.2: Heterogeneous Effects: Small versus Large Clients

	Δlog(Volume)				
	[1]	[2]	[3]	[4]	[5]
Affected Dealer * Small	-0.900***	-0.880***	-0.829*	-1.415**	-1.345***
	0.228	0.228	0.397	0.514	0.433
Affected Dealer	-0.139	-0.159	-0.196	-0.305	
	0.207	0.2	0.233	0.278	
Small	0.490**	0.446*	0.506**		
	0.19	0.204	0.195		
Relationship		-0.487	-0.575	-1.217	-1.101
		1.071	1.091	1.328	1.547
Constant	0.017	0.042			
	0.138	0.133			
Client's Sector FE	no	no	yes	no	no
Client FE	no	no	no	yes	yes
Dealer FE	no	no	no	no	yes
N	126	126	126	126	126
R^2	0.057	0.058	0.089	0.378	0.463

Significance Levels: .01***; .05**; .1*

Note: The table presents results from OLS regressions. Daily transactions are collapsed before and after the regulatory change using a time window of one month, where Pre={November 21-December 16} and Post={January 05-February 01}. *Δlog(Volume)* is defined as the pre-post change in the (log of) the total repo volume accepted by dealer *i* from client *j* and is winsorized at 1 and 99 percentiles. *Small* is a pre-determined dummy variable, defined as client with log volume of repo transactions below the median client in the market. *Relationship* is a (demeaned) pre-determined continuous variable, defined as the ratio of frequency of repo transactions between dealer - client pair to total number of repo transactions of the dealer. Standard errors allow for correlation at the dealer level.

In terms of economic magnitude, we find (using the most saturated specification in column 5) that affected dealers are willing to accept 134 percentage points lower volume from their smaller clients relative to their larger clients compared to non-affected dealers. Again, the magnitude reflects the combined effect of affected dealers reducing

repo volume they accept from their small relative to their large clients and the non-affected dealers increasing it. Because we control for client and dealer fixed effects in a first differences model, it is unlikely that our results are driven by observable or unobservable time-invariant or time-varying dealer heterogeneity or by changes in demand or credit-risk at the client level. Summarizing, our results thus indicate that affected dealers reduced their repo market intermediation for their smaller clients as a result of the change in reporting requirements that effectively made the leverage ratio more binding. Larger clients on the other hand were not affected.

5.3 Heterogeneous effects: Other client types

Motivated by the CGFS (2017) report on repo market functioning, we first focused our analysis on small vis-à-vis large clients with respect to the market as a whole. However, it is possible that affected dealers also react differently with respect to other client characteristics. Furthermore, one could be worried that *Small* dummy is a proxy for another client characteristic that might be driving our results. Therefore in this section we examine a number of other client characteristics. We use the same specification as in Table 2, column 5, meaning that in all regressions we control for changes in demand and credit risk at the client level and concurrent factors at the dealer level.

Table 1.3: Heterogeneous Effects: Other Client Types

	Δlog(Volume)							
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Affected Dealer * Relationship	1.259*	0.77						
	0.656	0.795						
Affected Dealer * Long-Term Repos			0.408	0.419				
			0.487	0.491				
Affected Dealer * Foreign					-0.483	-0.159		
					0.414	0.41		
Affected Dealer * Reverse Repo							-0.093	-0.300
							0.637	0.616
Affected Dealer * Small		-0.870**		-1.350**		-1.325**		-1.383***
		0.386		0.449		0.45		0.433
Client FE	yes	yes	yes	yes	yes	yes	yes	yes
Dealer FE	yes	yes	yes	yes	yes	yes	yes	yes
N	126	126	126	126	126	126	126	126
R^2	0.459	0.469	0.429	0.468	0.427	0.464	0.425	0.465

Significance Levels: .01***; .05**; .1*

Note: The table presents results from OLS regressions. Daily transactions are collapsed before and after the regulatory change using a time window of one month, where Pre={November 21-December 16} and Post={January 05-February 01}. *Δlog(Volume)* is defined as the pre-post change in the (log of) the total repo volume accepted by dealer *i* from client *j* and is winsorized at 1 and 99 percentiles. *Relationship* is a pre-determined dummy variable, defined as the above median ratio of the frequency of repo transactions between dealer i and client j to total number of repo transactions of the dealer. *Long-Term Repos* is a pre-determined dummy variable, defined as client with average repo maturity above the median client in the market. *Foreign* is a dummy variable, defined as client with headquarters outside the UK. *Reverse Repo* is a dummy variable, defined as client's sector traditionally transacting more in the reverse repo market and includes pension funds, insurance companies and asset managers. *Small* is a pre-determined dummy variable, defined as client with log volume of repo transactions below the median client in the market. Models [1]-[2] control for the level effect of *Relationship* (omitted Models [5]-[8] control for the strength of the pre-determined relationship of dealer - client pair (omitted). Standard errors allow for correlation at the dealer level.

First, we focus on the strength of the existing repo relationship between dealer and client and examine how this affects the adjustment in repo intermediation. We create a dummy variable *Relationship* which is one if the ratio of the frequency of repo transactions between dealer *i* and client *j* to total number of repo transactions of the dealer in the pre-period is above the median, zero otherwise. Since repo liquidity conditions are determined by the dealer, we want to capture the importance of the client in the dealer's portfolio. For this reason, we define the share within a dealer, rather than client.

The result in Table 1.3, column 1 shows that a stronger relationship between dealer and client prior to the policy change lowers the effect of the leverage ratio on repo volume and this effect is significant at the 10 percent level. In other words, relationships seem to matter. However, when we do a horserace between the impact of being small and having a strong relationship with the dealer, the impact of small is dominant (column 2).[27] In other words, while being an important client from the point of view of the dealer matters, the average size of the client seems to matter more.

Next, we test whether dealers are more likely to withdraw from clients that tend to want to place cash at longer maturities. With "daily averaging" a repo transaction with a one week maturity would count five days towards the exposure measure, while under "monthly averaging" only one day and only if it is on the dealers' balance sheet at months-end. Furthermore, small clients tend on average to have somewhat longer maturities. We create a dummy variable *Long-Term Repos* which is one if the average maturity of all repo transactions of the client in the pre-period is above the median, zero otherwise. The results in columns 3 and 4 show that the length of a normal repo transaction does not influence an affected dealer's decision to withdraw from a particular client. The interaction with *Small*, however, remains large and statistically significant at the 5 percent level.

Next we examine whether the adjustment is stronger for foreign clients as affected (UK) dealers might be more willing to

[27] The correlation between the relationship and the small dummy is below 50 percent.

continue lending to domestic clients. While the parameter estimate on the interaction with *Foreign* is negative, it is statistically insignificant (columns 5 and 6). Finally, we examine whether affected dealers are less likely to adjust to clients that engage more in reverse repo. For these clients it might be easier for the dealer to net out a repo with a reverse repo transaction and as a result the dealer might be more willing to accept repo from them. To examine this we create a dummy variable, *Reverse Repo*, which is one if the client's sector traditionally transacts more in the reverse repo market (pension funds, insurance companies and asset managers). The results, columns 7 and 8, show that affected dealers do not differentially adjust to these clients. Importantly, in both cases, the interaction between affected dealer and small remains of the same magnitude and statistically significant.

Summarizing, the defining client characteristic which determines whether a dealer faced with an intensification of the leverage ratio adjusts its repo intermediation seems to be the size of the client in the market. This finding is consistent with the conjecture of CGFS (2017) and market intelligence. In the rest of the paper we therefore continue to differentiate between small and large clients.

5.4 Dynamic effects

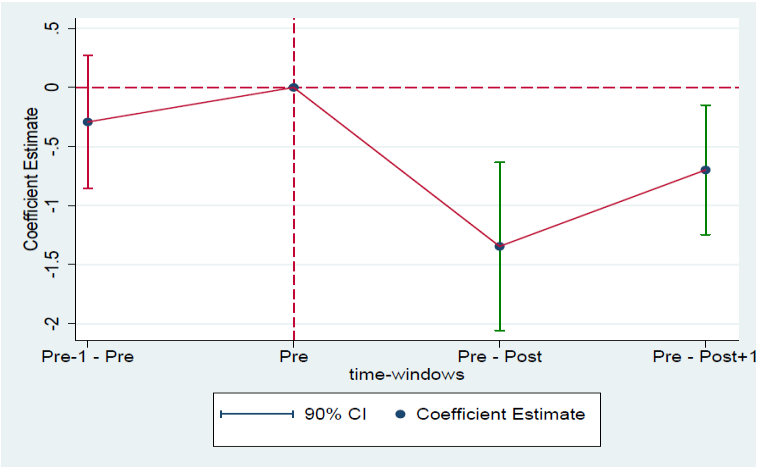
Up till now we focused exclusively on the period directly surrounding the change in reporting requirements. However, it is insightful to see how the parameter on our main interaction effect (*Affected Dealer * Small*) behaves over time. This allows us to examine how persistent the change in the market is and to make sure that our results are not driven

by any pre-event trends. To this end we re-estimate our model (fully saturated with client and dealer fixed effects) but estimate the coefficients with rolling symmetric time-windows that end or start in our original *Pre* period {November 21-December 16}. The blue dots in Figure 3 indicate the estimate of β_1 and the vertical lines indicate the 90 percent confidence intervals. Standard errors are again clustered at the dealer level.

The first point estimate in the graph (labelled as *Pre-1 – Pre*) represents a placebo test and examines whether in the months before the change in regulatory requirements affected and non-affected dealers behave differently. In this regression the pre-period is moved one month back and ranges from October 24 to November 18, 2016. The dependent variable $\Delta log\ (Volume)_{ij}$ is defined as the log change in repo volume accepted between this period and the original pre-period by dealer i from client j. The point estimate shows that in the months before the change in regulatory requirements affected and non-affected dealers do not behave differently, reducing concerns that our results are driven by different pre-event trends between the two types of dealers.[28]

[28] To further mitigate such concerns, we run a second placebo experiment comparing the beginning of our data sample period (October 03 to October 21) to our Pre-1 period (October 24 to November 18). The results from this exercise again confirm that there are no pre-event trends between treatment and control group. Results are available upon request.

Figure 1.3: Repo Volume Time-Varying DiD Estimates: Small-Large



After the change in regulatory reporting requirements, the two groups of dealers start diverging with the parameter labelled as Pre-Post representing the point estimate of Table 1.2, column 5. Importantly, the results show that this differential effect persists into February (labelled Pre-Post+1). This finding is consistent with the manifestation of a persistent change in repo market intermediation because of the intensification of the leverage ratio, with affected dealers moving away from smaller clients.

5.5 Other margins of adjustment

Up till now we focused our attention on how dealers adjusted repo volumes they accepted from their (smaller) clients. However, our database is rich and allows us to study other margins of adjustment as well. This helps us to put rigor to the causal interpretation of our findings as one would expect dealers to react to an intensification of the leverage ratio by adjusting volume and prices, however it should

not affect the margins that capture credit risk or business models as those are not affected by the change in the reporting requirements.

We construct four new dependent variables. First, we look at the extensive margin and create the dependent variable *Δlog(#Transactions)* which is the pre-post change in the (log of) the total number of repo transactions accepted by dealer *i* from client *j*. While our previous dependent variable captures the outcome of the negotiation between dealer and client in terms of repo size, this variable captures whether the dealer and client match (i.e. the extensive margin of trading activity). We would expect that affected dealers adjust on this margin.

Table 1.4: Other Margins of Adjustment

	Extensive Margin		*Repo Loan Terms*					
	Δlog(# Transactions)		ΔRate		ΔHaircut		Δlog(Maturity)	
	Baseline	Heterogeneous	Baseline	Heterogeneous	Baseline	Heterogeneous	Baseline	Heterogeneous
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Affected Dealer	-0.388**		-0.006		0.503		0.343	
	0.175		0.026		0.407		0.219	
Affected Dealer * Small		-0.829***		-0.088***		1.168		-0.155
		0.204		0.022		0.86		0.238
Client FE	yes	yes	yes	yes	yes	yes	yes	yes
Dealer FE	no	yes	no	yes	no	yes	no	yes
N	126	126	126	126	126	126	126	126
R^2	0.32	0.475	0.405	0.53	0.409	0.563	0.309	0.452

Significance Levels: .01***; .05**; .1*

Note: The table presents results from OLS regressions. Daily transactions are collapsed before and after the regulatory change using a time window of one month, where Pre={November 21-December 16} and Post={January 05-February 01}. In columns [1]-[2], *Δlog(# Transactions)* is defined as the pre-post change in the (log of) the total number of repo transactions accepted by dealer *i* from client *j* and is winsorized at 1 and 99 percentiles. In columns [3]-[8], *ΔRate, ΔHaircut* and *Δlog(Maturity)* denote the pre-post change in the average repo rate, average collateral haircut and the pre-post growth of average maturity (in days) and are winsorized at 1 and 99 percentiles. *Small* is a pre-determined dummy variable, defined as client with log volume of repo transactions below the median client in the market. All models control for the strength of the pre-determined relationship of dealer- client pair (omitted). Standard errors allow for correlation at the dealer level.

In line with our expectation, we find that affected dealers after the policy change reduced the number of transactions they engaged in with 39 percentage points compared to non-affected dealers (Table 1.4, column 1). When we again allow the impact to differ across small and large clients (column 2), we find that dealers subject to the regulatory change significantly reduced the number of transactions they engaged in with smaller clients relative to the number of transactions with large clients compared to dealers not affected by the change. Again, as we saturate the model with client and dealer fixed effects this result is not driven by changes in demand or riskiness as the client level or concurrent factors affecting dealers. In terms of economic magnitude, we find that affected dealers reduce with 83 percentage points the number of transactions with their smaller clients relative to larger clients compared to non-affected dealers.

Second, we study the adjustment in repo rates that affected dealers are willing to offer. If the cost of repo increases because of the intensification of the leverage ratio, dealers can, besides lowering the volume or the number of transactions, also lower the repo rates they are willing to offer to clients that want to place cash. To examine whether dealers also adjust on the price dimension we construct the dependent variable $\Delta Rate$ which equals the pre-post change in the average repo rate offered by dealer i to client j. The result in column (3) shows that following the change in reporting requirements affected dealers were on average not adjusting repo rates to their clients relative to non-affected dealers. However, when we allow for heterogeneous effects (column 4) we find that affected dealers indeed adjusted repo

rates offered to their small clients. In terms of economic magnitude, we find that affected dealers are willing to pay a 9 basis points lower repo rate to their smaller clients relative to their larger clients compared to non-affected dealers.

Third, we examine whether dealers adjust haircuts after the change in reporting requirements. In repo transactions haircuts are used to protect the cash lender from credit and liquidity risk associated with the asset used as collateral. A haircut represents the difference between the market value of the asset used as collateral in the transaction and the purchase price paid at the start of a repo. The haircut is expressed as the percentage deduction from the market value of collateral. As the haircut protects the cash lender against credit and liquidity risk, we should not expect an adjustment in the wake of the intensification of the leverage ratio. Hence, examining the change in haircut at the dealer-client pair level can function as a falsification test. We construct a new dependent variable, *ΔHaircut,* which measures the change in the average haircut before and after the change in reporting requirements. As expected, and in line with our interpretation of a causal impact of the leverage ratio on repo intermediation, we do not find an adjustment on haircuts (columns 5 and 6).

A final margin we look at is the maturity of repo. The majority of repo transactions tend to be overnight (70 percent in our sample), however they can also have longer maturities. The maturity requested by the end-user is often a function of their business model. For example, insurance companies tend to opt for longer maturities compared to banks. Furthermore, the willingness to extend longer

maturity repos is also related to the riskiness of the client. For both these reasons one would not necessarily expect a change in maturity due to the intensification of the leverage ratio. However, on the other hand, dealers might be less willing to engage in longer term repo after the change in regulatory reporting as now the dealer has to include the repo in its exposure measure on each day until maturity, while before it only had to include it if it had not matured at month-end. Our fourth dependent variable *Δlog(Maturity)* is defined as the pre-post change in the (log of) the average maturity (in number of days) of the transactions between dealer *i* from client *j*. In line with the interpretation that repo maturities reflect the business model of the client, we do not find a change in maturities after the change in regulatory reporting. Not in general and not for smaller clients in particular (columns 7 and 8).

Finally, we examine the dynamic adjustment for the two margins (number of transactions and repo rates) that are adjusted by the affected dealers differentiating between small and large clients. As with the adjustment in the repo volume, we find that in the months before the change in regulatory requirements affected and non-affected dealers do not behave differently (Figure 4). The two groups of dealers only start diverging after the shock and this differential effect persists.

5.6 Further robustness

In this section we set out to put further robustness to our results. We first perform an additional falsification test by examining whether affected dealers were also reducing the volume of cash they were

willing to lend (reverse repo) after the change in regulatory requirements. Reverse repo does not affect the balance sheet so we do not expect an impact of the intensification of the leverage ratio. Indeed, the results in Table 1.5 show that affected dealers were not reducing the amount of cash they were lending to their clients relative to non-affected dealers (column 1). We also do not detect any differential effect with respect to their small clients (column 2). These results again indicate that a reduction in repo intermediation by affected dealers can be attributed to the intensification of the leverage ratio. [29]

[29] It would also be insightful to examine whether the reduction in volume is stronger for repos conducted against general compared to repos conducted against special collateral. Special collateral is a repo in which the cash provider requests a specific security (individual ISIN) to be provided by the cash borrower (security-driven repos). General collateral is a repo in which the security lender may choose the security to pledge as collateral with the cash provider (cash-driven repos). When negotiating special repos, a dealer agrees on the collateral first and then the size, price and term of such transactions. As such, the rate of special repos is usually below the rate of general repos, in other words, the margin on these repos is higher. As such one would expect affected dealers to especially reduce general collateral repo. Unfortunately, our data do not allow us to identify with certainty whether repos are conducted against general or special collateral, because this field is optional to report. In our sample period, approximately 43 percent of transactions provide no such information, 24 percent are special and 33 percent are general repos.

Table 1.5: Leverage Ratio and Reverse Repos

	Δlog(Volume)	
	Baseline	Heterogeneous
	[1]	[2]
Affected Dealer	-0.283	
	0.197	
Affected Dealer * Small		0.703
		0.682
Client FE	yes	yes
Dealer FE	no	yes
N	133	133
R^2	0.372	0.494

Significance Levels: .01***; .05**; .1*

Note: The table presents results from OLS regressions. Daily transactions are collapsed before and after the regulatory change using a time window of one month, where Pre={November 21-December 16} and Post={January 05-February 01}. *Δlog(Volume)* is defined as the pre-post change in the (log of) the total repo volume accepted by dealer *i* from client *j* and is winsorized at 1 and 99 percentiles. *Small* is a pre-determined dummy variable, defined as client with log volume of reverse repo transactions below the median client in the market. All models control for the strength of the pre-determined relationship of dealer - client pair in the reverse repo market (omitted). Standard errors allow for correlation at the dealer level.

Next we examine the sensitivity of our results to our definition of small clients. Up till now we identified a client as small if it engaged in below median volume of repo transactions in the pre period. In Table 1.6 we first define small as a client with the number of

transactions below the median (column 1). In addition, we use three continuous variables: the log volume of the client in the repo market (column 2), the log number of transactions of the client in the repo market (column 3) and the log volume divided by the number of transactions of the client in the repo market (column 4), all three measured before the regulatory change. In all cases the interaction of affected with small is of the right sign and significantly different from zero, indicating that our results are not sensitive to our definition of small clients.

Table 1.6: Alternative Definitions for Small Client

	Δlog(Volume)			
	Frequency (dummy)	*Volume (continuous)*	*Frequency (continuous)*	*Volume/Trans.*
	[1]	[2]	[3]	[4]
Affected Dealer * Small	-1.345***	0.367**	0.427*	0.516**
	0.433	0.143	0.194	0.212
Client FE	yes	yes	yes	yes
Dealer FE	yes	yes	yes	yes
N	126	126	126	126
R^2	0.463	0.468	0.459	0.442

Significance Levels: .01***; .05**; .1*

Note: The table presents results from OLS regressions. Daily transactions are collapsed before and after the regulatory change using a time window of one month, where Pre={November 21-December 16} and Post={January 05-February 01}. *Δlog(Volume)* is defined as the pre-post change in the (log of) the total repo volume accepted by dealer *i* from client *j* and is winsorized at 1 and 99 percentiles. *Frequency (dummy)* is a pre-determined dummy variable, defined as client with log frequency of repo transactions below the median client in the market. *Volume (continuous)* is a pre-determined continuous variable, defined as the log volume of repo transactions of client in the market. *Frequency (continuous)* is a pre-determined continuous variable, defined as the log frequency of repo transactions of client in the market. *Volume/Trans.* is a pre-determined continuous variable, defined as the log volume to frequency of repo transactions of client in the market. All models control for the strength of the pre-determined relationship of dealer- client pair (omitted). Standard errors allow for correlation at the dealer level.

Any choice of sample period is arbitrary as it is not obvious how much time it would take for the adjustment in the market to take place. Focusing on a short time horizon could bias the results against finding anything because especially smaller clients might not be active in both periods. Taking a longer time horizon increases the risk of other factors (both in the UK and abroad) affecting the market convoluting our identification strategy. Furthermore, it is not entirely clear how much time one should account to nullify the impact of the end-of-year volatility. To this end we adjust in Table 1.7 the time period along several dimensions. In columns 1 and 2 we only exclude the last day of the year. In columns 3 and 4 we drop the days in November as at two points during this month there is a drop in repo volume accepted by the affected dealers. In columns 5 and 6 we expand the pre-period and have it start on October 31, 2016 and in columns 7 and 8 we extend the post-period and have it end on February 22. Regardless of the time period we exploit, our results indicate that dealer banks subject to the regulatory change reduced repo volume to their smaller clients compared to dealer banks not affected by the change.

Table 1.7: Alternative Time-Windows

	Δlog(Volume)							
	Drop Year-End Day Only		*Drop November Adjustment*		*Expand Pre-Period*		*Expand Post-Period*	
	Baseline	Heterogeneous	Baseline	Heterogeneous	Baseline	Heterogeneous	Baseline	Heterogeneous
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Affected Dealer	-0.598*		-0.916**		-0.594*		-0.354	
	0.303		0.331		0.277		0.271	
Affected Dealer * Small		-0.868*		-1.087*		-0.812*		-0.824**
		0.49		0.506		0.422		0.368
Client FE	yes	yes	yes	yes	yes	yes	yes	yes
Dealer FE	no	yes	no	yes	no	yes	no	yes
N	134	134	109	109	139	139	142	142
$\mathbf{R^2}$	0.265	0.397	0.352	0.48	0.466	0.555	0.394	0.455

Significance Levels: .01***; .05**; .1*

Note: The table presents results from OLS regressions. In columns [1]-[2] daily transactions are collapsed before and after the regulatory change dropping the year-end business day only, where Pre={November 21-December 29} and Post={January 02-February 01}. In columns [3]-[4] daily transactions are collapsed before and after the regulatory change dropping November adjustment, where Pre={December 05-December 16} and Post={January 05-February 01}. In columns [5]-[6] daily transactions are collapsed before and after the regulatory change expanding the pre-period, where Pre={October 31-December 16} and Post={January 05-February 01}. In columns [7]-[8] daily transactions are collapsed before and after the regulatory change expanding the post-period, where Pre={November 21-December 16} and Post={January 05-February 22}. *Δlog(Volume)* is defined as the pre-post change in the (log of) the total repo volume accepted by dealer *i* from client *j* and is winsorized at 1 and 99 percentiles. All models control for the strength of the pre-determined relationship of dealer- client pair (omitted). Standard errors allow for correlation at the dealer level.

Finally we test whether our results are robust to different specifications and assumptions regarding the clustering of the error terms and how we deal with outliers. In Table 1.8, in order to mitigate concerns that differences in maturity drives the impact of repo volumes on dealer balance sheets, we first re-estimate our baseline and heterogeneous models employing Weighted Least Squares (WLS) using as weights the average maturity of transactions of dealer-client pairs before the policy change.[30] Columns 1 and 2 confirm our conclusions, although the estimate of the interaction effect is somewhat smaller. Next, although Bertrand, Duflo and Mullainathan (2004) show that cluster-robust standard errors still perform reasonably well with 15 clusters, we eliminate remaining concerns by employing a wild cluster

[30] We also test whether our results are driven by clients trading in very long maturities. We confirm that our conclusions remain unchanged when we restrict our sample to dealer-client pairs that only engage in repo with a maturity of up to 4 weeks.

bootstrap method as recommended by Cameron, Gelbach and Miller (2008) and Cameron and Miller (2015). This procedure allows us to account for the correlation in the error terms of clients placing cash with the same dealer bank with relatively few clusters. In columns 3 and 4, we report wild cluster bootstrap p-values, which confirm our conclusions suggesting that the clustering strategy has little effect on our results.[31] Finally, we employ an alternative winsorising technique at the 5th and 95th level instead of the 1st
and 99th and we find again very similar results as in our baseline models.

Table 1.8: Further Robustness Checks

	Δlog(Volume)					
	WLS		*Wild Cluster Bootstrap*		*Winsorize 5/95*	
	Baseline	Heterogeneous	Baseline	Heterogeneous	Baseline	Heterogeneous
	[1]	[2]	[3]	[4]	[5]	[6]
Affected	-0.653**		-0.664*		-0.436*	
	0.275		[0.056]		0.227	
Affected Dealer * Small		-1.096*		-1.345*		-0.953***
		0.655		[0.054]		0.284
Client FE	yes	yes	yes	yes	yes	yes
Dealer FE	no	yes	no	yes	no	yes
N	126	126	126	126	126	126
R^2	0.342	0.586	-	-	0.362	0.492

Significance Levels: .01***; .05**; .1*

Note: The table presents results from baseline regressions. Daily transactions are collapsed before and after the regulatory change using a time window of one month, where Pre={November 21-December 16} and Post={January 05-February 01}. *Δlog(Volume)* is defined as the pre-post change in the (log of) the total repo volume accepted by dealer *i* from client *j* and is winsorized at 1 and 99 percentiles. In columns [1]-[2] we employ a weighted least squares estimation technique using as weights the average maturity before the policy change. In columns [3]-[4] we correct the inference with the wild cluster bootstrap method. Wild cluster bootstrap p-values are reported in brackets employing the post-estimation command boottest, assuming the null hypothesis and setting replications to 1000. In columns [5]-[6] we employ an alternative winsorizing technique at the 5 and 95 percentiles. *Small* is a pre-determined dummy variable, defined as client with log volume of repo transactions below the median client in the market. All models control for the strength of the pre-determined relationship of dealer- client pair (omitted). Standard errors allow for correlation at the dealer level.

[31] We generate these p-values by employing the post-estimation command *boottest* (Roodman, 2015), assuming the null hypothesis and setting replications to 1000.

6. Aggregate effect and market adjustment

Finally, we investigate the aggregate effect of the intensification of the leverage ratio which incentivised affected dealers to move away from small end-users. We can do a conservative back of the envelope calculation and assess to what extent small end-users were affected in aggregate. Using the OLS estimates of Table 2, column 1 we estimate that affected banks on average reduced repo volume to their small clients with 53 percent.[32] As affected dealers were prior to the regulatory change intermediating 61 percent of total repo volume from small end-users, this implies that, keeping all else equal and not allowing for the possibility of substitution, the withdrawal of affected dealers resulted in small end-users being able to place 32 percent, equaling 2.9 billion pounds, less cash in the gilt repo market.

The next question is whether these small end-users were able to switch to other, non-affected dealers and place their cash with them instead. To check whether indeed this was the case, we run a set of client-level regressions with the growth rate of the client's total repo volume as the dependent variable. We are interested to see if small clients that were more exposed to the affected dealers were experiencing lower growth rates compared to small clients less exposed. To this end we construct a measure of the average exposure to affected dealers for each client before the policy shock. That is, for each client we measure the ratio of each client's repo volumes with affected dealers to the client's total repo volumes before the regulatory

[32] This is the combined effect of the constant, the affected dummy, the small dummy and the affected*small interaction effect.

change. As we are interested in the growth rate at the client level, we cannot absorb client demand directly with client fixed effects. If the exposure measure is correlated with demand, something we cannot rule out, our OLS estimates would be biased. In order to control for clients' repo demand we follow Abowd, Kramarz and Margolis (1999), Bonaccorsi di Patti and Sette (2016) and Cingano, Manaresi and Sette (2016) and include in our model a vector of client-level estimated dummies $\hat{\mu}_j$ that we extract from model (2) in Section 5.2.[33] The model we estimate is as follows:

$$\Delta\, log(AggrVolume)_j = \beta_1 \times Highly\ Exposed_j + \beta_2 \times Highly\ Exposed_j \times Small_j + \beta_3 \times Small_j + \hat{\mu}_j + \varepsilon_j$$

where $\Delta log\ (AggrVolume)_{ij}$ is the pre-post change in the (log of) the total repo volume accepted by *all* (new and existing) dealers from client *j*, winsorized at the 1 and 99 percentiles. $HighlyExposed_j$ is a dummy variable equal to 1 if the client has above median share of its repos intermediated by affected dealers, zero otherwise; $Small_j$ is a dummy variable equal to 1 if the client is small, defined as engaging in

[33] Bonaccorsi di Patti and Sette (2016) and Cingano, Manaresi and Sette (2016) show that this methodology is equivalent to an alternative methodology to control for demand developed by Jimenez, Mian, Peydro and Saurina (2014), where a numerical correction of the difference of the OLS and FE estimate is applied.

below median volume of repo transactions in the pre period, and 0 if large; $\hat{\mu}_j$ is a vector of client-level estimated dummies capturing demand; and ε_{ij} is the error term. To account for correlation in the error terms of clients within the same sector, and given that the number of sectors is 7, we employ the wild cluster bootstrap method of Cameron, Gelbach and Miller (2008) and report the respective p-values.[34]

The result in Table 1.9, column 1 shows that highly exposed clients experience a lower growth in total repo volume (i.e. the amount of cash they are placing with all dealers), but this effect is not significant. When we allow this effect to differ between large and small clients (column 2) we find that it is driven by the small clients, in line with our previous results. The parameters are smaller (less negative) compared to the estimates at the dealer-client level. This suggests that partial substitution was possible, in line with our previous finding that non-affected dealers were on average accepting more repo from their small clients after the policy change.

[34] Clustering at the sector level would not perform well and would lead to high rejection rates when the number of clusters is approximately 6, as suggested by Bertrand, Duflo and Mullainathan (2004).

Table 1.9: Market Adjustment: Substitution and New Repo Relationships

	Δlog(AggrVolume)		New Repo Relationship	
	Baseline	Heterogeneous	Baseline	Heterogeneous
	[1]	[2]	[3]	[4]
Highly Exposed	-0.390	-0.136	-0.007	-0.093
	[0.273]	[0.889]	[0.971]	[0.452]
Highly Exposed * Small		-0.584*		0.165
		[0.088]		[0.3]
Small		-0.084		0.186
		[0.714]		[0.354]
Constant	0.285	0.371**	0.419	0.326
	[0.388]	[0.047]	[0.159]	[0.471]
Client Demand	yes	yes	yes	yes
N	38	38	38	38

Significance Levels: .01***; .05**; .1*

Note: The table presents results from OLS regressions. Daily transactions are collapsed before and after the regulatory change using a time window of one month, where Pre={November 21-December 16} and Post={January 05-February 01}. *Δlog(AggrVolume)* is defined as the pre-post change in the (log of) the total repo volume accepted by all dealers from client j and is winsorized at 1 and 99 percentiles. *New Repo Relationship* is a dummy that is one if the client established a new relationship with a dealer after the regulatory change. *Highly Exposed* is a pre-determined dummy variable, defined as client with above median share of repos intermediated by affected dealers to total repos intermediated by all dealers in the market. *Small* is a pre-determined dummy variable, defined as client with log volume of repo transactions below the median client in the market. Client demand is a vector of client-level dummies estimated in the within-client regression. We employ the wild cluster bootstrap method. Wild cluster bootstrap p-values are reported in brackets, assuming the null hypothesis and setting replications to 1000. Standard errors allow for correlation at the client's sector level.

In the last two columns of Table 1.9 we examine whether this substitution was primarily done through an intensification of pre-existing relationships or through the establishment of new ones. We construct a new dependent variable, *New Repo Relationship*, which is a dummy variable equal to one if the client started in the month after the regulatory change a relationship with a dealer with whom it had no relationship in the pre-period, zero otherwise. We do not find any indication that more exposed clients are more likely to start a new relationship, which suggests that exposed clients substitute with non-affected dealers with whom they already had a relationship and did not switch to new dealers.

Our finding that the small end-users, particularly the ones less exposed to affected dealers, were able to substitute with non-affected, foreign dealers is confirmed when we look at the change in market share of affected and non-affected dealers after the intensification of the leverage ratio. While the group of affected dealers increased their market share of the large clients from 31 to 34 percent, they reduced it from 61 to 51 percent for the smaller clients.

7. Conclusion and policy implications

This paper investigates the impact of the leverage ratio on dealer-client repo intermediation, focusing on both bank and non-bank end-users. We exploit a new, unique, supervisory transaction-level dataset capturing the near-universe of bilateral gilt repo market trading in combination with a regulatory change in the UK. Studying adjustments within dealer-client pairs, we find that dealers subject to a tightening of the leverage ratio due to a change in its reporting requirements persistently reduced repo volume they accepted from their small clients compared to dealers not affected by the change. Large clients were not affected. We also find that dealers tend to move away from clients with whom they have a weaker relationship; however the impact of size dominates. In addition, we document a (persistent) reduction in the frequency of transactions and in repo rates offered, but no adjustment in haircuts or maturities. Studying the aggregate effect, we find evidence that suggests that competing, non-constrained, foreign dealers took the opportunity to capture market share when affected, UK dealers withdrew from the small end-user segment of the dealer-client

market. The market therefore seems to have been resilient and adjusted quickly.

All in all, our results show that dealers react to an intensification of the leverage ratio by stepping away from smaller end-users. This finding has important policy implications as it shows that capital regulation has the potential to undermine the level playing field of small banks and non-bank financial institutions relative to their larger competitors as the increased cost of engaging in repo activity is disproportionately levied onto them. Without other dealers stepping in, this implies that these smaller end-users ultimately have to pass on these costs to their clients. Furthermore, it can incentivize them to invest their cash in more risky ways (e.g. longer maturities or against lower quality or no collateral), it can impair their access to derivatives markets and it can increase the cost they face when hedging interest rate risk. These effects can be mitigated if other dealers step into the void as seems to have happened in the UK. While this can alleviate the short-run impact of a more binding leverage ratio it has the potential to make the market more unstable. A stronger reliance on foreign dealers can potentially imply more instability as during times of stress foreign lenders tend to flight home (Gianetti and Laeven, 2012) and reduce lending especially to marginal borrowers (De Haas and Van Horen, 2013).

A possible way to reduce the impact of the leverage ratio on repo market liquidity for small end-users would be to widen participation in CCPs to end-users of repos. If end-users are members of the same CCP as their intermediating dealer, then the dealer will be

able to net the transaction for the purpose of the regulation. In recent years there have been several initiatives, including by the Bank of England, to reduce barriers for smaller firms to joining the CCP. Furthermore, intermediation might be improved through competition effects by disintermediation of banks in return for a larger role for non-bank intermediaries not subject to the leverage ratio. However, a growing role of non-bank dealers in the repo market can also make the market more susceptible to financial instability risks as these dealers are not regulated.

Importantly, our paper does not attempt to quantify the net benefits of the regulatory leverage ratio. The leverage ratio has important benefits for the financial system as a whole. By increasing the capitalization of banks, the leverage ratio mitigates the risk of destabilizing deleveraging processes. Furthermore, as it is independent of risk, it provides a safeguard against model risk and measurement error which affects the capital ratio. In addition, as there are risks associated with excessive liquidity a lower level of liquidity in the repo market might not be sub-optimal. While quantifying the net costs/benefits of the leverage ratio is beyond the scope of this paper, our results indicate that the leverage ratio affects some end-users in the repo market more than others. As such, policy measures that improve repo market liquidity for these end-users might be useful.

A Appendix

A.1 UK Leverage Ratio Timeline

Table A.1: UK Leverage Ratio Timeline

Dates	Policy Measure
December 2010	Basel announces 3% leverage ratio for disclosure purposes as of 01/01/2015 and with a view to moving to a minimum requirement in 2018
January 2011	Basel deadline for supervisory monitoring period for LR
January 2013	Basel deadline for LR reporting
January 2013	PRA contacts the 7 major UK banks asking them to start disclosing year-end and mid-year leverage ratios based on the Basel definition
June 2013	Publication of EU CRR, announcing a mandatory LR disclosure requirement as of 01/01/2015
December 2013	Major EU banks start voluntarily disclosing LRs
July 2014	FPC consults on a review considering the need for a LR requirement
October 2014	FPC finalises its LR review and recommends HMT give them powers of Direction for a LR
January 2015	Introduction of LR disclosure requirements as per EU law
April 2015	HMT gives FPC powers of Direction over a LR
July 2015	FPC publishes policy statement on the LR and directs PRA to implement a LR
December 2015	PRA finalises LR policy
January 2016	LR requirement comes into force for the 7 major UK banks, which also start reporting exposures based on the average of the last day of every month ("monthly average")
August 2016	FPC and PRA announce the exclusion of central bank reserves from the exposure measure of the UK requirement that applies to the 7 banks
January 2017	7 UK banks start reporting leverage exposures based on average of every day in quarter ("daily average")
June 2017	FPC and PRA consult on a recalibration of the minimum LR requirement that applies to the 7 major UK banks
October 2017	FPC and PRA recalibrate the minimum LR requirement that applies to major UK banks to 3.25%
January 2018	The 7 major UK banks start disclosing daily average exposure measures

Note: The table presents the timeline of the UK leverage ratio requirement.

A.2 Summary Statistics

Table A.2: Summary Statistics

Variables	*Units*	*Definition*	*N*	*mean*	*sd*	*p(10)*	*p(25)*	*p(50)*	*p(75)*	*p(90)*
Δlog(Volume)	%	The log change in repo volume accepted by dealer *i* from client *j* in the month after the regulatory change compared to the month before, winsorized at 1 and	126	-0.02	1.19	-1.26	-0.48	0.05	0.54	1.18
Δlog(# Transactions)	%	The log change in frequency of repo transactions between dealer *i* and client *j* in the month after the regulatory change compared to the month before, winsorized at 1 and 99th percentile	126	-0.04	0.70	-0.92	-0.41	0	0.34	0.69
ΔRate	Δ	The first-difference change in the average repo rate offerred by dealer *i* to client *j* in the month after the regulatory change compared to the month before, winsorized at 1 and 99th percentile	126	0.04	0.1	-0.03	0.00	0.03	0.05	0.11
ΔHaircut	Δ	The first-difference change in the average collateral haircut required by dealer *i* from client *j* in the month after the regulatory change compared to the month before, winsorized at 1 and 99th percentile	126	0.19	1.47	0	0.00	0.00	0.00	0.26
Δlog(Maturity)	%	Log change of average maturity (in days) offerred by dealer *i* to client *j* in the month after the regulatory change compared to the month before, winsorized at 1 and 99th percentile	126	0.01	0.91	-0.92	-0.39	0.00	0.37	1.18
Affected dealer	0/1	Dealer in gilt repo market subject to the regulatory change	126	0.38	0.49	0	0	0	1	1
Small	0/1	Client with repo volume below the median client in month before the regulatory	126	0.29	0.45	0	0	0	1	1
Small (frequency dummy)	0/1	Client with number of transactions below the median client in month before the regulatory change	126	0.30	0.46	0	0	0	1	1
Small (volume)	continuous	Log repo volume of client in month before the regulatory change	126	22.13	1.79	19.48	21.12	22.24	23.34	24.44
Small (frequency)	continuous	Log number of transactions of client in month before the regulatory change	126	4.43	1.37	2.30	3.14	4.88	5.20	6.15
Small (volume per transaction)	continuous	Log volume per transaction of client in month before the regulatory change	126	17.74	0.76	16.9	17.34	17.79	18.24	18.65
Relationship	continuous	Ratio of number of repo transactions between dealer - client to total number of repo transactions of the dealer in month before the regulatory change	126	0.02	0.10	-0.05	-0.04	-0.02	0.02	0.13
Δlog(AggrVolume)	%	Log change in repo volume accepted by all dealers from client *j* in the month after the regulatory change compared to the month before, winsorized at 1 and 99th	38	-0.06	0.73	-1.04	-0.26	0.08	0.41	0.57
New Repo Relationship	0/1	Dummy that is one if the client established a new relationship with a dealer after the regulatory change, zero otherwise	38	0.39	0.5	0	0	0	1	1
Highly Exposed	0/1	Client with above median share of repos intermediated by affected dealers to total repos intermediated by all dealers in the market	38	0.50	0.51	0	0	0.50	1	1

Note: The table presents the definitions and summary statistics of all variables used in our regressions.

Chapter 2

THE REAL EFFECTS OF CAPITAL OUTFLOW CONTROLS: THE TRADE AND FINANCIAL CHANNELS

Joint with Dimitris Malliaropulos

"Permanent capital controls can be applied on a subset of assets either on the inflow side or the outflow side. It is, at this stage, hard to assess rigorously the effect of such policy on financial stability and its side effects (...)"

Helene Rey[35]

1. Introduction

Helene Rey in her Jackson Hole speech (Rey, 2013) argued that a global financial cycle is affecting local credit conditions in emerging markets. A large literature supports this view (Cetorelli and Goldberg (2011), Paravisini, Rappoport, Schnabl and Wolfenzon (2015), Baskaya, di Giovanni, Kalemli-Ozcan, Peydro and Ulu (2017), Morais, Peydro, Roldan and Ruiz (2019)). After

[35] The quote is from the paper of Helene Rey "Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence" in 2013.

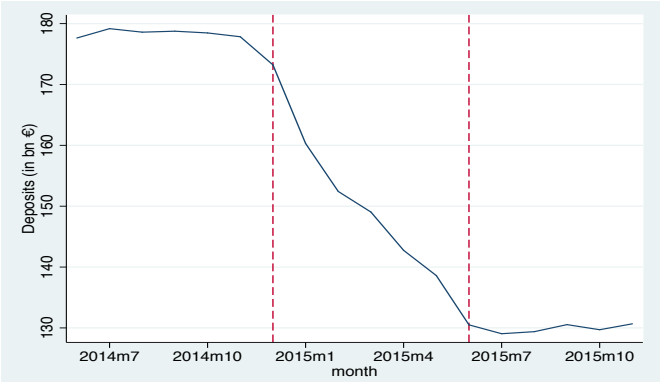
nearly a decade, as monetary policy in advanced economies begins to normalize and global financial conditions tighten, many emerging market economies either adjust their FX market operations or explicitly manage capital outflows. While recent evidence suggests that FX market operations mitigate the vulnerability of local banks to the global financial cycle (Ahnert, Forbes, Friedrich and Reinhardt (2018)), much less is known on capital outflow controls. How effective are controls in preventing capital outflows? What is the effect on financial stability? Are there any real (side) effects? And, if so, what are the channels of transmission? As the quote of Helene Rey above implies, the evaluation of capital outflow controls remains an open question[36].

We address these questions analyzing microdata from Greece. In June 2015, Greece introduced a series of administrative restrictions on capital outflows to stabilize the banking system following a period of increased uncertainty and an extensive bank run. Restrictions on capital outflows contained the bank run and helped to restore financial stability (Figure 2.1). However, they restricted the ability of firms to pay for imported inputs and

[36] Korinek (2011) provides an overview of the new economics of prudential capital controls that focus exclusively on capital inflows. Demirguc-Kunt and Serven (2010) discuss that capital outflow controls are of equal importance.

affected the availability of bank credit in subsequent months.

Figure 2.1: Level of Deposits in the Greek Banking System



We analyze and separate effects on exports arising from changes in imported inputs – the *trade* channel – and external financing conditions – the *financial* channel. During outflow controls, importers were required to apply to a centralized committee to approve transactions, submit extensive documentation that was often not easily accessible and abide by specific thresholds regarding the amounts to be transferred abroad for import-related purposes. The committee scrutinized the submitted documents to avoid the transfer of funds abroad for unauthorized purposes. Applications were often revised for further documentation or even rejected, which implied

additional costs to the importing process[37]. As such, importers were facing difficulties to meet their obligations with international suppliers of raw materials[38]. During this period, imports decreased by 13% on average on a yearly basis (Figure 2.2, top panel). As the literature has documented (Amiti and Konings (2007), Feng, Li and Swenson (2016)), exports adjust to the extent that imported inputs are embodied in the exported products and this gives rise to the *trade* channel of capital outflow controls.

At the same time, banks were facing severe liquidity and solvency issues. In the wake of outflow controls, the investment possibilities of domestic firms were restricted as they were cut off from the global financial markets. Their ability to diversify risks was restricted, increasing the volatility of their value (Merton (1974), Forbes (2007b)). Banks responded by curtailing the provision of credit and tightening financial constraints[39]. During this period, total credit contracted by 2% (Figure 2.2, bottom panel). As the literature has documented (Foley

[37] The primary reason of rejection of an application was the lack of proper documentation, which accounted for 31% of all submitted applications to the committee.

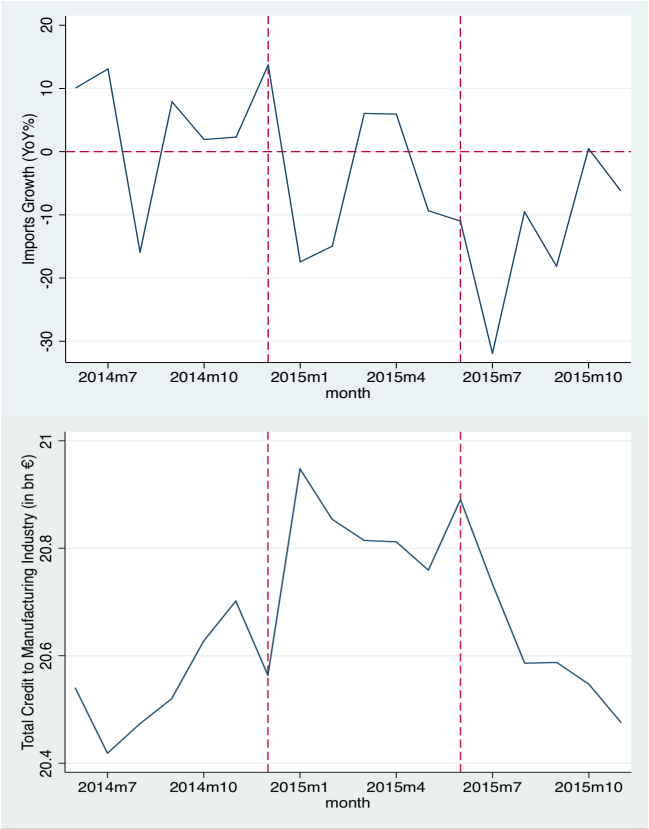
[38] Contractual obligations with domestic suppliers could still be met since payments were taking place within the Greek banking system.

[39] Controls on capital outflows lower the cost of borrowing for firms because national savings remain captive in the local market (Gallego and Hernandez (2003)). As a result, the effect on credit supply might be the opposite.

and Manova (2015)), exports adjust to the extent that bank credit is used to cover exports-related costs such as product customization, insurance and transportation and this gives rise to the *financial* channel of outflow controls.

In this period, exports decreased by 10% on average on a yearly basis (Figure 2.3). This suggests that capital outflows regulation implies a significant cost to the real economy. How much of this decrease is because of changes in imported inputs and how much of this decrease is because of changes in external financing conditions is an important question to design policy responses. If the decrease in imported inputs is the main driver behind the decrease in exports, the focus should be on loosening capital outflow controls. Instead, if credit factors are the main drivers behind the decrease in exports, the policy response should involve the recapitalization of the banking sector. This paper is the first to analyze the transmission channels and side effects on the real economy of capital outflow controls as a financial stability tool.

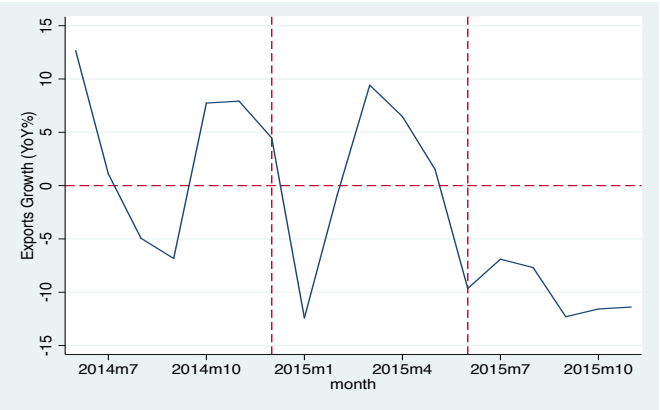
Figure 2.2: Imports and Credit Supply before and after Capital Controls



For identification, we combine customs data for all firms in Greece at the product-destination level and pre-capital controls benchmark industry characteristics. We analyze the variation in the export activity of the *same* firm across industries at different levels of import and credit

intensities. Pre-determined benchmark industry characteristics are by construction exogenous to individual firms, allowing us to circumvent endogeneity concerns due to omitted variables and reverse causality. The advantage of our approach (i.e. exploiting within-firm variation) is to more convincingly establish the causal effect of outflow controls on firm exports. We proxy for the trade channel with an industry's *Import Content of Exports*, which builds directly on the work of Hummels, Ishii and Yi (2001). This measure calculates the direct and indirect participation of imported intermediate inputs in an industry's gross exports. In other words, it gives a sense of an industry's international backward linkages in global value chains. The larger this measure is, the greater the imported input content of an industry's gross exports. We proxy for the financial channel with an industry's *External Finance Dependence*, which builds directly on the work of Rajan and Zingales (1998). This measure calculates the share of capital expenditures not financed with internally generated cash flows and identifies the outside funding that firms require for operational purposes. The larger this measure is, the greater the dependence of an industry on bank credit.

Figure 2.3: Exports before and after Capital Controls



We find the following robust results. At the intensive margin, firms reduced the exports of products with larger import content compared to products with lower import content; in particular, a one standard deviation in an industry's dependence on imported inputs is related to a 5pp lower exports growth during capital controls. One concern is that this effect could be contaminated by changes in credit conditions. This is because, as the Greek crisis intensified, foreign suppliers were more likely to request bank guarantees (e.g. letters of credit) from Greek importers due to concerns about the financial health of the latter. Greek importers therefore had likely difficulties importing goods purely because of a deterioration of financial conditions and not because of the administrative restrictions per se. We show that this is not the case. During

the Greek crisis and in the run-up to outflow controls, firms changed their cash reserves strategy by stockpiling cash out of the Greek banking system and in foreign banks insulating them from the weak local banks. We show that firms with higher dependence on banking services (e.g. bank guarantees, loans etc.) did *not* perform worse compared to firms with lower dependence on banking services in terms of exports of the *same* import-intensive product. To put it differently, there is no financial channel that drives the adjustment of exports at the intensive margin. This is in line with firms having increased their demand for cash *before* outflow controls insulating them from the weak local banks *during* outflow controls. Indeed, circumventing endogeneity concerns, we show that firms with active foreign bank accounts did better in terms of exports of the *same* import-intensive product as compared to firms with no foreign bank accounts. In other words, in the run-up to outflow controls, firms became more cash- and less credit-dependent and this cash buffer abroad was sufficient to cover the variable short-run costs of exports, which are associated with the intensive margin. Conditional on a foreign bank account, large firms, multinationals and net exporters were even less negatively affected by outflow controls as they were likely to retain relatively more cash in foreign banks in the run-up to the policy shock.

However, the cash buffer abroad was only limited to cover the large, sunk costs of exports that are associated with the extensive margin. It is well documented in the literature (e.g. Foley and Manova (2015)) that banks play a critical role in the financing of the large upfront costs of exports (e.g. product customization, maintenance of an international distribution network). We show that, regardless of their cash reserves strategy prior to the policy shock, firms with greater dependence on external financing reduced the range of products they exported and the range of destinations (export markets) they served; in particular, a one standard deviation in an industry's dependence on external financing is related to a 3pp lower growth of products exported, 4pp lower growth of destinations served and 5.3pp lower growth of export trading relationships (i.e. product–destination pairs) of a firm.

Taken together, these results suggest that capital outflow controls help to restore financial stability, but has unintended real consequences that manifest themselves through multiple channels (Demirguc-Kunt and Serven (2010)). These unintended effects are not evenly distributed across industries confirming that capital controls have distributional consequences (Rajan and Zingales (2003)) and are *no free lunch* (Forbes (2005a)).

Our most important contribution is to identify the transmission channels and side effects on the real economy

of capital outflow controls as a financial stability tool. In contrast to the new economics literature that focuses exclusively on capital inflow controls (Korinek (2011)), outflow controls are a crisis management, rather than a crisis prevention tool (Demirguc-Kunt and Serven (2010)). As such, along with FX market operations, capital outflow controls are an important policy tool for emerging markets to mitigate the effects of the global financial cycle as monetary policy in advanced economies begins to normalize. Our paper is the first to analyze the channels of transmission and real effects of an episode of outflow controls. Ahnert, Forbes, Friedrich and Reinhardt (2018) show how macroprudential FX regulations unintentionally shift the FX vulnerability from local banks to local firms. We add to this literature by showing that outflow controls have unintended consequences on the real economy through multiple channels and, as such, are *no free lunch*. Emerging markets should therefore weigh the benefits to financial stability and costs to the real economy of capital outflow controls when dealing with the consequences of the global financial cycle.

More broadly, we contribute to the literature of capital controls using microdata. Forbes (2003) studies the impact of Chilean encaje controls and documents increased financing costs for small traded firms. A more recent paper by Forbes, Fratzscher, Kostka and Straub (2016) shows

how investors re-allocated their portfolios away from Brazilian assets following a tax on capital inflows, as well as away from countries that seem more likely to impose similar restrictions. Focusing on the real effects, Alfaro, Chari and Kanczuk (2017) evaluate how capital controls affected firms' investment decisions in Brazil. Keller (2018) studies the impact of capital controls in Peru to show that local banks switched lending to domestic firms from local currency to dollars in order to hedge dollar deposits with real effects on firms' employment because of tighter financial constraints. Andreasen, Bauducco and Dardati (2018) study the effects of capital controls on firms' production, investment and exporting decisions using plant-level panel data from Chile. All of these papers analyze capital controls as a crisis prevention tool (i.e. controls on inflows) in contrast to our paper that analyzes capital controls as a crisis management tool (i.e. controls on outflows). Closest to our work are the papers of Tamirisa (1999) and Wei and Zhang (2007) who study the effects of capital inflow and outflow restrictions on trade for a large sample of countries across years. In contrast to these studies that rely on aggregate data and, as such, it is difficult to shed light on the mechanisms, we analyze customs data at the firm-product-destination level combined with detailed firms' financial information and

exogenous benchmark industry characteristics that allow us to study the channels of transmission.

Finally, we add to the literature that studies the role of imported inputs and credit constraints on firms' export performance. It is well documented that imported inputs are of high quality and act as a channel of diffusion of technology, which in turn improves a firm's productivity (Amiti and Konings (2007), Kasahara and Rodrigue (2007), Halpern, Koren and Szeidl (2015)), product scope (Goldberg, Khandelwal, Pavcnik and Topalova (2010)) and export performance (Bas (2012), Chevassus-Lozza, Gaigne and Mener (2013), Bas and Strauss-Kahn (2015), Feng, Li and Swenson (2016)). A large literature also documents that access to external financing can be a source of comparative advantage in the presence of financial frictions (Kletzer and Bardhan (1987)). This is particularly important for firms' exporting activities because exporters face additional costs when serving foreign markets as compared to firms serving only the domestic economy (Muuls (2008), Minetti and Zhu (2011), Amiti and Weinstein (2011), Paravisini, Rappoport, Schnabl and Wolfenzon (2015), Manova, Wei and Zhang (2015)). Our contribution is to identify the potency of each channel – trade and financial – when both are operational. As such, our paper informs on the policy responses when both channels differently affect the real economy.

2. Institutional Background

Following the failure of the Greek parliament to elect a President of the Republic in December 2014, general elections in January 2015 brought into power a coalition government of the radical left party of SYRIZA with the smaller right-wing party of "Independent Greeks"[40]. Both parties had fiercely opposed the economic adjustment program, which had been agreed by previous governments with the troika of international lenders (European Central Bank, International Monetary Fund and EU member states) following the bailout of the Greek sovereign in May 2010. Lengthy negotiations and increased uncertainty over a new bailout plan and Greece's future within the Eurozone drove depositors to withdraw 48.6bn euros during the first six months of 2015, accounting for more than one quarter of deposits of the Greek banking system. At the same time, Emergency Liquidity Assistance (ELA) provided by the Bank of Greece to Greek banks increased drastically from 45bn to 127bn euros (including Eurosystem funding) to fill the funding gap from the flight of deposits and the drying of the interbank market for Greek banks. At the time of imposition of capital controls in June 2015, deposits accounted for less than 50%, while central bank funding

[40] Priftis and Rousakis (2017) provide an overview of the latest stages of the Greek crisis.

(Eurosystem and ELA) accounted for more than 50% of total bank liabilities.

The new bailout agreement between the Greek government and the troika was brought into a referendum, which was unexpectedly announced on June 27, 2015[41]. As a response, the ECB refused to increase its loan limit for the provision of ELA to Greek banks on the same day, triggering the shutdown of banks (bank holiday) and the imposition of capital controls on June 28 2015[42]. Capital controls can be broadly characterized as restrictions on capital transactions and comprised of three pillars: (a) measures to prevent outflows of funds abroad, (b) measures limiting cash withdrawals from banks and (c) measures to prevent the rapid decline of bank assets and liabilities (e.g. repayment of the remaining capital on bank loans). Despite these measures, there was no explicit restriction on the provision of credit by financial institutions. In addition, during the first phase of restrictions, all credit institutions

[41] Although the new bailout plan was rejected in the referendum of July 5, the Greek government came to an agreement with lenders for a new bailout program which envisaged financing of up to 86bn euros over a three year period in exchange of a programme of fiscal austerity measures and structural reforms.

[42] Although Bank of Greece is responsible for ELA funding, it is ECB's decision to extend or restrict the ELA ceiling, i.e. the maximum amount of ELA available to Greek banks

operating in Greece, including branches of foreign banks, were forced to close until July 20, 2015, the Athens Stock Exchange remained closed and daily cash withdrawals were limited to a maximum of 60 euros per depositor per bank. No capital restrictions were applied to credit cards issued by foreign banks.

During this phase, a special Banking Transactions Approval Committee (BTAC) was established to examine requests for transfers of funds abroad. The committee was responsible to gather, approve, reject or revise requests for transfer of funds abroad. Especially for importers, this was a particularly resource-intensive process, as firms were required to provide detailed documentation of past imports-related capital transfers as well as invoices and other trade-related documents. These documents were not easily accessible to firms, which further impaired their ability to import as compared to the period before capital controls. To reduce the burden of documentation requirements submitted to the centralized committee, special subcommittees were established in each financial institution to approve or reject submitted applications. The special subcommittees were responsible for the approval of transfers under a certain threshold. Transfers larger than

this threshold had to be approved by BTAC[43]. The purpose of these thresholds was to control the flow of funds abroad, but exogenously restricted the ability of importers to meet their contractual obligations with international suppliers. Following the agreement over the new bailout plan between the Greek government and the troika in August 2015 and a new round of parliamentary elections in September 2015, capital controls were significantly relaxed in January 2016[44].

3. Data and Identification Strategy

We combine financial information and administrative customs data at the product-destination level for all firms in Greece matched with pre-capital controls benchmark industry characteristics. We obtain export flows before and after capital controls from the Hellenic Statistical Authority (ELSTAT). There are approximately 17,000 firms. The data report the universe of both intra-EU (Intrastat) and extra-EU (Extrastat) transactions at a

[43] The threshold of the total amount of transfers abroad by any individual firm was set initially at 100,000 euro per working day. This limit has been gradually increased to 150,000 euros by August 2015 and to 250,000 by January 2016.

[44] Nevertheless, capital controls are still effective at the time of writing of this paper (March 2019), although significantly relaxed as compared to the first six months of their imposition.

monthly frequency[45]. We take a number of steps to clean the data. First, we drop a handful of destinations that are not named for confidentiality reasons (e.g. military transactions). Second, we aggregate 5-digit SITC Rev.4 products, which is the level of reporting, in 2-digit ISIC Rev.3 industries. Since there is no concordance table to map directly, we first map 5-digit SITC Rev.4 to 6-digit HS 2007 products[46] and then 6-digit HS 2007 products to 4-

[45] Intrastat refers to the trading of goods between EU Member States, while Extrastat refers to the trading of goods with third countries. Firms that perform intra-EU transactions are liable for providing statistical information to ELSTAT, while firms that perform extra-EU transactions fill the Single Administrative Document (SAD) and submit it to the Customs Authorities. Documents are then transmitted to ELSTAT, which is responsible for compiling the total trade data within and outside the EU. Although Extrastat system records virtually all flows, EU National Authorities impose statistical thresholds for intra-EU trade, below which Intrastat declarations are not submitted by firms. ELSTAT has set exports' exemption reporting thresholds at 90,000 euros in 2014 and 2015. Data below the statistical threshold are still included in the Intrastat database and are estimates based on the Recapitulative Statements of intra-EU Deliveries and Acquisitions that all firms submit for fiscal purposes to the Ministry of Finance. Essentially, these are administrative documents that *all* firms are obliged to submit and thus can be considered of high quality.

[46] Table is from UN (https://unstats.un.org/unsd/cr/registry/regdnld.asp?Lg=1).

digit ISIC Rev.3 industries[47]. We then aggregate at the 2-digit level and restrict our attention to the manufacturing industry (codes 15-37). Benchmark characteristics of the manufacturing industry, *Import Content of Exports* and *External Finance Dependence*, vary at the 2-digit ISIC Rev.3 level and are obtained from the OECD STAN Input-Output Database and Kroszner, Laeven and Klingebiel (2007) respectively[48]. *Import Content of Exports* is measured for Greece as of 2005. *External Finance Dependence* is constructed from data on all publicly listed US-based firms over the period 1980-1999. This is motivated by the fact that the US has the least frictionless financial system and, as such, the behavior of US firms reflects the optimal asset structure and exposure to external financing worldwide (Rajan and Zingales (1998)). Both benchmark characteristics are measured well before our policy shock and, by construction, are exogenous to individual firms belonging to the industry. Appendix Table A.1 summarizes the distribution of import and credit intensities across 18 manufacturing industries at the 2-digit ISIC Rev.3 level.

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[47] Table is from WITS (http://wits.worldbank.org/product_concordance.html).

[48] *External Finance Dependence* is obtained at the 3-digit ISIC Rev.2 level and is concorded by the authors as weighted averages at the 2-digit ISIC Rev.3 level to match with *Import Content of Exports* which is available only 2-digit ISIC Rev.3 level.

Because we analyze the adjustment of exports of industries at different levels of import and credit intensities *within* the same firm, we drop firms that export products of only one industry. Since we are also interested in the firms' export supply decisions, we control for (unobservable) exports demand with destination fixed effects. As such, we further restrict our sample to include firms serving multiple destinations. Taken together, the firms that we drop represent less than 6% of the total value of exports before capital controls. We quantify the effect of capital controls on both margins of exports, estimating the following regression:

$$Y_{fpd} = \beta_1 * (Import\ Content\ of\ Exports)_s + \beta_2 * (External\ Finance\ Dependence)_s + \beta_3 * (Controls)_s + \alpha_f + \alpha_d + \varepsilon_{fpd}$$

In the above specification, f denotes a firm exporting products p that belong to an industry s and serving a destination d. Since firms do not necessarily export each product every month, the sample contains a number of intermittent export flows. To avoid introducing selection bias, we thus collapse the data into two time periods, t={*pre* , *post*}, where Pre={June 2014-November 2014} and Post={June 2015-November 2015} and consider an export flow to be active at t if positive exports were

registered at any month during this period[49]. That way, we avoid potential estimation bias due to serial correlation concerns. The cross-section specification in first-differences has the advantage of eliminating all time-invariant heterogeneity at the firm, product and destination level (and a combination of those) as well as macroeconomic factors common to all firms and industries. Our *Pre* period is ideal for our analysis, because it captures the most politically and economically stable period during the Greek crisis since 2010[50]. Depending on the margin of exports that we study, the dependent variable in the above specification denotes the log growth of exports $(\Delta\, log(Exports)\; fpd)$ at the intensive margin and the percent change in the number of products *(%Δ(# Products))* at the firm-sector-destination level, the percent change in the number of destinations *(%Δ(# Destinations))* at the firm-sector level and the percent change in the number of product-destinations *(%Δ(# Product-Destinations))* at the firm-sector level. We proxy with these adjustments the

[49] We drop December 2014 from our sample period because of the increased political uncertainty which was associated with the presidential election.

[50] During our *Pre* period, the yield of the 10-year Greek government bond was at its lowest level since the outburst of the Greek crisis in 2010.

extensive margin of exports[51]. The dependent variables are winsorized at the 1st and 99th percentiles to minimize the probability that outliers drive our findings. The terms α_f and α_d are firm and destination fixed effects respectively and ε_{fpd} is the error term.

The total value of exports was approximately 12 billion euros, firms were exporting 2,328 products and were serving 205 destinations before capital controls. There were approximately 32,000 export trading relationships (i.e. product-destination pairs) before capital controls. Panel A in Appendix Table 2 provides information on benchmark industry characteristics. The import content of exports was on average 28% in the Greek manufacturing sector in 2005, similar to the rest of the EU. Panel B provides information on firms' financial information.

4. Results

4.1 The Effect of Capital Controls on Exports Growth

Table 2.1 reports the baseline estimates of outflow controls on exports growth. For identification, we analyze variation

[51] We opt in constructing these variables as percent changes, that is *(#products$_{post}$ - #products$_{pre}$) / #products$_{pre}$*, as compared to log-differences, that is *log(#products$_{post}$) – log(#products$_{pre}$)*, in order to account for the fact that the number of products might equal 0 after capital controls and, as such, to allow for a more precise evaluation of the extensive margin of exports.

within the same firm and, as such, we include firm fixed effects in a first-differences model. Because we can introduce destination fixed effects, shifts in demand for Greek products are absorbed and the estimated effect reflects a firm's exports supply decision. The potency of each channel – trade and financial – is proxied by the *Import Content of Exports* and *External Finance Dependence*. We include additional industry observables, such as physical capital intensity, human capital intensity, contract intensity, durability and trade credit intensity that the literature has documented to affect exports beyond and above the imported input content of exports and the external finance dependence.

Table 2.1: Effect of Capital Controls on Exports Growth

Capital Controls: June 2015	Δlog(Exports)			
	[1]	[2]	[3]	[4]
Import Content of Exports	-0.358**	-0.348**	-0.435**	-0.434**
	0.13	0.128	0.175	0.174
External Finance Dependence	-0.068	-0.073	-0.04	-0.045
	0.084	0.084	0.084	0.082
Capital, Skills, Contract, Durability, Trade Credit Intensities	no	no	yes	yes
Destination FE	no	yes	no	yes
Firm FE	yes	yes	yes	yes
Adj. R^2	0.067	0.068	0.067	0.068
N	50,033	50,033	50,033	50,033

Note: The table presents results from difference-in-differences regression models at the firm-product-destination level. The time-window is Pre={June 2014-November 2014} and Post={June 2015-November 2015}. Dependent variable is *Δlog(Exports)*, which denotes the log growth of exports following the imposition of controls on capital outflows in June 2015. Additional sector-level control variables include capital and skills intensity, contract intensity, durability and trade credit intensity. Capital and skills intensity are from Manova (2013), contract intensity is from Nunn (2007), durability is from Kroszner, Laeven and Klingebiel (2007) and trade credit intensity is from Fisman and Love (2003) at the 3-digit ISIC Revision 2 level and are concorded by the authors as weighted averages at the 2-digit ISIC Revision 3 level. Standard errors are clustered at the sector level. Statistical significance is denoted as .01***; .05**; .1*.

The estimates in Table 2.1 suggest that outflow restrictions have a negative effect on exports growth

through the trade channel. The coefficients of the financial channel, although negative, are not statistically different from zero. In all cases, the coefficients of the trade channel are statistically significant. This is robust when we control for shifts in exports demand (column 2) and additional industry observables (column 3). The effect is also economically relevant. Using the strictest of our specifications (column 4), a one standard deviation differential in an industry's use of imported inputs is related to 5pp lower exports. This is a considerable effect relative to the -10% exports growth during capital controls.

Our main assumption is that exports adjust because of capital outflow controls. In other words, in the absence of capital controls, exports of products at different levels of import and credit intensities would have behaved in a similar way. In Table 2.2, we directly test for the validity of this assumption.

Table 2.2: Effect of Placebo Capital Controls on Exports Growth

Placebo Capital Controls: June 2014	Δlog(Exports)			
	[1]	[2]	[3]	[4]
Import Content of Exports	0.012	0.022	-0.009	-0.004
	0.136	0.135	0.156	0.157
External Finance Dependence	-0.04	-0.046	-0.008	-0.015
	0.084	0.085	0.135	0.131
Capital, Skills, Contract, Durability, Trade Credit Intensities	no	no	yes	yes
Destination FE	no	yes	no	yes
Firm FE	yes	yes	yes	yes
Adj. R^2	0.055	0.057	0.055	0.057
N	45,604	45,604	45,604	45,604

Note: The table presents results from difference-in-differences regression models at the firm-product-destination level. The time-window is Pre={June 2013-November 2013} and Post={June 2014-November 2014}. Dependent variable is *Δlog(Exports)*, which denotes the log growth of exports following the imposition of placebo controls on capital outflows in June 2014. Additional sector-level control variables include capital and skills intensity, contract intensity, durability and trade credit intensity. Capital and skills intensity are from Manova (2013), contract intensity is from Nunn (2007), durability is from Kroszner, Laeven and Klingebiel (2007) and trade credit intensity is from Fisman and Love (2003) at the 3-digit ISIC Revision 2 level and are concorded by the authors as weighted averages at the 2-digit ISIC Revision 3 level. Standard errors are clustered at the sector level. Statistical significance is denoted as .01***; .05**; .1*.

We consider a *placebo* episode of outflow controls a year before the imposition of the actual restrictions with two time periods, t={*pre-1*, *pre*}, where Pre-1={June 2013-November 2013} and Pre={June 2014-November 2014}. We choose these time periods to eliminate the possibility that seasonality of exports drives our results. We thus re-run our baseline specifications as if *placebo* restrictions were imposed in June 2014. The results in Table 2.2 suggest that there is no trend in exports of products at different levels of import and credit intensities before the policy shock. This suggests that our main identification assumption is valid and confirms that we can adequately employ a difference-in-differences estimation technique.

4.2 The Role of External Financing for the Trade Channel

Our main finding is that the trade channel was responsible for the adjustment of exports at the intensive

margin. In other words, capital outflow controls imposed to firms a significant cost to import inputs which in turn affected exports at the intensive margin. One concern with this finding is whether the trade channel is adequately disentangled from the financial channel. In the aftermath of outflow controls, it is very likely that foreign exporters were a lot less willing to sell to Greek firms on open account and requested bank guarantees or cash in advance to settle transactions. In order to settle transactions, before goods are shipped, Greek importers might have applied for letters of credit or loans from their banks in order to pay for the imported inputs. Importers therefore had likely difficulties importing goods purely because of a decrease in the provision of banking services. In that case, we falsely attribute the estimated effect to the trade channel. In that case, the policy prescription should be very different and include the direct liquidity injection in the banking system rather than the relaxation of outflow restrictions.

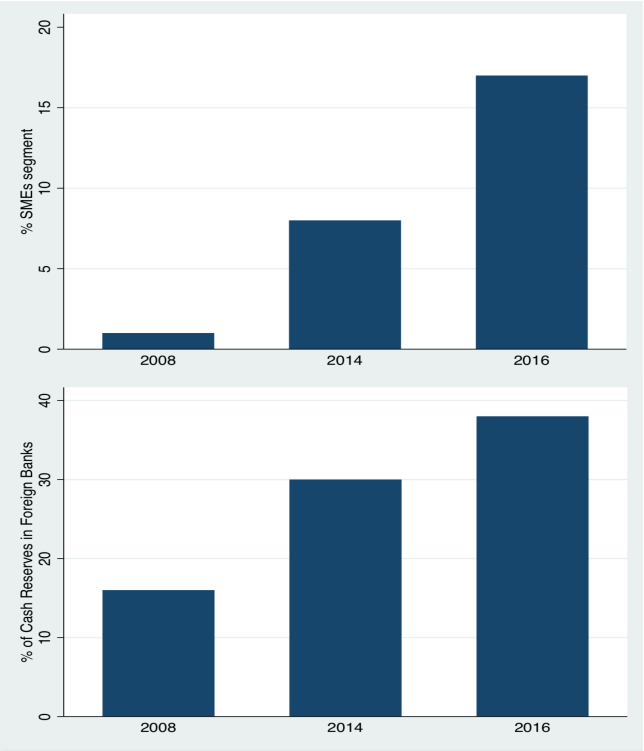
However, we show that the financial channel does not confound with the trade channel. In the run-up to outflow controls and during the bank run in the first six months of 2015, Greek banks came under intense pressure. The confidence to a banking sector that was close to its collapse was eroded and firms became much less dependent on domestic banking services. As Figure 2.4 suggests, firms appear to have been stockpiling cash reserves out of

the Greek banking system and in foreign banks since the outburst of the Greek crisis in 2010. This was intensified in the period before the outflow controls. Having increased their cash buffer in foreign banks, firms were aiming to alleviate the effects of possible outflow restrictions on their daily operations. In other words, firms appear to have self-insured against the risk of changes in government policy by changing their cash reserves strategy. However, of the 47% of SMEs that have changed and adopted a new cash reserves strategy, more than half were retaining only a limited amount of cash abroad (National Bank of Greece Survey (2016)). This implies that the cash buffer was sufficient to more likely cover export-related costs in the short-run (e.g. paying salaries, freight and insurance) rather than in the long-run (e.g. product customization, set up and maintain an international distribution network) and, as such, alleviate the effect of capital controls on the intensive rather than the extensive margin of exports. This cash-based channel is also supported in Priftis and Rousakis (2017) who analyze the behavior of Greek households before the imposition of capital outflow controls.

To provide formal evidence on this cash-based channel, we start by showing that the financial channel does not confound with and is well disentangled from the trade channel by exploiting a *unique* institutional feature of the capital outflows regulation. For public safety purposes,

certain products were exempted from outflow restrictions. In particular, importing medicines, fuel and food products was not subject to submitting documentation that justifies the transfer of funds abroad. There were hardly any restrictions in the importing process of these products and, as such, they serve as a placebo group for the products that were subject to capital controls. Because of this institutional feature, the trade channel of products *not* subject to the restrictions effectively shuts down. We can therefore conduct a counterfactual exercise and isolate the trade from the financial channel.

Figure 2.4: Cash Reserves in Foreign Banks



We do that in Table 2.3. We re-run our baseline regressions by splitting our sample into *exempted* and *restricted* products. The coefficient of the trade channel for the *exempted* products is not statistically significant. The coefficient of the trade channel for the *restricted* products is statistically significant and economically more relevant

as compared to the coefficient in column 4 of Table 2.1. This suggests that the adjustment of exports at the intensive margin is driven by the lack of imported inputs rather than credit factors.

Table 2.3: Falsification Test: The Trade Channel of Products Not Subject to Capital Controls

	Δlog(Exports)	
	Exempted	Restricted
	[1]	[2]
Import Content of Exports	0.89	-0.522**
	1.098	0.226
External Finance Dependence	-0.574	-0.103
	0.88	0.072
Capital, Skills, Contract, Durability, Trade Credit Intensities	yes	yes
Destination FE	yes	yes
Firm FE	yes	yes
Adj. R^2	0.089	0.065
N	8,671	41,036

Note: The table presents results from difference-in-differences regression models at the firm-product-destination level. The time-window is Pre={June 2014-November 2014} and Post={June 2015-November 2015}. Dependent variable is Δlog(Exports), which denotes the log growth of exports following the imposition of controls on capital outflows in June 2015. *Exempted* are medicines, fuel and food products, which correspond to codes 54, 3 and 0 in the SITC Revision 4 classification. Additional sector-level control variables include capital and skills intensity, contract intensity, durability and trade credit intensity. Capital and skills intensity are from Manova (2013), contract intensity is from Nunn (2007), durability is from Kroszner, Laeven and Klingebiel (2007) and trade credit intensity is from Fisman and Love (2003) at the 3-digit ISIC Revision 2 level and are concorded by the authors as weighted averages at the 2-digit ISIC Revision 3 level. Standard errors are clustered at the sector level. Statistical significance is denoted as .01***; .05**; .1*.

Although this exercise suggests that the two channels are well disentangled, an important concern is that the *exempted* products might differ from the *restricted* products <u>*exactly*</u> in their dependence on external finance. In other words, if the *exempted* products are relatively <u>*less*</u> credit-intensive, then the trade channel would still mask the effect of credit factors. In this case, our identification strategy would still not convincingly separate the effects on exports arising from changes in imported inputs and changes in external financing conditions. Indeed, only by

eyeballing the external finance dependence of the relevant *exempted* industries in Appendix Table A.1, this seems to be a valid concern since the dependence of food products on external financing lies on the left tail of the distribution.

We address this issue by analyzing within-industry variation *across* firms' credit constraints[52]. In other words, we compare two firms that export products of the *same* import-intensive sector (and, as such, are equally subject to the trade channel) but are differentially dependent on domestic banking services. If the financial channel is operational, it must be captured at the firm-level. In other words, the effect of the financial channel on the intensive margin of exports will be picked up by our coefficients in a model where firms differ only to the extent they use domestic banking services. Formally, we estimate the following model:

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[52] A downside of our data is that firms are marked with a unique numerical identifier. This is not a problem in our baseline regressions since we analyze within-firm variation. We retrieve a firm's identity by matching with a second administrative dataset that reports the *same* information at the *same* level of disaggregation and overlaps with our anonymized database. We access this dataset through the Bank of Greece. This identified dataset has been extracted from ELSTAT's intra-EU and extra-EU databases, but at an earlier point in time as compared to the anonymized dataset and therefore reports fewer transactions because of subsequent revisions by the Statistical Authority. The precise steps to match the two datasets can be made available upon request.

$$\Delta\, log(Exports)_{fpd} = \beta_1 * (High - IC\ of\ Exports)_s * (Firm\ Characteristic)_f + \alpha_f + \alpha_{ds} + \varepsilon_{fpd}$$

In the above specification, *High-IC of Exports* is dummy equal 1 if an industry's dependence on imported inputs is above the median industry, 0 otherwise. We consider a number of pre-determined (as of 2013) bank observables as *Firm Characteristic* to measure dependence on domestic banking services. This specification allows us to include a set of destination-sector fixed effects to *fully* control for shifts in export demand that are destination- *and* industry-specific.

In Table 2.4, we start by considering the role of bank guarantees. It has been shown that bank guarantees play an important role in international trade (Niepmann and Schmidt-Eisenlohr (2017)) and this channel is likely to be operational in the aftermath of capital controls in Greece. As discussed above, foreign exporters were likely to accept bank guarantees and letters of credit instead of open account in order to settle transactions. We obtain information on firm's dependence on bank guarantees at the firm-bank level from the Bank of Greece and we

aggregate this information at the firm-level[53]. The coefficient in column 1 is not statistically different from zero suggesting that the bank guarantees channel does not confound with the trade channel.

Table 2.4: The Role of External Financing for the Trade Channel

	Δlog(Exports)					
	Bank Guarantees	Short-Term Debt/Liabilities	Short-Term Debt/Sales	Inventories /Sales	Cash Conversion Cycle	Collateral
	1	*2*	*3*	*4*	*5*	*6*
High Import Content of Exports * Firm's Dependence	0.008	-0.379	0.018	0.158	0.001	0.275
	0.018	0.422	0.203	0.311	0.001	0.185
Destination * Sector FE	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
Adj. R^2	0.065	0.065	0.065	0.065	0.065	0.065
N	11,347	11,347	11,347	11,347	11,347	11,347

Note: The table presents results from difference-in-differences regression models at the firm-product-destination level. The time-window is Pre=[June 2014-November 2014] and Post=[June 2015-November 2015]. Dependent variable is *Δlog(Exports)*, which denotes the log growth of exports following the imposition of controls on capital outflows in June 2015. *High Import Content of Exports* is a dummy equal 1 if sector's dependence on imports is above the median sector. Each column uses a different measure of Firm's Dependence. In column 1, *Bank Guarantees* is firm's dependence on log bank guarantees as of 2013. In column 2, *Short-Term Debt/Liabilities* is the share of firm's short-term bank credit to total liabilities as of 2013. In column 3, *Short-Term Debt/Sales* is the share of firm's short-term bank credit to total sales as of 2013. In column 4, *Inventories/Sales* is the share of firm's inventory investment to total sales as of 2013. In column 5, *Cash Conversion Cycle* is the length in days between the moment a firm pays for its raw materials and the moment it is paid for the sale of its final output as of 2013. In column 6, *Collateral* is the share of firm's fixed assets (land, buildings and machines) to total assets as of 2013. All measures are constructed from balance sheet and income statement items except for *Bank Guarantees* that is from the credit register of the Bank of Greece. Standard errors are clustered at the firm level. Statistical significance is denoted as .01***; .05**; .1*.

However, because banks were already weak in the run-up to outflow controls, it is likely that foreign banks increased their fees to accept guarantees, on behalf of their customers, from Greek banks or maybe even refused to accept them at all. Importers were then left to pay cash in advance and might have turned to their banks to ask for regular loans. A decrease in the provision of credit therefore, as Figure 2.2 suggests, would induce an adjustment in imported inputs and as a result an adjustment in exports. In other words, the trade channel might mask

[53] Unfortunately, the database does not distinguish which guarantees are trade-related and which are not. As a result, we treat all bank guarantees as trade-related guarantees.

the effect of the bank credit channel. To formally test for that, we construct four measures of a firm's dependence on bank credit. These measures are standard in the literature. We consider the ratio of short-term debt over total liabilities (column 2) and over total sales (column 3). None of these are statistically significant when we interact them with the dummy of an import-intensive industry. As alternative measures of credit constraints, we consider the ratio of inventories over sales (column 4) and the cash conversion cycle (column 5). The first measure calculates the working capital firms require to maintain inventories and meet external demand. The second measure estimates the length in days between the moment a firm pays for its raw materials and the moment it is paid for the sale of its final output. The higher the measures are, the greater the dependence on external capital[54]. Columns 4 and 5 confirm that none of these proxies are statistically significant, which in turn suggests that the banks credit channel does not confound with the trade channel.

A final concern with these findings has to do with the *foreign* bank credit channel. In other words, firms might have turned to their *foreign* banks exploiting existing lending relationships to ask for credit and pay cash in advance for their imported inputs. In that case, the trade

[54] Both measures are motivated from Raddatz (2006).

channel would still mask the effects of the financial channel. Because we do not observe a firm's outstanding debt from foreign banks, we use the ability of a firm to borrow as this is proxied by a firm's available collateral. Intuitively, a firm with more collateral would borrow relatively more from a foreign bank. In column 6, we use the ratio of fixed assets to total assets as a firm's ability to raise external financing. We construct the ratio as the sum of land, buildings and machines over a firm's total assets. The higher the ratio is, the greater the ability of a firm to raise external financing. The coefficient of the interaction is again not statistically significant. Taken together, these results suggest that credit factors do not drive the adjustment of exports at the intensive margin in the aftermath of capital outflow controls. In other words, credit factors do not confound with the trade channel.

To shed light on the cash-based mechanism, we next compare firms with and without foreign bank accounts that export the *same* import-intensive products. In other words, we ask whether firms that were stockpiling cash reserves in foreign banks before capital controls did better in terms of exports at the intensive margin during capital controls. In line with survey evidence (National Bank of Greece Survey (2016)), we claim that this cash buffer abroad was only sufficient to cover the short-run export-

related costs that are most likely associated with the intensive margin of exports.

Table 2.5: Exports of Firms with Foreign Bank Accounts

	Δlog(Exports)			
		Size	Foreign Ownership	Net Exporter
	[1]	[2]	[3]	[4]
High Import Content of Exports * Foreign Bank Account	0.518**	0.188	3.291***	2.301***
	0.216	0.405	0.874	0.544
High Import Content of Exports * Foreign Bank Account * Firm's Characteristic		0.300**	0.083**	0.000**
		0.14	0.03	0.000
High Import Content of Exports * Firm's Characteristic		0.074	-0.164**	-0.000**
		0.077	0.059	0.000
Destination * Sector FE	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes
Adj. R^2	0.11	0.10	0.10	0.10
N	713	713	713	713

Note: The table presents results from difference-in-differences regression models at the firm-product-destination level. In column 1, the time-window is Pre={June 2014-November 2014} and Post={June 2015-November 2015}. Dependent variable is *Δlog(Exports)*, which denotes the log growth of exports following the imposition of controls on capital outflows in June 2015. *High Import Content of Exports* is dummy equal 1 if sector's dependence on imports is above the median sector. *Foreign Bank Account* is dummy equal 1 if firm has bank account with a foreign bank as of 2013. In column 2, *Size* is the log of firm's total assets as of 2013. In column 3, *Foreign Ownership* is the percentage of firm's foreign equity as of 2013. In column 4, *Net Exporter* is the difference of firm's exports and imports as of 2013. Standard errors are clustered at the firm level. Statistical significance is denoted as .01***; .05**; .1*.

Table 2.5 presents our results. In column 1, we interact a dummy for an import-intensive industry with a dummy for a firm that holds a foreign bank account as of 2013. It is crucial to use this information as of 2013 in order to control for the endogenous response of firms to open accounts with foreign banks both during the bank run and in the aftermath of capital outflow controls. Unfortunately, this dummy is available to us only for approximately 70 listed firms as of 2013. With this caveat in mind, the coefficient is positive and statistically significant at the 5% level. Firms with foreign bank accounts did better in terms of exports of import-intensive

products as compared to firms with no foreign bank accounts. Conditional on a foreign bank account, large firms (column 2), multinationals (column 3) and net exporters (column 4) did better in terms of exports as they were likely to have been stockpiling relatively more cash in the run-up to outflow controls[55]. We exploit these types of firms as a proxy for the amount of cash that firms were stockpiling in foreign banks before capital controls. In all cases, the coefficient of the triple interaction is positive and statistically significant at the 5% level.

Taken together, these results suggest that the lack of imported inputs is responsible for the adjustment of exports at the intensive margin during capital outflow controls. The effect is not driven by credit factors, because firms hedge against the risk of imposition of capital outflow controls by changing their cash reserves strategy, stockpiling cash in foreign banks and becoming less dependent on the weak local banks before the policy shock. These findings inform on the policy responses required to mitigate the unintended consequences of capital outflow controls as a financial stability tool on the real economy.

[55] The idea of a net exporter is intuitive as these firms make relatively more of their revenues abroad and, as such, it is likely to retain relatively more cash in a foreign bank account as compared to a net importer.

4.3 The Extensive Margin

We now turn our attention to the extensive margin of exports. This margin is associated with the large upfront costs that an exporter needs to cover. We follow Manova, Wei and Zhang (2015) and consider three models of the extensive margin. The percent change of products exported by a firm at the sector-destination level *(i.e. %Δ(# Products))*, the percent change of destinations served by a firm at the sector level *(i.e. %Δ(# Destinations))* and the percent change of all trading relationships of a firm at the sector level *(i.e. %Δ(# Product-Destinations))*.

Table 2.6: The Extensive Margin

	By Firm-Sector-Destination	By Firm-Sector	
	%Δ (#Products)	%Δ (#Destinations)	%Δ (#Product-Destinations)
	[1]	[2]	[3]
Import Content of Exports	0.014	0.233	0.206
	0.166	0.163	0.171
External Finance Dependence	-0.164*	-0.281***	-0.310***
	0.089	0.054	0.045
Capital, Skills, Contract, Durability, Trade Credit Intensities	yes	yes	yes
Destination FE	yes	yes	yes
Firm FE	yes	yes	yes
Adj. R^2	0.196	0.230	0.253
N	54,062	13,160	13,160

Note: The table presents results from difference-in-differences regression models. The time-window is Pre={June 2014-November 2014} and Post={June 2015-November 2015}. In column 1, the dependent variable is *%Δ (#Products)* (product scope) at the firm-sector-destination level, which denotes the percent change in the number of products exported. In column 2, the dependent variable is *%Δ (#Destinations)* (destination scope) at the firm-sector level, which denotes the percent change in the number of export markets served. In column 3, the dependent variable is *%Δ (#Product-Destinations)* (product-destination scope) at the firm-sector level, which denotes the percent change in the number of products exported - export market served pairs. Additional sector-level control variables include capital and skills intensity, contract intensity, durability and trade credit intensity. Capital and skills intensity are from Manova (2013), contract intensity is from Nunn (2007), durability is from Kroszner, Laeven and Klingebiel (2007) and trade credit intensity is from Fisman and Love (2003) at the 3-digit ISIC Revision 2 level and are concorded by the authors as weighted averages at the 2-digit ISIC Revision 3 level. Standard errors are clustered at the sector level. Statistical significance is denoted as .01***; .05**; .1*.

The estimates in Table 2.6 suggest that a decline in credit provision has a negative effect on the range of products a firm exported and the range of destinations a firm served in the aftermath of capital outflow controls. Note that all models include a rich set of important industry observables *and* destination fixed effects to account for shifts in exports demand. In all models, the coefficients are statistically significant. They are also economically relevant. A one standard deviation in an industry's dependence on external financing is related with 3pp lower growth of products exported, 4pp lower growth of destinations served and 5.3pp lower growth of a firm's trading relationships. These results suggest that the

financial channel is the key driver behind the decrease in exports at the extensive margin.

Next, we ask whether the cash buffer that firms were stockpiling in foreign banks was sufficient to cover the sunk costs of exports, such as customizing products and maintaining an international distribution network. Survey evidence suggests that the majority of firms were retaining only a limited amount of cash in foreign banks (National Bank of Greece Survey (2016)). As such, the cash buffer abroad might have not be sufficient to cover the sunk costs of exports that are mostly associated with the extensive margin.

Table 2.7: The Extensive Margin of Exports of Firms with Foreign Bank Accounts

	By Firm-Sector-Destination	By Firm-Sector	
	%Δ (#Products)	%Δ (#Destinations)	%Δ (#Product-Destinations)
	[1]	[2]	[3]
High External Finance Dependence * Foreign Bank Account	-0.364	-0.117	-0.012
	0.24	0.187	0.371
Destination * Sector FE	yes	-	-
Sector FE	-	yes	yes
Firm FE	yes	yes	yes
Adj. R^2	0.168	0.029	0.061
N	655	160	160

Note: The table presents results from difference-in-differences regression models. The time-window is Pre=[June 2014-November 2014] and Post=[June 2015-November 2015]. In column 1, the dependent variable is *%Δ (#Products)* (product scope) at the firm-sector-destination level, which denotes the percent change in the number of products exported. In column 2, the dependent variable is *%Δ (#Destinations)* (destination scope) at the firm-sector level, which denotes the percent change in the number of export markets served. In column 3, the dependent variable is *%Δ (#Product-Destinations)* (product-destination scope) at the firm-sector level, which denotes the percent change in the number of products exported - export market served pairs. *High External Finance Dependence* is dummy equal 1 if sector's dependence on external financing is above the median sector. *Foreign Bank Account* is dummy equal 1 if firm has bank account with a foreign bank as of 2013. Standard errors are clustered at the firm level. Statistical significance is denoted as .01***; .05**; .1*.

We formally test this in Table 2.7. We create a dummy *High External Finance Dependence* which is equal to 1 if an industry's dependence on external capital is above

the median industry and 0 otherwise. We interact this dummy with a firm dummy of having a foreign bank account as of 2013. The idea behind this interaction term is to check whether credit constraints were relatively less binding for firms with foreign bank accounts. Our estimates suggest that the existence of a foreign bank account was not sufficient to cover the sunk costs of exports. A firm decreased both the range of products it exported *and* the range of destinations it served. In other words, credit constraints were binding for all firms regardless of their cash reserves strategy prior the imposition of capital controls. This is an intuitive result. The extensive margin of exports is associated with large upfront costs that firms cannot cover with cash. Instead, firms turn to their banks to ask for loans and other relevant banking products (e.g. letters of credit). When trade-related banking products are more expensive or not available, regardless of a firm's cash management practices, exports adjust accordingly. These findings suggest that injecting liquidity directly into the banking system or recapitalizing the banking sector might mitigate the negative effects of capital outflow controls through the financial channel.

5. Back-of-the-Envelope Calculations of the Total Effect

We have computed the elasticities of the trade and financial channels to the adjustment of exports after the imposition of capital outflow controls in Greece. In this section, we use these elasticities to perform a back-of-the-envelope calculation of the contribution of each channel to the overall adjustment. To do so, following Paravisini, Rappoport, Schnabl and Wolfenzon (2015), we make the simplifying assumption that less import- and credit intensive industries (i.e. below the median industry respectively) do *not* adjust their exports throughout our sample period. As such, the estimated effects in Tables 2.1 and 2.6 are driven only by a subset of industries, which are highly import- and credit-dependent. This assumption generates a conservative estimate of the total effect and should be treated as a lower bound.

The coefficient in column 4 of Table 2.1 implies that industries with import content of exports above the median industry reduce their exports by 43% after capital controls. These industries account for 71% of total exports before the policy shock. This means that the trade channel is responsible for 31% of the overall exports adjustment at the intensive margin. Of course, other determinants are also related to the within-firm exports adjustment after capital controls, such as a firm's management practices and

demand for Greek products. Failure to control for these factors would severely bias our estimates. We isolate the supply-side response of firms and show that the trade channel has a first-order effect at the intensive margin of exports.

The coefficient in columns 1, 2 and 3 of Table 2.6 imply that industries that are dependent on external finance above the median industry reduce their product scope by 16%, their destination scope by 28% and the universe of their export trading relationships by 31%. These industries account for 33% of all products exported, 87% of all destinations served and 34% of all export trading relationships before capital controls. This means that the financial channel explains 5% of the adjustment of the products exported, 25% of the adjustment of the destinations served and 11% of the adjustment of product-destination pairs.

6. Conclusion

As Helene Rey puts it, it is necessary to rigorously assess the effect of capital outflow controls on financial stability along with their side effects on the real economy (Rey, 2013). We take a first step to this direction and analyze an episode of capital outflows regulation in Greece in June 2015. Our most important contribution is to identify the transmission channels and real side effects of outflow

controls for financial stability purposes. Our main message is that although outflow controls help to restore financial stability, they have unintended effects on the real economy through multiple channels. Similar unintended effects are related to FX market operations (Ahnert, Forbes, Friedrich and Reinhardt (2018)). As such, it is crucial to weigh the benefits to financial stability against the costs to the real economy when dealing with the consequences of the global financial cycle. This is particularly timely as monetary policy in advanced economies begins to normalize. Identifying the transmission channels through which the effects manifest themselves is crucial to design policy responses. Outflow controls restrict a firm's ability to pay for imported inputs and affect the availability of bank credit. We show that the decrease in imported inputs (the *trade* channel) is the main driver behind the decrease in exports at the intensive margin, while credit constraints (the *financial* channel) are the key driver behind the decrease in exports at the extensive margin. As such, both loosening the regulation and recapitalizing the banking sector might alleviate the real side effects of such policy. Overall, we show that capital outflows controls have unintended real consequences as a crisis management and financial stability tool (Demirguc-Kunt and Serven (2010)), which are not evenly distributed across firms and industries (Rajan and Zingales (2003)) and are *no free lunch* (Forbes (2005a)).

B Appendix

B.1 Industry Characteristics

Table B.1: Industry Characteristics

ISIC Rev. 3	Industry	Import Content of Exports	External Finance Dependence
C15T16	Food products, beverages and tobacco	15.6%	-16.1%
C17T19	Textiles, textile products, leather and footwear	20.5%	-9.9%
C20	Wood and products of wood and cork	26.4%	-3.0%
C21T22	Pulp, paper, paper products, printing and publishing	22.3%	-17.7%
C23	Coke, refined petroleum products and nuclear fuel	67.9%	1.3%
C24	Chemicals and chemical products	32.3%	-11.4%
C25	Rubber and plastics products	27.0%	4.2%
C26	Other non-metallic mineral products	16.6%	-21.1%
C27	Basic metals	44.7%	-13.4%
C28	Fabricated metal products except machinery and equipment	32.6%	-13.3%
C29	Machinery and equipment n.e.c	28.5%	-1.7%
C30	Office, accounting and computing machinery	17.8%	34.1%
C31	Electrical machinery and apparatus n.e.c	32.3%	10.8%
C32	Radio, television and communication equipment	17.7%	24.0%
C33	Medical, precision and optical instruments	27.5%	35.3%
C34	Motor vehicles, trailers and semi-trailers	32.7%	-9.1%
C35	Other transport equipment	28.8%	-2.0%
C36T37	Manufacturing n.e.c; recycling	19.8%	-3.4%

Note: The table presents *Import Content of Exports* and *External Finance Dependence* measures at the 2-digit ISIC Revision 3 sector level. *Import Content of Exports* is defined as the share of total imported intermediated inputs used in the production of an industry's gross exports in Greece in 2005 and is obtained by the OECD STAN Input-Output Database. *External Finance Dependence* is defined as the share of capital expenditures not financed with cash flow from operations and corresponds to the median level of investment needs for ISIC sectors in the U.S. in period 1980-1999. *External Finance Dependence* is obtained from Kroszner, Laeven and Klingebiel (2007) at the 3-digit ISIC Revision 2 level and is concorded by the authors as weighted averages at the 2-digit ISIC Revision 3 level.

B.2 Summary Statistics

Variable	Mean	Median	S.D.	N
Panel A: Industry-level Characteristics				
Import Content of Exports	0.28	0.27	0.12	18
External Finance Dependence	-0.01	-0.03	0.17	18
Physical Capital Intensity	0.07	0.07	0.01	18
Human Capital Intensity	1.04	1.07	0.15	18
Contract Intensity	0.54	0.50	0.16	18
Durability	0.65	0.84	0.39	18
Trade Credit Intensity	0.09	0.09	0.01	18
Panel B: Firm-level Financial Information				
Log(Bank Guarantees)	3.12	0.00	4.18	11,374
Short-Term Debt/Total Liabilities	0.32	0.29	0.21	11,374
Short-Term Debt/Total Sales	0.34	0.19	0.50	11,374
Inventories/Total Sales	0.30	0.23	0.29	11,374
Cash Conversion Cycle	190.75	165.79	174.48	11,374
Collateral (Fixed Assets/Total Assets)	0.73	0.70	0.34	11,374

Note: The table presents summary statistics of the main variables used in the empirical specifications.

Chapter 3

FINANCIAL REGULATION, FINANCIAL GLOBALIZATION AND TRADE INTEGRATION

Joint with Elias Papaioannou and Jose-Luis Peydro

1. Introduction

We investigate the causal relationship between financial integration and trade integration. Departing from the standard Heckscher-Ohlin (HO) paradigm, where international trade and international capital flows are substitutes, we test for the predictions of various theoretical models on finance and trade. For example, Kemp (1966) shows that trade and capital flows are complements with causality running from finance to trade. A similar result is also shown in Jones (1967) and Inada and Kemp (1969), who establish that due to differences in technology, factors of production are internationally mobile. Helpman and Razin (1978) also show that when trade in securities is allowed in their model, trade in goods carries over to uncertain environments. However, the OLS estimates that are generated from a simple regression of financial integration on trade integration suffer from reverse causation. Antras and Caballero (2009) show that in the

presence of financial frictions in underdeveloped countries, which are the source of capital misallocation across sectors, trade integration increases financial integration. The idea is that trade reduces the misallocation problem by re-organizing the domestic production and, as such, increases the return on capital. As a result, it increases the incentive of capital to flow into these countries.

Our contribution is to use a unique quasi-natural experiment in order to identify the causal effect of financial integration on trade integration. We exploit quasi-natural experiment variation at the country-pair level from the Financial Services Action Plan (FSAP) in the EU in period 1999-2003. FSAP was a set of reforms in banking, insurance and securities markets, which harmonized EU member states' financial regulation, integrated financial markets and reduced the costs of cross-border financial intermediation. It included 29 legislative acts, of which 2 Regulations and 27 Directives. Unlike Regulations that imply immediate effect across EU countries, Directives become enforceable only after member states pass domestic legislation to transpose EU law. The transposition into national law can be slow, often beyond the EU official deadlines. Although the timing of the transposition of a Directive is an endogenous decision in a member state, it is plausibly orthogonal to the timing of the transposition of the *same* Directive in another member state. In other words,

we exploit *within-country-pair across-time* variation in regulatory harmonization of EU financial legislation to proxy for the similarity of countries' financial intermediation structures. It seems also reasonable to assume that harmonization of financial intermediation affects trade integration primarily through banking integration.

Exploiting this experimental setting, we first update and expand the index used in Kalemli-Ozcan, Papaioannou and Peydro (2010, 2013) by constructing two variants of this index to capture the speed and intensity of regulatory harmonization. As such, for the first time, we shed light on whether the speed and intensity of regulatory harmonization matters for de-facto financial integration. Our estimates suggest that *maximal* financial regulation (i.e. regulation that leaves no discretion to member states over the rules to be implemented) increases financial integration. This is an important finding that speaks directly to the importance of a level playing field in financial regulation. We proceed by studying the effect on trade integration and find that financial integration has no aggregate effect on bilateral trade among 17 industrial economies[56]. Both our reduced-form and panel estimates

[56] Our sample includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland,

suggest that exogenously driven financial integration does not increase bilateral international trade. Motivated by this finding, we build on Fisman and Love (2004, 2007) and study potential heterogeneous effects based on an industry's growth opportunities. Unlike previous studies, As Fisman and Love (2007) discuss, the assumptions of the seminal work of Rajan and Zingales (1998) are related more to an industry's response to global shocks rather than to inherent (technological) financial dependence[57]. However, unlike Fisman and Love's (2004) growth opportunities proxy that does not vary over time, we construct a time-varying measure, because growth opportunities that arise from global shocks are likely to be temporal rather than permanent. We perform our analysis on a highly disaggregated level of sector classification of 387

Italy, Japan, Netherlands, Portugal, Spain, Sweden, Switzerland and United Kingdom.

[57] A related issue with measures previously employed in the literature is whether "external finance dependence" (Rajan and Zingales, 1998) actually measures dependence on outside trade-related capital. Ahn, Amiti and Weinstein (2011) show that by using cash flow as a proxy for internal finance, the Rajan-Zingales measure is by construction not correlated to trade finance used by exporters. In other words, banks cannot confirm whether a loan is used for domestic sales or for exports. This is in line with the discussion in Feenstra, Li and Yu (2014) that banks cannot follow a loan once it enters a firm. The same assumption, but in a different content, is also made in Bolton and Scharfstein (1990).

manufacturing industries and find that industries that grow faster are the ones that reap the benefits of greater financial integration when it comes to international trade. We show that the industries trade more at both intensive and extensive margins of trade. Taken together, our most important contribution is to solve a challenging endogeneity problem and show that bilateral financial integration implies greater trade integration with some industries winning and some industries losing from financial globalization.

Our paper belongs to the literature that studies the role of financial development and credit constraints on international trade using rich micro datasets[58] (e.g. Manova, 2008; Amiti and Weinstein, 2011; Minetti and Zhu, 2011; Chor and Manova, 2012; Paravisini, Rappoport, Schnabl and Wolfenzon, 2015; Muuls, 2015). However, none of these studies explicitly examine the role of financial globalization on trade integration. In contrast, consistent with causality running from trade to finance, Do and Levchenko (2007) and Braun and Raddatz (2008) show that higher export demand could lead to higher levels of credit domestically. Kalemli-Ozcan and Nikolsko-Rzhevskyy (2010) also provide evidence on a similar mechanism

[58] Foley and Manova (2015) provide an excellent review of the literature that relies on aggregate data.

exploiting fluctuations in rainfall as exogenous variation in trade. Three related to ours papers are by Hale, Candelaria and Caballero (2019) and Michalski and Ors (2012) and Claessens, Hasib and van Horen (2017). Hale, Candelaria and Caballero (2019) examine how bank-to-bank linkages in the syndicated loan market reduce export risk and, thus, increase bilateral trade. Michalski and Ors (2012) exploit the U.S. interstate banking deregulation to show that banks present in two regions charge the appropriate risk premiums for trade-related projects and, as such, affect regional trade flows. In a similar fashion, Claessens, Hasib and van Horen (2017) show that financial integration in the form of foreign bank presence expands available credit and overcomes information asymmetries, which in turn leads to higher exports. However, as theory predicts, a positive association between financial and trade integration does *not* necessarily imply causation. Unlike the previous studies, we undertake an instrumental variables approach to identify the causal effect of banking integration on trade integration.

2. Data and Descriptive Statistics

2.1 Trade Integration

We obtain data on bilateral trade flows at the 6-digit Harmonized System (HS) classification from the UN

COMTRADE Database in period 1994-2006[59]. Approximately every five years, UN revises classification of products by announcing an updated edition, where products change, merge or split. To avoid products entering and exiting our analysis, which could be misleading for the extensive margin of trade, we use UN conversion tables and map HS 1996 and HS 2002 back to HS 1992 to use it as our classification benchmark year[60]. When we study aggregate effects, all products are aggregated at the country-pair-year level. Instead, when we study heterogeneous effects at the country-pair-industry-year level, we map 6-digit HS 1992 products to 4-digit SIC 1987 industries[61]. We then restrict our attention to the manufacturing sector, which corresponds to codes 2000-3999. This leaves us with 387 unique industries at the 4-digit level. Normally, within a given country-pair(-industry-year), same trade flows are reported twice as exports of one country and imports of the other. These values may differ, typically by a small amount, due to differences in reporting practices of the two countries. We construct trade (at the intensive margin) from country *i* to

[59] We start our sample period in 1994, because the data before that year are contaminated with issues regarding VAT fraud (Baldwin, 2006; Baldwin and Di Nino, 2006).

[60] The next edition was HS 2007, which is outside our sample period.

[61] The concordance table is from WITS (https://wits.worldbank.org/product_concordance.html)

country *j* as the average of the corresponding real (deflated using the US price deflator) exports-imports as measure of a one directional trade flow and then measure trade integration as the trade value of the two countries by taking the average of both directional flows of the country-pair. We apply the same logic at the extensive margin as well. We construct trade from country *i* to country *j* as the average of the corresponding exported-imported goods as measure of a one directional trade flow and then measure trade integration as the goods traded between the two countries by taking the average of both directional flows of the country-pair. We match these data with industry-level information from the NBER Manufacturing Database[62]. In particular, we construct a benchmark measure to proxy for growth opportunities, which is defined as an industry's annual sales growth in period 1994-2006[63]. Unlike Fisman and Love (2004), we construct a time-varying measure, because growth opportunities that arise from global shocks are likely to be temporal rather than permanent. We also construct time-varying proxies for factor intensities, that is we define an industry's capital intensity as the log of the

[62] We opt in employing the NBER Manufacturing Database to get information for 387 industries as compared to Compustat, because the latter leaves us with only 200 industries at the 4-digit SIC 1987 level.

[63] We deflate these series with the U.S. CPI index to account for price changes.

real capital stock to total employment and skills intensity as one minus the share of production employment to total employment.

Figure 3.1: Evolution of Trade Integration

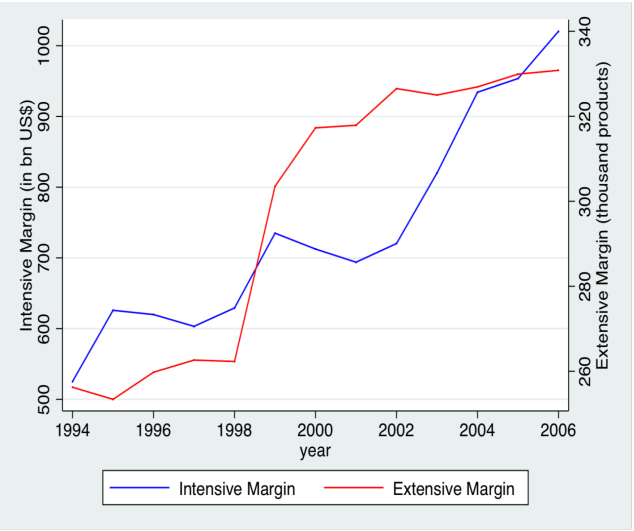
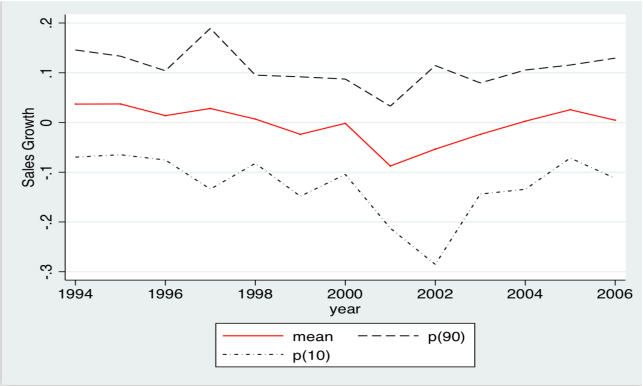


Figure 3.1 presents the evolution of trade integration among industrial countries. The blue line represents the intensive margin of trade, which is defined as the total bilateral assets and liabilities holdings. During our sample period 1994-2006, bilateral exports and imports have doubled from approximately 500 billion U.S. dollars to more than 1 trillion U.S. dollars. The red line represents the extensive margin of trade, which is defined as the sum of bilateral goods exported and imported. In other words,

for each country-pair and industry at the 4-digit SIC level, we count the number of 6-digit HS classification products traded bilaterally and then plot the total number of products in each year. Similar to the intensive margin, there was an increase in the products being traded among industrial countries in period 1994-2006.

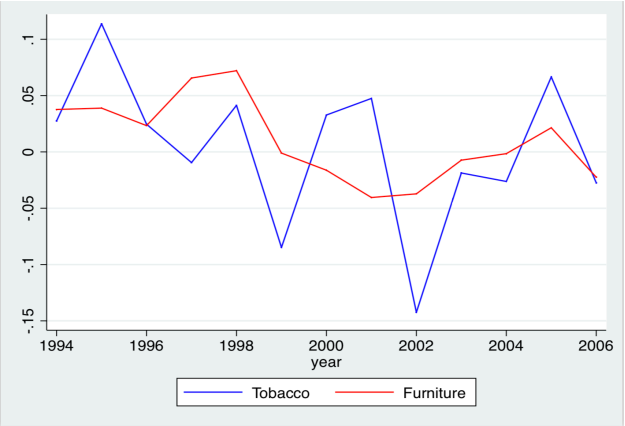
In Figure 3.2, we plot the average annual sales growth of all manufacturing industries at the 4-digit SIC level (387 industries), as well as the 10th and 90th percentiles of the distribution. It is worth noting that the lowest tail of the distribution was growing by as much as -30% in 2001, the upper tail recorded increased sales growth. Although the average sales growth of the manufacturing sector appears to be relatively stable over time, this masks important heterogeneity across industries.

Figure 3.2: Industry Sales Growth Over Time



In figure 3.3, we plot the average annual sales growth of the tobacco (code 21) and furniture (code 25) industries. The plot suggests that industries respond to shocks only temporarily rather than in a permanent manner, which motivates the use of a time-varying measure of growth opportunities.

Figure 3.3: Variation in Sales Growth Over Time



2.2 Banking Integration

We match the trade data with information from the confidential version of the BIS Locational Banking Statistics (LBS), which reports assets and liabilities holdings of banks located in rich industrial economies (reporting economies) in other countries (vis-a-vis

countries)[64]. Data are supervisory and are collected by domestic monetary authorities, which are then passed to and centrally compiled by BIS. The data capture banks' on-balance sheet exposures and approximate for more than 99% of the overall international exposure of a country's banking system (Kalemli-Ozcan, Papaioannou and Peydro, 2013). Data include international bank-to-bank debt holdings, such as interbank deposits and loans. BIS does not distinguish between foreign direct and portfolio equity investments. Although foreign direct and portfolio investments have become more important after the late 1990s (BIS, 2003a), standard banking activities still comprise the bulk of external asset and liability holdings

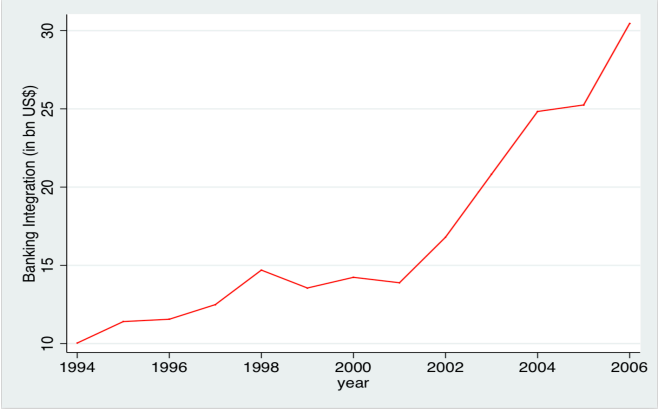
[64] In an effort to enhance its statistical offering to support monetary and financial stability analysis, the BIS has made part of the LBS publicly available. In addition to the positions of banks in all reporting countries on counterparties in individual countries and the positions of banks in individual reporting countries on all counterparties abroad, a matrix of reporting countries and counterparty countries is now disclosed as well. Despite the improvement, a significant part of the data that countries report to the BIS are classified as confidential and are not for publication (BIS, 2016). As BIS (2016) reports, for 15 of the 44 countries that report, limited details are published and for the rest 29 for which more details are published, historical data are not shown. Thus, these confidentiality restrictions result in holes in the data BIS can make publicly available (BIS, 2016). For these reasons, we opt in working with the confidential version of the LBS.

(Kalemli-Ozcan, Papaioannou and Peydro, 2013). This makes the data suitable for our purposes. Because data are expressed in current U.S. dollars, we convert into constant U.S. dollars by deflating the series with the U.S. CPI index. We construct our quantity-based measure of banking integration between country *i* and country *j* as the average value of the real bilateral assets and liabilities holdings (i.e. stocks)[65]. Our sample includes 17 industrial economies, which are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Portugal, Spain, Sweden, Switzerland and United Kingdom[66]. We plot the evolution of banking integration in period 1994-2006 in Figure 3.4.

[65] Importantly, following Baldwin (2006), our trade and banking integration measures are constructed as the average of the log values and not the log of the average values, as this could lead to biased estimates. The error in the calculation of bilateral flows (bank and trade) is getting larger the more unbalanced those bilateral flows are (Baldwin, 2006). Following Rose and Spiegel (2004), we do not standardize the banking integration measure with income or population characteristics, rather we explicitly control for the log of product income per capita and log of product population.

[66] We drop Luxemburg, because of extremely large cross-border assets and liabilities holdings and Greece, because data are available from 2003.

Figure 3.4: Evolution of Banking Integration



2.3 Regulatory Harmonization

We address the endogenous relationship between banking and trade integration by employing the unique "quasi-natural" experimental setting of adopting EU-wide legislation. The index is as in Kalemli-Ozcan, Papaioannou and Peydro (2010, 2013) and reflects the harmonization in financial services as part of the Financial Services Action Plan (FSAP) across EU member states in period 1999-2003. Unlike Regulations, the gradual transposition of Directives into national law generates variation at the country-pair *and* year level, which is ideal for our analysis. We exploit the variation in the implementation of the *same* Directive by two different countries and define our structural measure of financial integration as

$$HARMON_{ijt} = ln \sum_{k=1}^{k=27} (1 + LEX_{ijt,k})$$

We update and extend the index of Kalemli-Ozcan, Papaioannou and Peydro (2010, 2013) in two ways. First, since financial integration *actually* takes place when laws are implemented rather than transposed into national laws, we manually collect the universe of *implementation dates* of EU-Directives for each member state. Second, we construct two variants of the new index that reflect the speed and the intensity of regulatory harmonization. These improvements allow us to carefully track the implementation of financial regulation along with its speed and intensity. To do so, we combine data from the European Commission and data from the *EUR-LEX* portal, which is the official portal of all European Union laws. We retrieve detailed information on all 27 Directives, such as all relevant transposed legal acts and their official documents published at government Gazettes, dates of publication, notification dates of European authorities and actual implementation dates. When implementation dates are not available, we conduct an *extensive manual* search in official documents and legal acts, often available only in the national language to pick up the right dates. In case a member state presents multiple legal acts to transpose the same Directive, we collect information on both the *earliest*

and the *latest* implementation date to proxy for the speed of harmonization. Finally, we follow Enriques and Gatti (2008) taxonomy of EU Directives and distinguish between *minimal* and *maximal* harmonization. The idea behind this taxonomy is that with minimal harmonization, member states may impose stricter rules on top of what is the least harmonized guidelines. On the other hand, maximal harmonization promotes the idea of uniformity across member states, by transposing the rules devised in the Directive and leaving no room for discretion at the member state level[67]. We collect this information from the Directives' official documents and assign a dummy "minimal" for Directives with only minimum requirements[68]. Out of 27 Directives, 23 imply minimal and 4 imply maximal harmonization. We use this taxonomy to proxy for the intensity of financial regulation. Appendix Tables 2 and 3 present the updated and expanded index in the EU 15 countries[69]. Although a laborious task to manually collect this information, these indexes will help

[67] Two notable examples of maximal harmonization include the Directive 2002/65/EC on the distance marketing of financial services and Directive 2004/39/EC on the markets in financial instruments (MiFID).

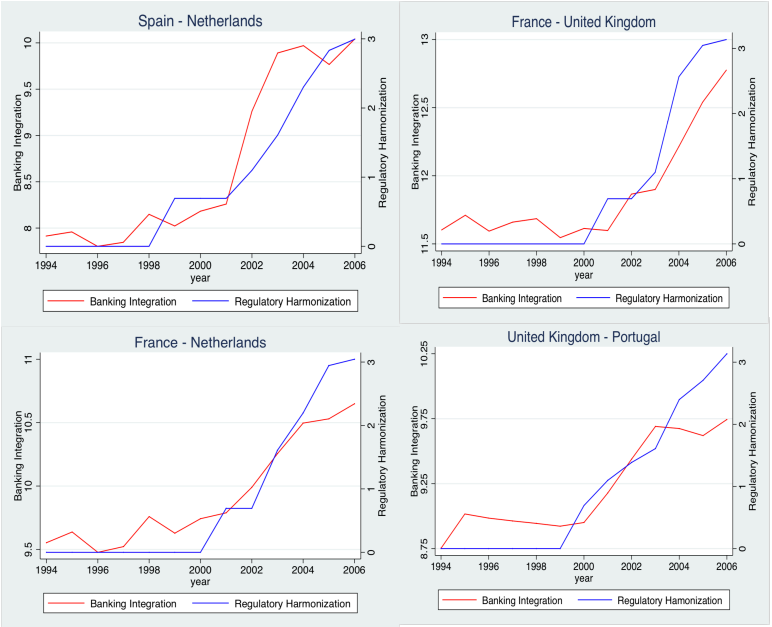
[68] For example, Directive 2002/83/EC for life assurance allows member states to "lay down stricter rules for assurance undertakings authorized by its own competent authorities" (paragraph 28).

[69] The correlation between the various variants of the index is 99.8%.

us shed light on important questions for the design of financial regulation.

In Figure 3.5, we plot the regulatory harmonization of financial intermediation measure along with banking integration for four country-pairs in Europe. In all cases, although there were international financial linkages among country-pairs, de-facto financial integration was relatively stable until 1999. Regulatory harmonization, which was designed to reduce barriers in financial legislation, spurred cross-border financial flows and increased banking integration. These plots suggest that the relationship between our de-jure measures of financial integration with our de-facto measure of financial integration is positive and strong.

Figure 3.5: Regulatory Harmonization and Banking Integration



3. Identification

As discussed above, we overcome the endogeneity issues between banking and trade integration by employing a measure of harmonization of financial intermediation across EU member states in period 1999-2003. We exploit the variation that arises from the gradual transposition of each of the 27 Directives of the Financial Services Action

Plan (FSAP) into national laws at the country-pair and year level as an exogenous component of banking integration. Formally, we estimate the following model:

$$BANKINT_{ijt} = \beta_1 * HARMON_{ij,t-1} + Controls_{ij,t-1}\Gamma + \alpha_{ij} + \alpha_t + \varepsilon_{ijt}$$

This model serves as our first-stage regression. We make two assumptions regarding the validity of HARMON as an instrument. First, there is a strong relationship between regulatory harmonization and banking integration. This seems rather plausible, because the experimental setting of harmonizing a particular aspect of law (financial intermediation) EU-wide relates with outcomes in the same industry (banking industry). Second, conditional on other factors, the harmonization of financial services legislation affects international trade through increasing bilateral cross-border financial linkages. This is also a reasonable assumption, because the Financial Services Action Plan (FSAP) was designed to further develop a common market for the provision of financial services and spur financial flows in Europe. To isolate the impact of regulatory harmonization on banking integration, we control for macroeconomic characteristics (income per capita, population and indicator variables for membership in the EU and the Eurozone), as well as for time-invariant

country-pair-specific factors and global shocks with an extensive set of country-pair and year dummies. Finally, we allow for heteroskedastic and serially correlated errors for each country-pair by clustering at the country-pair level.

At the aggregate level, we ask what the effect of increasing bilateral financial linkages is on trade integration at the country-pair level. Formally, we estimate the following model:

$$TRADE_{ijt} = \beta_1 * BANKINT_{ij,t-1} + Controls_{ij,t-1}\Gamma + \alpha_{ij}t + \alpha_{ij} + \alpha_t + \varepsilon_{ijt}$$

The dependent variable represents either the intensive or the extensive margin of trade integration. All right-hand side variables are lagged one year to account for the fact that banking integration is a quantity-based measure (stocks) and trade integration is a flow-based measure (flows). We include country-pair and year fixed effects and, crucially, we add a country-pair-specific linear time trend to account for unobserved dynamics in the banking integration of the country-pair (e.g. an upward or a downward trend). Finally, we produced t-statistics that are based on robust clustered standard errors by country-pair.

We explore potential heterogeneous effects across industries from increased financial linkages on trade integration. As discussed above, following Fisman and

Love (2004, 2007), we focus on industries that differ with respect to how responsive are to global shocks (e.g. a global demand shock or an oil production shock). The assumptions in the seminal work of Rajan and Zingales (1998) are revisited in Fisman and Love (2007), who conclude that financial intermediaries allow firms to respond to these shocks rather than to grow in industries with an inherent dependence on external capital. To this end, we use an industry's annual sales growth as a proxy for responsiveness to global shocks. However, unlike Fisman and Love's (2004) growth opportunities measure which is time-invariant, we construct a time-varying measure as growth opportunities are likely to be temporal rather than permanent. Formally, we estimate the following model:

$$TRADE_{ijst} = \beta_1 * BANKINT_{ij,t-1} * GrOpp_{s,t-1} + \alpha_{ijt} + \alpha_{ijs} + \alpha_{st} + \varepsilon_{ijst}$$

All right-hand side variables are again lagged one year. We isolate the effect of banking integration from other confounding factors by controlling for an exhaustive set of dummies at the country-pair-industry, country-pair-year and industry-year level. The first set of dummies controls for hard-to-measure time-invariant country-pair-specific comparative advantage in international trade. For example, a country may have a comparative advantage in

exporting leather products within a pair, despite its overall comparative advantage in exporting wood products. Since we exploit variation at the country-pair-industry level, these dummies are necessary to isolate the channel. The second set of dummies controls for time-varying country-pair-specific factors that have been found to be important in standard gravity models of international trade (e.g. income and population characteristics). The third set of dummies controls for time-varying heterogeneity across industries. For example, to the extent that physical or human capital intensity varies over time within the same sector, the effect is isolated with the set of industry-year dummies. To allow for rather conservative inference, we follow Cameron, Gelbach and Miller (2011) and calculate the standard errors under multiway clustering at the country-pair and industry-year level.

4. Results

4.1 First-Stage

In Table 3.1 we examine whether regulatory harmonization has explanatory power on cross-border financial flows. All models control for country-pair and year fixed effects. As reported in column 1, the effect is positive and statistically significant at the 99\% confidence level. It is also economically relevant (0.18), suggesting that countries that transposed into domestic law the EU-

wide regulatory harmonization policies on banking, insurance and capital markets became more financially integrated through international banking activities. In column 2, we add two time-varying bilateral measures to proxy for macroeconomic conditions and continue to control for country-pair and year fixed effects. Both the statistical and economic relevance remain unchanged. Since the regulatory harmonization policies took place starting in 1999, we re-run our specifications restricting the time window in period 1999-2006. Column 3 presents the results of this robustness test. Although the economic significant is somewhat smaller, the effect of harmonization on banking integration remains positive and highly statistically significant. Across all specifications, the first-stage F-statistic of the excluded instrument is greater than 10, which serves as a rule of thumb for a weak instrumental variable. Taken together, our results suggest that a significant part of financial integration in Europe was driven by the harmonization of domestic policies in financial services.

Table 3.1: First-Stage: Harmonization and Banking Integration

	Bank. Int.		
	1994-2006		1999-2006
	[1]	[2]	[3]
L1. Harmon.	**0.18*****	**0.18*****	**0.13*****
	0.0005	*0.0000*	*0.0005*
	3.6	*4.4*	*3.57*
GDP & Population Controls	no	yes	yes
Country-Pair FE	yes	yes	yes
Year FE	yes	yes	yes
First-stage F-score	14.55	17.51	11.29
p-value	0.0000	0.0000	0.0000
Within-R^2	0.0374	0.1658	0.1179
N	1,546	1,546	1,069

Note: The table presents OLS estimates. In columns 1-2, the sample period is 1994-2006 and in column 3, the sample period is 1999-2006. The dependent variable is *Banking Integration (BankInt)*, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). *Regulatory Harmonization (Harmon)* is a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the earliest date. Control variables include the log of the product GDP per capita and the log of the product population of the two countries. All variables are lagged one year. Standard errors are clustered at the country-pair level and corresponding p-values and t-statistics (in parentheses) are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p < 0.05, *p < 0.1.

We now restrict our attention to two related issues and ask whether the *speed* and *intensity* of regulatory harmonization matter for the depth of financial integration. To this end, we exploit three variants of our benchmark index of harmonization, one that reflects the *latest* date of implementation of a Directive nationally, one that reflects the *earliest* date of implementation of a minimal Directive nationally and one that reflects the *latest* date of implementation of a minimal Directive nationally. The first variant aims to capture the speed at which national authorities transpose EU-wide legislation and, as a result, how fast they integrate with other member-states. The

second and third variants aim capture the intensity of regulatory harmonization, in other words the implementation of only the minimal requirements set out by a Directive. The estimated coefficients in panel A of Table 3.2 suggest that the speed of harmonization does not materially affect the depth of bilateral financial integration. In other words, despite the piecemeal transposition of an EU Directive by a member state, this does not seem to affect international financial integration. In contrast, the intensity of harmonization seems to matter for the depth of banking integration (panels B and C). The estimated effect, although highly statistically significant, is smaller suggesting that transposing only the minimal of the requirements set out by EU Directives leads to a lower level of bilateral financial integration. Overall, our results suggest that it is *what* is being transposed rather than *when* it is transposed that matters for financial integration. These novel results point to the importance of a level playing field in the harmonization of financial regulation.

Table 3.2: Speed and Intensity of Harmonization

	Bank. Int.		
	1994-2006		1999-2006
	[1]	[2]	[3]
Panel A: Speed			
L1. *latest* -Harmon.	**0.19*** **	**0.19*** **	**0.13*** **
	0.0004	*0.0000*	*0.0008*
	3.61	*4.36*	*3.42*
First-stage F-score	14.71	17.68	10.45
p-value	0.0000	0.0000	0.0000
Within-R2	0.0380	0.1654	0.1162
Panel B: Intensity			
L1. *earliest-minimal* -Harmon.	**0.15*** **	**0.13*** **	**0.10*** **
	0.0011	*0.0007*	*0.0022*
	3.35	*3.49*	*3.12*
First-stage F-score	12.94	11.18	9.42
p-value	0.0000	0.0000	0.0000
Within-R2	0.0253	0.1517	0.1118
Panel C: Speed & Intensity			
L1. *latest-minimal* -Harmon.	**0.15*** **	**0.13*** **	**0.10*** **
	0.001	*0.0009*	*0.004*
	3.36	*3.39*	*2.93*
First-stage F-score	12.98	10.79	8.33
p-value	0.0000	0.0000	0.0000
Within-R2	0.0255	0.1509	0.1100
GDP & Population Controls	no	yes	yes
Country-Pair FE	yes	yes	yes
Year FE	yes	yes	yes
N	1,546	1,546	1,069

Note: The table presents OLS estimates. In columns 1-2, the sample period is 1994-2006 and in column 3, the sample period is 1999-2006. The dependent variable is *Banking Integration (BankInt)* , which is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). In panel A, *Regulatory Harmonization (latest-Harmon)* is a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the latest date. In panel B, *Regulatory Harmonization (earliest-minimal-Harmon)* is a country-pair time-varying measure of the minimal harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 23 indicator variables, one for each minimal EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the earliest date. In panel C, *Regulatory Harmonization (latest-minimal-Harmon)* is a country-pair time-varying measure of the minimal harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 23 indicator variables, one for each minimal EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the latest date. All variables are lagged one year. Standard errors are clustered at the country-pair level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p < 0.05, *p < 0.1.

4.2 Aggregate Effects

We start by analyzing aggregate effects at the country-pair level. Our starting point is to study the relationship between the measure of financial sector harmonization and trade integration. Table 3.3 presents the results from these reduced-form OLS estimates. In columns 1-3, we restrict our attention to the intensive margin of trade, which is defined as the average of the logs of bilateral real exports and imports. All models include a set of country-pair and year dummies to account for time-invariant country-pair characteristics and common shocks respectively, as well as country-pair-specific linear time trends to account for unobserved dynamics at the country-pair level. As a result, the coefficients of interest are identified from variation at the country-pair-year level. In column 1, we document a statistically insignificant relationship between harmonization and trade integration at the intensive margin. In fact, this relationship is far from being statistically meaningful and it remains so when we further control for macroeconomic conditions (column 2) and indicator variables for EU and Eurozone membership (column 3). When we look at the extensive margin, which is defined as the average of the logs of bilaterally exported and imported goods, we again fail to detect any meaningful relationship. Taken together, and regardless of the specification considered, the relationship between our

structural measure of financial integration and trade integration is not significant at the *aggregate* level and this holds for both intensive and extensive margins of trade.

In Table 3.4, we examine the role of our de-facto measure of banking integration in explaining trade integration. To mitigate concerns regarding reverse causality, as well as to reconcile our stocks-based measure of banking integration with our flows-based measure of trade integration, all regressors enter with one year lag in our specifications. For both margins of trade, the estimated coefficients are positive suggesting that an increase in international financial linkages leads to an increase in real linkages. However, the effect is not statistically significant. Conditional on all fixed effects and country-pair-specific linear time trends, these findings imply that there is no meaningful association between banking and trade integration at the aggregate level.

Table 3.3: Aggregate Effects: Harmonization and Trade Integration

	Trade Integration					
	Intensive Margin			Extensive Margin		
	[1]	[2]	[3]	[4]	[5]	[6]
L1. Harmon.	**-0.02**	**-0.01**	**-0.01**	**-0.01**	**-0.00**	**-0.00**
	0.3207	*0.6522*	*0.6549*	*0.2109*	*0.6384*	*0.425*
	-1.00	*-0.45*	*-0.45*	*-1.26*	*-0.47*	*-0.80*
GDP & Population Controls	no	yes	yes	no	yes	yes
EU & EUROZONE dummies	no	no	yes	no	no	yes
Country-Pair Time Trends	yes	yes	yes	yes	yes	yes
Country-Pair FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Within-R2	0.7917	0.8006	0.8029	0.836	0.8403	0.8414
N	1,546	1,546	1,546	1,546	1,546	1,546

Note: The table presents OLS estimates. The sample period is 1994-2006. Intensive margin is presented in columns 1-3, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. Extensive margin is presented in columns 4-6, which is defined as the average of the logs of goods bilaterally exported and imported. *Regulatory Harmonization (Harmon)* is a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the earliest date. Control variables include the log of the product GDP per capita, the log of the product population and indicator variables for Eurozone and EU membership. All variables are lagged one year. Standard errors are clustered at the country-pair level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p < 0.05, *p < 0.1.

Table 3.4: Aggregate Effects: Banking and Trade Integration

	Trade Integration					
	Intensive Margin			Extensive Margin		
	[1]	[2]	[3]	[4]	[5]	[6]
L1. Bank. Int.	**0.02**	**0.02**	**0.02**	**0.01**	**0.01**	**0.01**
	0.1905	*0.1497*	*0.1558*	*0.2323*	*0.1734*	*0.1358*
	1.32	*1.45*	*1.43*	*1.20*	*1.37*	*1.50*
GDP & Population Controls	no	yes	yes	no	yes	yes
EU & EUROZONE dummies	no	no	yes	no	no	yes
Country-Pair Time Trends	yes	yes	yes	yes	yes	yes
Country-Pair FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Within-R2	0.7925	0.8019	0.8042	0.8361	0.8407	0.8419
N	1,546	1,546	1,546	1,546	1,546	1,546

Note: The table presents OLS estimates. The sample period is 1994-2006. Intensive margin is presented in columns 1-3, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. Extensive margin is presented in columns 4-6, which is defined as the average of the logs of goods bilaterally exported and imported. *Banking Integration (BankInt)* is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). Control variables include the log of the product GDP per capita, the log of the product population and indicator variables for Eurozone and EU membership. All variables are lagged one year. Standard errors are clustered at the country-pair level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p<0.05, *p<0.1.

4.3 Heterogeneous Effects

Having established no meaningful relationship between banking and trade integration at the aggregate level, we now explore the idea that there might be winners and losers from financial globalization at the industry level. Building on Fisman and Love (2004, 2007), we study heterogeneous effects based on industry's growth opportunities. As Fisman and Love (2007) discuss, the assumptions of the highly influential work of Rajan and Zingales (1998) are related more to an industry's response to global shocks rather than to inherent (technological) financial dependence. Unlike Fisman and Love's (2004) growth opportunities proxy that does not vary over time, we construct a time-varying measure, because growth opportunities that arise from global shocks are likely to be temporal rather than permanent[70].

We start by exploring the relationship between our harmonization index and trade integration. We present the intensive margin results in columns 1-3 of Table 3.5. The variable of interest in column 1 is the interaction between harmonization and growth opportunities. Along with standard macroeconomic variables and dummies for EU

[70] To maximize the coverage of industries, we employ the NBER Manufacturing Database to get information for 387 industries as compared to Compustat that leaves us with approximately 200 industries at the 4-digit SIC 1987 level.

and Eurozone membership, we control for an extensive set of year and country-pair-industry dummies. The rationale for the latter is to account for the hard-to-measure country-pair-specific comparative advantage in international trade. The estimated effect is positive, highly statistically significant (at the 99%) and highly economically relevant (0.23). In addition, the level effect of financial harmonization enters also positive and statistically significant. In column 2, we add country-pair-year fixed effects and, as such, we absorb the level effect and all macroeconomic variables. We find no change in the estimated effect of the interaction variable. Finally, in column 3, we add a set of industry-time dummies. This very restrictive specification with an exhaustive set of fixed effects suggests that industries in the upper percentile of the distribution of growth opportunities benefit more from the regulatory harmonization as compared to industries in the lower percentile of the distribution. Columns 4-6) focus on the extensive margin. Regardless of how we saturate the model, we find that regulatory harmonization is associated with an increase in the number of products that are traded in industries that are relatively more responsive to global shocks.

Table 3.5: Heterogeneous Effects: Harmonization and Trade Integration

	Trade Integration					
	Intensive Margin			Extensive Margin		
	[1]	[2]	[3]	[4]	[5]	[6]
L1. Harmon. x GrOpp	**0.23*** **	**0.26*** **	**0.10*** **	**0.02*** **	**0.01** **	**0.03*** **
	0.0000	*0.0000*	*0.0075*	*0.0098*	*0.0311*	*0.0001*
	5.74	*6.32*	*2.72*	*2.62*	*2.18*	*4.15*
L1. Harmon.	**0.05*** **			**0.00**		
	0.0002			*0.1666*		
	3.86			*-1.39*		
L1. GrOpp	**0.00**	**-0.01**		**-0.00**	**-0.00**	
	0.92	*0.64*		*0.62*	*0.86*	
	0.10	*-0.47*		*-0.50*	*-0.18*	
GDP & Population Controls	yes	no	no	yes	no	no
EU & EUROZONE dummies	yes	no	no	yes	no	no
Year FE	yes	no	no	yes	no	no
Country-Pair-Industry FE	yes	yes	yes	yes	yes	yes
Country-Pair-Year FE	no	yes	yes	no	yes	yes
Industry-Year FE	no	no	yes	no	no	yes
Within-R2	0.0045	0.0008	0.0001	0.0088	0.0001	0.0002
N	545,849	545,849	545,849	545,849	545,849	545,849

Note: The table presents OLS estimates. The sample period is 1994-2006. Intensive margin is presented in columns 1-3, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. Extensive margin is presented in columns 4-6, which is defined as the average of the logs of goods bilaterally exported and imported. *Regulatory Harmonization (Harmon)* is a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the earliest date. *Growth Opportunities (GrOpp)* is the annual sales growth of an industry and is constructed from the NBER Manufacturing Database at the 4-digit SIC 1987 level. Control variables include the log of the product GDP per capita, the log of the product population and indicator variables for Eurozone and EU membership. All variables are lagged one year. Standard errors are double clustered at the country-pair and industry-time level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p< 0.05, *p<0.1.

In Table 3.6, we present the estimated effect of our de-facto measure of banking integration on trade integration. We eliminate concerns regarding reverse causation by considering variables that are lagged one year. All models control for hard-to-measure country-pair-specific comparative advantage in international trade with an extensive set of country-pair-industry dummies. Then, we gradually saturate with fixed effects to isolate the heterogeneous effect of banking integration across industries on trade integration. At the intensive margin (columns 1-3), we document a strong association between

banking and trade integration for industries that are highly responsive to global shocks. Based on the most restrictive specification, the estimated elasticity is 0.04, which implies that trade integration is 1.6pp per year higher in industries with relatively greater growth differential (i.e. 75^{th} – 25^{th} percentiles) for high levels of bilateral banking integration (i.e. 75^{th} percentile) as compared to low levels of bilateral banking integration (i.e. 25^{th} percentile). We obtain an equally strong correlation between banking and trade integration at the extensive margin of trade. Regardless of how we saturate the model, the effect is highly statistically significant suggesting that greater bilateral financial linkages are associated with mode products being traded in industries with higher growth opportunities.

Table 3.6: Heterogeneous Effects: Banking and Trade Integration

	Trade Integration					
	Intensive Margin			Extensive Margin		
	[1]	[2]	[3]	[4]	[5]	[6]
L1. Bank. Int. x GrOpp	**0.01**	**0.04*** **	**0.04*** **	**0.01*** **	**0.00** **	**0.00*** **
	0.1200	*0.0000*	*0.0000*	*0.0000*	*0.0235*	*0.0092*
	1.56	*5.15*	*4.44*	*7.02*	*2.29*	*2.64*
L1. Bank. Int.	**0.01**			**-0.01***		
	0.6081			*0.0634*		
	0.51			*-1.87*		
L1. GrOpp	**-0.01**	**-0.25*** **		**-0.10*** **	**-0.02**	
	0.88	*0.00*		*0.00*	*0.12*	
	-0.15	*-3.25*		*-5.90*	*-1.55*	
GDP & Population Controls	yes	no	no	yes	no	no
EU & EUROZONE dummies	yes	no	no	yes	no	no
Year FE	yes	no	no	yes	no	no
Country-Pair-Industry FE	yes	yes	yes	yes	yes	yes
Country-Pair-Year FE	no	yes	yes	no	yes	yes
Industry-Year FE	no	no	yes	no	no	yes
Within-R2	0.0032	0.0003	0.0001	0.0096	0.0000	0.0001
N	545,849	545,849	545,849	545,849	545,849	545,849

Note: The table presents OLS estimates. The sample period is 1994-2006. Intensive margin is presented in columns 1-3, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. Extensive margin is presented in columns 4-6, which is defined as the average of the logs of goods bilaterally exported and imported. *Banking Integration (BankInt)* is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). *Growth Opportunities (GrOpp)* is the annual sales growth of an industry and is constructed from the NBER Manufacturing Database at the 4-digit SIC 1987 level. Control variables include the log of the product GDP per capita, the log of the product population and indicator variables for Eurozone and EU membership. All variables are lagged one year. Standard errors are double clustered at the country-pair and industry-time level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p< 0.05, *p< 0.1.

Having established a significant relationship between our index of regulatory harmonization and trade integration and our de-facto measure of banking integration and trade integration, we now combine the two in an IV setup. This allows us to establish the causal effect of banking integration on trade integration and eliminate concerns regarding reverse causation as theory predicts. Columns 1-3 of Table 3.7 report a highly statistically significant and economically relevant effect at the intensive margin. The strictest of our specifications (column 3) suggests a 5.7pp per year trade effect of high versus low bilateral banking integration in industries at the 75th

percentile as compared to industries at the 25th percentile. We document string positive effects at the extensive margin as well with the elasticity at the strictest specification being statistically significant at the 99%. Economically, it suggests that trade integration is 1.2pp per year higher in industries with relatively greater growth differential for high levels of bilateral banking integration (i.e. 75th percentile) as compared to low levels of bilateral banking integration (i.e. 25th percentile). Taken together, these findings suggest that banking integration has a strong positive effect on trade integration with the benefits being distributed unequally across industries. Industries that respond relatively stringer to global shocks tend to benefit more from increased international financial linkages and this holds for both intensive and extensive margins of trade.

Table 3.7: Heterogeneous Effects IV Estimates: Banking and Trade Integration

	Trade Integration					
	Intensive Margin			Extensive Margin		
	[1]	[2]	[3]	[4]	[5]	[6]
L1. Bank. Int. x GrOpp	**0.38*** **	**0.40*** **	**0.14** **	**0.02** **	**0.02** **	**0.03*** **
	0.0001	*0.0000*	*0.0139*	*0.0237*	*0.0401*	*0.001*
	4.15	*4.34*	*2.49*	*2.29*	*2.07*	*3.38*
L1. Bank. Int.	**0.41** **			**-0.04**		
	0.0231			*0.1696*		
	2.30			*-1.38*		
L1. GrOpp	**-2.82*** **	**-3.02*** **		**-0.17** **	**-0.15** **	
	0.00	*0.00*		*0.03*	*0.05*	
	-3.95	*-4.14*		*-2.23*	*-2.01*	
GDP & Population Controls	yes	no	no	yes	no	no
EU & EUROZONE dummies	yes	no	no	yes	no	no
Year FE	yes	no	no	yes	no	no
Country-Pair-Industry FE	yes	yes	yes	yes	yes	yes
Country-Pair-Year FE	no	yes	yes	no	yes	yes
Industry-Year FE	no	no	yes	no	no	yes
N	545,849	545,849	545,849	545,849	545,849	545,849

Note: The table presents IV estimates. The sample period is 1994-2006. Intensive margin is presented in columns 1-3, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. Extensive margin is presented in columns 4-6, which is defined as the average of the logs of goods bilaterally exported and imported. Banking Integration (BankInt) is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). Banking integration is instrumented with a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the earliest date. Growth Opportunities (GrOpp) is the annual sales growth of an industry and is constructed from the NBER Manufacturing Database at the 4-digit SIC 1987 level. Control variables include the log of the product GDP per capita, the log of the product population and indicator variables for Eurozone and EU membership. All variables are lagged one year. Standard errors are double clustered at the country-pair and industry-time level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p< 0.05, *p<0.1.

5. Robustness Checks

In this section, we perform additional tests to check the robustness of our findings. Since our analysis points to the distributional, rather than aggregate, impact of banking integration across industries, we check the robustness of heterogeneous effects. In Table 8, we include the interactions of regulatory harmonization and banking integration with the factors of production, namely capital and skills intensity. As with the growth opportunities, we employ the NBER Manufacturing Database and construct capital and skills intensity measures that vary over time at the 4-digit SIC 1987 level. The idea behind this exercise is that our baseline estimates of growth opportunities might be biased in case capital and skills intensive industries are differentially affected by greater regulatory harmonization and banking integration. We start by presenting reduced-form OLS estimates (i.e. harmonization on trade integration) and benchmark OLS estimates (i.e. de-facto banking integration on trade integration) and, finally, we combine the two in an instrumental variables setup. As columns 1-3 of Table 3.8 report, our conclusions remain unchanged regarding the intensive margin of trade. Across all specifications, the effect is statistically significant and the economic magnitude is also meaningful. The estimated coefficient (0.11) implies that trade integration is 3.9pp per year higher in industries with relatively greater growth

differential for high levels of bilateral banking integration (i.e. 75th percentile) as compared to low levels of bilateral banking integration (i.e. 25th percentile). Our conclusions remain unchanged for the extensive margin of trade as well. Based on IV estimates (column 6), an estimated effect of 0.04 implies that the cross-country-pair difference between the growth differentials is 1.6pp per year. These results confirm our findings of the positive trade effect of banking integration in industries that are relatively more responsive to global shocks.

Table 3.8: Robustness Test I: Controlling for Factor Intensities

	Trade Integration					
	Intensive Margin			Extensive Margin		
	Reduced-Form	OLS	IV	Reduced-Form	OLS	IV
	[1]	[2]	[3]	[4]	[5]	[6]
L1. Harmon. x GrOpp	**0.12*** **			**0.03*** **		
	0.0024			*0.0000*		
	3.1			*4.26*		
L1. Bank. Int. x GrOpp		**0.03*** **	**0.11***		**0.00**	**0.04*** **
		0.0003	*0.086*		*0.1563*	*0.0011*
		3.7	*1.73*		*1.43*	*3.33*
L1. Harmon. x CapInt/Skills	yes	no	no	yes	no	no
L1. Bank. Int. x CapInt/Skills	no	yes	yes	no	yes	yes
Country-Pair-Industry FE	yes	yes	yes	yes	yes	yes
Country-Pair-Year FE	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Within-R2	0.0004	0.0002	-	0.0003	0.0004	-
N	545,849	545,849	545,849	545,849	545,849	545,849

Note: The table presents OLS and IV estimates. The sample period is 1994-2006. Intensive margin is presented in columns 1-3, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. Extensive margin is presented in columns 4-6, which is defined as the average of the logs of goods bilaterally exported and imported. *Regulatory Harmonization (Harmon)* is a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the earliest date. *Banking Integration (BankInt)* is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). In columns 3 and 6, banking integration is instrumented with regulatory harmonization. *Growth Opportunities (GrOpp)* is the annual sales growth of an industry, *Capital Intensity (CapInt)* is the log of the real capital stock to total employment of an industry and *Skills Intensity (Skills)* is one minus the share of production employment to total employment of an industry. All measures are time-varying and are constructed from the NBER Manufacturing Database at the 4-digit SIC 1987 level. All variables are lagged one year. Standard errors are double clustered at the country-pair and industry-time level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p <0.05, *p< 0.1.

In Table 3.9, we consider an alternative time window and restrict our attention in period 1999-2006. We

motivate this exercise by the fact that regulatory harmonization was initiated in 1999. We re-run our baseline regressions for all three models for both margins of trade, in other words we obtain reduced-form OLS and benchmark estimates as well as IV estimates. Across all specifications (columns 1-3 for the intensive and columns 4-6 for the extensive margin), the statistical significance of the estimated effect is retained. Economically, although the magnitude is somewhat smaller, our elasticities suggest that the trade effect of bilateral financial linkages across industries with differential growth opportunities remains meaningful. As a result, despite the time window considered for the analysis, our conclusions remain unchanged.

Table 3.9: Robustness Test II: Alternative Time Window

	Trade Integration					
	Intensive Margin			Extensive Margin		
	Reduced-Form	OLS	IV	Reduced-Form	OLS	IV
	[1]	[2]	[3]	[4]	[5]	[6]
L1. Harmon. x GrOpp	**0.07****			**0.02*****		
	0.0218			*0.0001*		
	2.32			*3.92*		
L1. Bank. Int. x GrOpp		**0.03*****	**0.10****		**0.00***	**0.02*****
		0.0017	*0.0307*		*0.0898*	*0.0023*
		3.21	*2.18*		*1.71*	*3.11*
Country-Pair-Industry FE	yes	yes	yes	yes	yes	yes
Country-Pair-Year FE	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Within-R2	0.0004	0.0002	-	0.0003	0.0004	-
N	545,849	545,849	545,849	545,849	545,849	545,849

Note: The table presents OLS and IV estimates. The sample period is 1999-2006. Intensive margin is presented in columns 1-3, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. Extensive margin is presented in columns 4-6, which is defined as the average of the logs of goods bilaterally exported and imported. *Regulatory Harmonization (Harmon)* is a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the earliest date. *Banking Integration (BankInt)* is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). In columns 3 and 6, banking integration is instrumented with regulatory harmonization. *Growth Opportunities (GrOpp)* is the annual sales growth of an industry and is constructed from the NBER Manufacturing Database at the 4-digit SIC 1987 level. All variables are lagged one year. Standard errors are double clustered at the country-pair and industry-time level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p<0.05, *p<0.1.

6. The Role of Common Currency

In the final section, we turn our attention to the role of common currency. The financial integration effect of the euro has been documented in the literature and is mainly associated with the elimination of currency risk (e.g. Kalemli-Ozcan, Papaioannou and Peydro, 2010). The trade effect of the euro has also been discussed extensively in the literature (e.g. Baldwin, 2006). Here, we ask whether there is a differential effect of higher financial integration on trade between country-pairs that belong to the same monetary union as compared to country-pairs where at least one of the two countries is not part of the union. To put it differently, we ask whether eliminating the currency risk has any materially differential impact on the effects of greater financial linkages on international trade. And, if so,

we ask whether the impact differs along the margins of trade. To this end, we interact our de-facto banking integration measure with an industry's growth opportunities with an indicator variable that is equal to one if both countries in a pair are members of the Eurozone, zero otherwise and we instrument with the triple interaction of harmonization with an industry's growth opportunities with the Eurozone indicator variable. Table 3.10 presents our estimated elasticities. As we report in column 1, conditional on all fixed effects, there is no *differential* effect at the intensive margin of trade. The interaction of banking integration with an industry's growth opportunities continues to enter significant and of the same magnitude as our baseline estimates. In contrast, when we estimate the extensive margin of trade, we find that the trade effect of banking integration in industries that grow relatively faster is more pronounced between country-pairs that belong to the Eurozone. The level effect of banking integration with an industry's growth opportunities continues to enter statistically significant. These results suggest that the euro along with the increased banking integration that stems from harmonization of financial intermediation in Europe had led to an increase in the number of products being traded in industries that are highly responsive to global shocks. Economically, as compared to non-Eurozone country-pairs, trade integration is 3.6pp per year higher in

industries with relatively greater growth differential for high levels of bilateral banking integration (i.e. 75th percentile) as compared to low levels of bilateral banking integration (i.e. 25th percentile).

7. Conclusion

In this paper we provide causal evidence on the aggregate effect of banking integration on trade integration and explore the channels of transmission based on different industry characteristics. We update and expand an exogenous index of regulatory harmonization of financial services that was part of the Financial Services Action Plan in the EU in period 1999-2003. FSAP was a set of reforms in banking, insurance and securities markets, which harmonized EU member states' financial regulation, integrated financial markets and reduced the costs of cross-border financial intermediation. Exploiting the piecemeal transposition of EU-Directives into national law at the country-pair-year level, we find that bilateral banking integration does not cause greater bilateral trade. However, we document statistically and economically significant heterogeneous effects across industries with different responsiveness to global shocks. In other words, industries that grow faster benefit more in terms of trade at higher levels of bilateral banking integration as compared to industries that grow slower. Our findings suggest that the

benefits of financial globalization are not evenly distributed across industries, as some industries win and some industries lose from greater financial globalization. Overall, despite recent evidence on the transmission of local shocks globally through international financial linkages, our findings suggest that financial globalization has important positive effects on trade integration (Obstfeld, 2015).

Table 3.10: The Role of Common Currency

	Trade Integration	
	Intensive Margin	Extensive Margin
	[1]	[2]
L1. Bank. Int. x GrOpp x EUROboth	**0.3**	**0.09****
	0.1438	*0.0163*
	1.47	*2.43*
L1. Bank. Int. x GrOpp	**0.11***	**0.02****
	0.0546	*0.0205*
	1.94	*2.35*
L1. EUROboth x GrOpp	**-2.55**	**-0.77****
	0.1504	*0.0189*
	-1.45	*-2.38*
Country-Pair-Industry FE	yes	yes
Country-Pair-Year FE	yes	yes
Industry-Year FE	yes	yes
N	545,849	545,849

Note: The table presents IV estimates. The sample period is 1994-2006. Intensive margin is presented in column 1, which is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. Extensive margin is presented in column 2, which is defined as the average of the logs of goods bilaterally exported and imported. *Banking Integration (BankInt)* is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). Banking integration is instrumented with a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP) transposed into national law at the earliest date. *Growth Opportunities (GrOpp)* is the annual sales growth of an industry and is constructed from the NBER Manufacturing Database at the 4-digit SIC 1987 level. *EUROboth* is an indicator variable that is equal to one if both countries belong to the Eurozone, zero otherwise. All variables are lagged one year. Standard errors are double clustered at the country-pair and industry-time level and corresponding p-values and t-statistics are reported below the estimates. Statistical significance is denoted as follows ***p<0.01, **p<0.05, *p<0.1.

C Appendix

C.1 Summary Statistics

Variables	Observations	Mean	Min	10%	25%	50%	75%	90%	Max	SD
Panel A: Aggregate Effects										
Trade (Intensive Margin)	1546	21.43	17.3	19.45	20.3	21.44	22.44	23.53	24.92	1.5
Trade (Extensive Margin)	1546	7.54	5.59	6.72	7.19	7.62	7.98	8.23	8.37	0.57
Banking Integration	1546	7.72	0.69	4.74	6.12	7.82	9.52	10.54	12.88	2.26
Regulatory Harmonization	1546	0.6	0	0	0	0	0.69	2.71	3.14	1
Panel B: Heterogeneous Effects										
Trade (Intensive Margin)	545849	13.27	0.66	9.62	11.34	13.34	15.27	16.82	22.71	2.77
Trade (Extensive Margin)	545849	1.6	0.69	0.69	0.97	1.45	2.08	2.68	5.25	0.77
Banking Integration	545849	7.84	0.69	4.84	6.27	7.93	9.63	10.58	12.88	2.22
Regulatory Harmonization	545849	0.62	0	0	0	0	0.69	2.71	3.14	1.01
Growth Opportunities	545849	-0.01	-0.37	-0.14	-0.06	0	0.06	0.11	0.29	0.11

Note: Panel A reports summary statistics at the country level (aggregate effects). Panel B reports summary statistics at the industry level (heterogeneous effects). *Trade (Intensive Margin)* is defined as the average of the logs of bilateral real (deflated with the US price deflator) exports and imports. *Trade (Extensive Margin)* is defined as the average of the logs of goods bilaterally exported and imported. *Banking Integration* is defined as the average of the logs of bilateral real (deflated with the US price deflator) assets and liabilities holdings (stocks). *Regulatory Harmonization* is a country-pair time-varying measure of the harmonization of financial intermediation in European Union, which is constructed as the log of one plus the sum of 27 indicator variables, one for each EU Directive of the Financial Services Action Plan (FSAP). *Growth Opportunities* is the annual sales growth of an industry and is constructed from the NBER Manufacturing Database at the 4-digit SIC 1987 level.

C.2 Earliest Transposition Dates

Directive	Minimal	AT	BE	DE	DK	ES	FR	FI	GR	IE	IT	LU	NL	PT	SE	UK
		year quarter	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*
1998/26/EC	0	1999 Q4	1999 Q2	1999 Q4	2000 Q2	1999 Q4	2001 Q2	1999 Q4	2000 Q1	1999 Q1	2001 Q2	2001 Q1	1999 Q1	2000 Q1	2000 Q1	1999 Q4
2000/46/EC	1	2002 Q2	2003 Q1	2002 Q3	2005 Q1	2002 Q4	2003 Q1	2003 Q1	2003 Q2	2002 Q2	2002 Q2	2002 Q2	2002 Q3	2002 Q1	2002 Q2	2002 Q2
2000/64/EC	1	2003 Q3	2004 Q1	2002 Q1	2004 Q1	2002 Q4	2004 Q4	2004 Q2	2004 Q4	Not Yet	Not Yet	2001 Q3	2003 Q1	2000 Q4	2000 Q3	2001 Q2
2001/17/EC	1	2003 Q3	2004 Q4	2003 Q4	2006 Q3	2003 Q4	2004 Q2	2004 Q2	Not Yet	2003 Q2	2003 Q2	2004 Q2	2004 Q2	2003 Q2	2006 Q1	2003 Q2
2001/24/EC	1	2003 Q3	2004 Q4	2004 Q1	2004 Q2	2005 Q2	2004 Q4	2004 Q2	2006 Q2	2004 Q2	2004 Q3	2004 Q2	2005 Q2	2006 Q4	2006 Q1	2004 Q2
2001/65/EC	1	2004 Q1	2005 Q1	2004 Q4	2002 Q1	2004 Q1	2004 Q4	2004 Q4	2006 Q2	2004 Q4	2005 Q1	2006 Q2	2005 Q3	2004 Q2	2004 Q1	2004 Q4
2001/86/EC	1	2004 Q4	2004 Q4	2004 Q4	2004 Q2	2006 Q4	2005 Q3	2004 Q4	2006 Q2	2006 Q4	2005 Q4	2006 Q3	2005 Q2	2005 Q4	2004 Q3	2004 Q4
2001/97/EC	1	2003 Q2	2004 Q1	2002 Q3	2005 Q1	2003 Q3	2004 Q1	2003 Q2	2005 Q4	2003 Q2	2004 Q1	2004 Q4	2001 Q4	2004 Q2	1999 Q3	2004 Q2
2001/107/EC	1	2003 Q3	2004 Q2	2004 Q1	2004 Q1	2004 Q1	2003 Q3	2004 Q2	2004 Q4	2003 Q4	2003 Q4	2003 Q1	2005 Q3	2004 Q1	2004 Q2	2004 Q1
2001/108/EC	1	2003 Q3	2004 Q2	2004 Q1	2005 Q3	2004 Q1	2003 Q3	2004 Q2	2004 Q4	2003 Q4	2003 Q4	2003 Q1	2005 Q3	2004 Q1	2004 Q2	2004 Q1
2002/13/EC	1	2003 Q3	2004 Q1	2004 Q1	2004 Q1	2004 Q1	2003 Q3	2004 Q2	2005 Q1	2005 Q1	2004 Q1	2004 Q2	2003 Q4	2003 Q4	2004 Q1	2004 Q1
2002/47/EC	1	2003 Q4	2005 Q1	2004 Q2	2004 Q1	2002 Q4	2005 Q1	2004 Q1	2004 Q4	2004 Q1	2004 Q3	2005 Q3	2004 Q2	2004 Q2	2005 Q2	2003 Q4
2002/65/EC	0	2004 Q4	2006 Q1	2004 Q4	2004 Q4	2007 Q4	2005 Q2	2005 Q2	2005 Q2	2004 Q4	2005 Q4	2006 Q4	2006 Q1	2006 Q2	2002 Q3	2004 Q4
2002/87/EC	1	2005 Q1	2005 Q1	2005 Q1	2004 Q3	2005 Q2	2004 Q4	2004 Q3	2006 Q2	2005 Q1	2005 Q3	2006 Q4	2007 Q1	2006 Q3	2006 Q3	2004 Q3
2002/83/EC	1	2003 Q3	2004 Q1	2004 Q1	2004 Q1	2004 Q1	2003 Q3	2004 Q2	2005 Q1	2005 Q1	2004 Q1	2004 Q2	2003 Q4	2003 Q4	2004 Q1	2005 Q1
2002/92/EC	1	2004 Q4	2005 Q1	2007 Q2	2005 Q3	2006 Q3	2005 Q4	2005 Q3	2005 Q1	2005 Q1	2006 Q2	2005 Q3	2005 Q3	2006 Q4	2005 Q3	2004 Q4
2003/6/EC	1	2005 Q1	2005 Q3	2004 Q4	2005 Q2	2005 Q4	2005 Q3	2005 Q3	2005 Q3	2005 Q3	2005 Q2	2006 Q2	2005 Q4	2006 Q1	2005 Q3	2005 Q3
2003/41/EC	1	2005 Q3	2006 Q4	2005 Q3	2005 Q4	2005 Q1	2006 Q2	2006 Q2	2002 Q3	2005 Q3	2007 Q1	2005 Q3	2006 Q2	2006 Q1	2005 Q1	2005 Q4
2003/48/EC	1	2004 Q1	2005 Q3	2005 Q1	2004 Q2	2004 Q1	2003 Q4	2004 Q1	2005 Q1	2003 Q4	2005 Q2	2005 Q2	2004 Q1	2004 Q1	2004 Q1	2005 Q1
2003/51/EC	1	2005 Q1	2005 Q1	2004 Q4	2004 Q2	2005 Q1	2004 Q4	2004 Q4	2006 Q3	2005 Q1	2007 Q2	2006 Q2	2005 Q3	2005 Q1	2005 Q1	2004 Q4
2003/71/EC	0	2005 Q3	2006 Q3	2005 Q3	2005 Q2	2005 Q1	2005 Q3	2005 Q3	2005 Q4	2005 Q3	2007 Q2	2005 Q3	2005 Q3	2006 Q1	2004 Q2	2005 Q3
2004/25/EC	1	2006 Q2	2007 Q3	2006 Q3	2005 Q2	2007 Q3	2006 Q2	2006 Q4	2006 Q2	2006 Q2	2007 Q4	2006 Q2	2007 Q4	2006 Q4	2006 Q3	2006 Q2
2004/109/EC	1	2007 Q4	2008 Q1	2007 Q4	2007 Q4	2007 Q3	2007 Q4	2007 Q4	2007 Q2	2007 Q2	2007 Q4	2008 Q3	Not Yet	2007 Q4	2007 Q4	2007 Q4
2004/39/EC	0	2007 Q4	2007 Q4	2007 Q4	2007 Q2	2007 Q4	2007 Q4	2007 Q1	2007 Q4	2007 Q4	2007 Q4	2007 Q4	2007 Q4	2007 Q4	2007 Q1	2007 Q1
2005/56/EC	1	2007 Q4	2008 Q3	2007 Q2	2007 Q3	Not Yet	2008 Q3	2007 Q4	Not Yet	2008 Q2	2008 Q3	Not Yet	2008 Q3	Not Yet	2008 Q1	2007 Q4
2006/48/EC	1	2007 Q1	2007 Q4	2007 Q1	2007 Q1	2008 Q1	2007 Q2	2007 Q1	2007 Q3	2007 Q1	2007 Q1	2007 Q4	2007 Q1	2007 Q2	2007 Q1	2007 Q1
2006/49/EC	1	2007 Q1	2007 Q4	2007 Q1	2007 Q1	2008 Q1	2007 Q2	2007 Q1	2007 Q3	2007 Q1	2007 Q1	2007 Q4	2007 Q1	2007 Q2	2007 Q1	2007 Q1

The table reports the earliest year and quarter of the implementation of each of the 27 Directives of the FSAP by EU15 countries. Dummy minnimal refers to Directives that imply minimal harmonization into national laws (see Enriques and Gatti (2008)). Source: EU Commission, EU Law database (EUR-LEX) and each of the EU15 countries.

Appendix Table 3: Latest Transposition Dates

Directive	Minimal	AT	BE	DE	DK	ES	FR	FI	GR	IE	IT	LU	NL	PT	SE	UK
		year quarter	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*	*year quarter*
1998/26/EC	0	1999 Q4	1999 Q2	1999 Q4	2000 Q2	1999 Q4	2001 Q2	1999 Q4	2000 Q1	1999 Q1	2001 Q2	2001 Q1	1999 Q1	2000 Q1	2000 Q1	1999 Q4
2000/46/EC	1	2002 Q2	2003 Q2	2002 Q3	2005 Q1	2002 Q4	2003 Q1	2003 Q1	2003 Q2	2002 Q2	2002 Q2	2002 Q2	2002 Q3	2002 Q1	2002 Q2	2002 Q2
2000/64/EC	1	2003 Q3	2004 Q1	2004 Q1	2004 Q1	2002 Q4	2006 Q1	2004 Q2	2004 Q4	Not Yet	Not Yet	2004 Q2	2003 Q1	2002 Q3	2000 Q3	2003 Q2
2001/17/EC	1	2003 Q3	2004 Q4	2003 Q4	2006 Q3	2003 Q4	2005 Q1	2004 Q2	Not Yet	2003 Q2	2003 Q2	2004 Q2	2004 Q2	2003 Q2	2006 Q1	2005 Q3
2001/24/EC	1	2003 Q3	2004 Q4	2004 Q1	2004 Q2	2005 Q2	2004 Q4	2004 Q2	2006 Q2	2004 Q2	2004 Q3	2004 Q2	2005 Q2	2006 Q4	2006 Q1	2004 Q2
2001/65/EC	1	2004 Q1	2005 Q1	2004 Q4	2002 Q1	2004 Q1	2004 Q4	2004 Q4	2006 Q2	2004 Q4	2005 Q1	2006 Q2	2005 Q3	2004 Q2	2004 Q1	2004 Q4
2001/86/EC	1	2004 Q4	2006 Q1	2004 Q4	2004 Q2	2006 Q4	2005 Q3	2004 Q4	2006 Q2	2006 Q4	2005 Q4	2006 Q3	2005 Q2	2005 Q4	2004 Q3	2004 Q4
2001/97/EC	1	2003 Q2	2004 Q1	2002 Q3	2005 Q1	2003 Q3	2006 Q2	2003 Q2	2005 Q4	2003 Q3	2006 Q1	2004 Q4	2001 Q4	2004 Q2	2005 Q1	2004 Q2
2001/107/EC	1	2003 Q3	2004 Q2	2004 Q1	2005 Q4	2004 Q1	2003 Q4	2004 Q2	2004 Q4	2003 Q4	2003 Q4	2003 Q1	2005 Q3	2004 Q1	2004 Q2	2004 Q1
2001/108/EC	1	2003 Q3	2004 Q2	2004 Q1	2005 Q3	2004 Q1	2003 Q4	2004 Q2	2004 Q4	2003 Q4	2003 Q4	2003 Q1	2005 Q3	2004 Q1	2004 Q2	2004 Q1
2002/13/EC	1	2003 Q3	2004 Q2	2004 Q1	2005 Q1	2004 Q1	2004 Q2	2004 Q2	2005 Q1	2005 Q1	2004 Q1	2004 Q2	2003 Q4	2003 Q4	2004 Q1	2004 Q1
2002/47/EC	1	2003 Q4	2005 Q1	2004 Q2	2004 Q1	2002 Q4	2005 Q1	2004 Q1	2004 Q4	2004 Q1	2004 Q3	2005 Q3	2004 Q2	2004 Q2	2005 Q2	2003 Q4
2002/65/EC	0	2004 Q4	2006 Q1	2004 Q4	2004 Q4	2007 Q4	2005 Q2	2005 Q2	2005 Q2	2005 Q1	2005 Q4	2006 Q4	2006 Q1	2006 Q2	2004 Q2	2004 Q4
2002/87/EC	1	2005 Q1	2005 Q1	2005 Q1	2004 Q3	2005 Q2	2004 Q4	2004 Q3	2006 Q2	2005 Q1	2005 Q3	2006 Q4	2007 Q1	2006 Q3	2006 Q3	2004 Q3
2002/83/EC	1	2003 Q3	2004 Q2	2004 Q1	2005 Q1	2004 Q1	2004 Q2	2004 Q2	2005 Q1	2005 Q1	2004 Q1	2004 Q2	2003 Q4	2003 Q4	2004 Q1	2005 Q1
2002/92/EC	1	2004 Q4	2005 Q1	2007 Q2	2005 Q3	2006 Q3	2006 Q3	2005 Q3	2005 Q1	2005 Q1	2006 Q2	2005 Q4	2005 Q3	2006 Q4	2005 Q3	2005 Q1
2003/6/EC	1	2005 Q1	2005 Q3	2004 Q4	2005 Q2	2005 Q4	2005 Q3	2005 Q3	2005 Q3	2005 Q3	2005 Q2	2006 Q2	2005 Q4	2006 Q2	2005 Q3	2005 Q3
2003/41/EC	1	2005 Q3	2006 Q4	2005 Q3	2005 Q4	2005 Q1	2006 Q2	2006 Q2	2005 Q3	2005 Q3	2007 Q1	2006 Q2	2006 Q2	2006 Q1	2006 Q1	2005 Q4
2003/48/EC	1	2004 Q1	2005 Q3	2005 Q1	2004 Q2	2004 Q1	2003 Q4	2004 Q1	2005 Q1	2003 Q4	2005 Q2	2005 Q2	2004 Q1	2005 Q3	2005 Q3	2005 Q1
2003/51/EC	1	2005 Q1	2006 Q1	2004 Q4	2004 Q2	2005 Q1	2004 Q4	2004 Q4	2006 Q3	2005 Q1	2007 Q2	2006 Q2	2005 Q3	2005 Q1	2006 Q1	2005 Q1
2003/71/EC	0	2005 Q3	2006 Q3	2005 Q3	2005 Q2	2005 Q1	2005 Q3	2005 Q3	2005 Q4	2005 Q3	2007 Q2	2005 Q3	2005 Q3	2006 Q2	2006 Q1	2005 Q3
2004/25/EC	1	2006 Q2	2007 Q3	2006 Q3	2006 Q2	2007 Q3	2006 Q2	2006 Q4	2006 Q2	2006 Q2	2007 Q4	2006 Q2	2007 Q4	2006 Q4	2006 Q3	2006 Q2
2004/109/EC	1	2007 Q4	2008 Q3	2007 Q4	2007 Q4	2007 Q4	2007 Q4	2007 Q4	2007 Q2	2007 Q2	2007 Q4	2008 Q3	Not Yet	2007 Q4	2007 Q4	2007 Q4
2004/39/EC	0	2007 Q4	2007 Q4	2007 Q4	2007 Q2	2007 Q4	2007 Q4	2007 Q1	2007 Q4	2007 Q4	2007 Q4	2007 Q4	2007 Q4	2007 Q4	2007 Q1	2007 Q1
2005/56/EC	1	2007 Q4	2008 Q3	2007 Q2	2007 Q3	Not Yet	2008 Q3	2007 Q4	Not Yet	2008 Q2	2008 Q3	Not Yet	2008 Q3	Not Yet	2008 Q1	2007 Q4
2006/48/EC	1	2007 Q1	2007 Q4	2007 Q1	2007 Q1	2008 Q1	2007 Q2	2007 Q1	2007 Q3	2007 Q1	2007 Q1	2007 Q4	2007 Q1	2007 Q2	2007 Q1	2007 Q1
2006/49/EC	1	2007 Q4	2007 Q4	2007 Q1	2007 Q1	2008 Q1	2007 Q2	2007 Q1	2007 Q3	2007 Q1	2007 Q1	2007 Q4	2007 Q1	2007 Q2	2007 Q1	2007 Q1

The table reports the latest year and quarter of the implementation of each of the 27 Directives of the FSAP by EU15 countries. Dummy minnimal refers to Directives that imply minimal harmonization into national laws (see Enriques and Gatti (2008)). Source: EU Commission, EU Law database (EUR-LEX) and each of the EU15 countries.

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Lebenslauf

Antonios Kotidis wurde am 30. Oktober 1989 in Veroia, Griechenland geboren. Nach er sein Bachelor-Studium in Wirtschaftswissenschaft an der Aristoteles-Universität Thessaloniki und dem Masterstudium in Wirtschaftswissenschaft an der Universität Manchester erfolgreich abgeschlossen hat, hat er in 2013 das Promotionsstudium in Volkswirtschaftslehre an der Bonn Graduate School of Economics der Universität Bonn angefangen. Vom September 2015 bis Februar 2016 war er für einen Forschungsaufenthalt an der Universitat Pompeu Fabra (UPF) in Barcelona, Spanien. Während seines Promotionsstudiums verbrachte er fast zwei und halb Jahre in Forschungsabteilungen von Zentralbanken wie der Bank von Griechenland und der Bank von England, um über Bankgeschäfte zu forschen.