Taxing the Financial Sector: Micro-Level Evidence on Banks' Reactions

Inauguraldissertation
zur Erlangung des Grades
Doctor oeconomiae publicae (Dr. oec. publ.)
an der Ludwig-Maximilians-Universität München

vorgelegt von
Franz Reiter

2018

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Promotionsabschlussberatung: 11. Juli 2018

Acknowledgements

First and foremost, I would like to thank my supervisor Andreas Haufler who was always available to discuss ideas, gave valuable comments and excellently guided me while writing this dissertation. Thank you for supporting me in all aspects, and for providing an enjoyable and motivating working atmosphere at the chair. Special thanks is also due to my co-supervisor Dominika Langenmayr, who inspired me to focus on the taxation of the financial sector. I am grateful for her constructive comments, her helpful advice and for being a perfect co-author on the first chapter. I also would like to thank Christian Holzner for joining my thesis committee.

Moreover, I am grateful to the Research Data and Service Centre of the Deutsche Bundesbank for granting access to the various data sets I use throughout my dissertation, and for supporting me during my numerous research stays in Frankfurt. I also thank the Oxford University Centre for Business Taxation, in particular Michael Devereux and Martin Simmler, for enabling me an exciting and stimulating research stay.

I also thank for the generous financial support from the Egon-Sohmen-Foundation. Moreover, I am grateful to Hans-Werner Sinn who supported me at the start of my dissertation with a position at the Center for Economic Studies.

I really enjoyed my time at the Seminar for Economic Policy. Thanks go to Daniel Gietl for his never-ending ironic comments, Florian Loipersberger for broaden my mind and vocabulary in many dimensions, and to Grete Bukauskaite, Lucas Coronel, Ulrich Glogowsky, Tobias Hauck, Theresa Koch, Miriam Müting, Renate Schwirtz and Davide Suverato for making the time at the chair an unforgettable experience.

Last but not least, my thanks go to my parents and Bernd, who always supported and encouraged me in every respect. My greatest gratitude goes to Franziska – your love and support have been invaluable. Thank you.

Franz Reiter

Munich, March 2018

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Preface

> *"The banking industry is the circulatory system of the economy. It's analogous to the heart. Breaking your arm is unpleasant – it takes awhile to recover but eventually you're as good as new. If your heart fails, you're in trouble."*
>
> John Steele Gordon, a business historian in The Financial Times,
> 17 November 2010

The financial sector has an enormous influence on the real economy and on welfare: When it is in a good shape, it generates economic growth and prosperity by funding investments and consumption. But when the banking industry gets into trouble, there are immense consequences for the whole economy, as the financial crisis in 2007/2008 has impressively demonstrated: In the aftermath, the global economy was shrinking for the first time since the Second World War (International Monetary Fund, 2018). In particular many developed countries suffered from severe slumps in their GDPs.[1] Economic literature confirms the role of banks as the heart of an economy, with periods of instability in the banking sector causing substantial decreases in real output growth (Jokipii and Monnin, 2013).

Accordingly, the fiscal costs that a troubled financial industry causes can be enormous. During the financial crisis, governments around the world have implemented tremendously large bail out programs for ailing banks to keep their economies alive: For instance, in Ireland the costs of bank bail outs summed up to 40.7% of the country's GDP. And also countries less specialized in the financial industry spent large sums to support their banks (e.g. 8.8% of GDP in the United Kingdom and 4.5% in

[1] As data of the International Monetary Fund (2018) shows, the world wide real GDP was shrinking by -0.4% in 2009. Many developed countries faced much sharper declines, for instance the UK with a real GDP growth of -4.3%, the US with -2.8% or Germany with -5.6%.

the United States) and prevent even more severe economic consequences (Laeven and Valencia, 2012).

By contrast, the financial sector's contributions to the state budget do not adequately correspond to these potential fiscal costs and the risks the banking sector poses to the economy. Anecdotal evidence shows that particularly large commercial banks pay only a strikingly small amount in corporate taxes (FAZ, 2013), and that multinational banks have set up extensive tax avoidance schemes (Financial Times, 2017). As Oxfam (2017) illustrates by evaluating the newly introduced country-by-country reporting in the banking sector, European banks report a large share of their profits in tax havens instead, although employing only a small fraction of their workforce there: Average profits per employee were €6.3 million in affiliates in the Cayman Islands, for instance, whereas the same banks report only €29,000 of profits per employee in their high-tax home countries.

This thesis considers the challenges the legislator faces in the taxation of the financial sector. The focus is led on banks' reactions to taxation and the ways banks shift the tax base to affiliates in low-tax countries. Two major channels of profit shifting for corporate tax avoidance are investigated. Moreover, I study a newly introduced bank-specific tax instrument, bank levies, and whether banks shift also this tax base to lower taxed affiliates. Previous literature on tax avoidance has largely ignored the banking sector, and literature on bank activities has mostly not considered the role of taxes. Contributing to these strands of literature, this dissertation studies how banks react to taxes.

There is substantial work on profit shifting of non-financial multinationals, both theoretical studies (e.g. Haufler and Schjelderup, 2000; Peralta et al., 2006; Huizinga and Laeven, 2008; Hong and Smart, 2010) and empirical contributions (e.g. Bartelsman and Beetsma, 2003; Weichenrieder, 2009; Dharmapala, 2014; Heckemeyer and Overesch, 2017). By contrast, literature on tax avoidance in the financial sector is sparse: Demirgüç-Kunt and Huizinga (2001) are the first showing that banks engage in extensive profit shifting to avoid corporate taxes. Also Huizinga et al. (2014), Gu et al. (2015) and Merz and Overesch (2016) find profit shifting evidence in the financial sector, but all of these studies cannot identify precise channels through which banks shift their profits to lower taxed affiliates.

The first two chapters of my dissertation contribute to this line of literature by identifying two main profit shifting channels in the financial sector: Chapter 1 studies the strategic relocation of the highly profitable proprietary trading business to low-tax

countries, without actually shifting the real activity of trading there. Chapter 2 investigates banks' strategic use of internal debt, a profit shifting channel well established in the literature on non-financial multinationals (e.g. Fuest et al., 2011; Buettner et al., 2012; Egger et al., 2014). The results of these two essays suggest that the corporate tax is not sufficient to ensure that banks pay an appropriate share in taxes. After having incurred the high costs of the financial crisis, several countries introduced a new tax instrument: As a tax on inter-bank liabilities, bank levies do not only generate additional tax revenues, but they should also have a Pigouvian effect on banks' potentially risk-transmitting funds. Chapter 3 shows that this intention largely has worked out for the German bank levy, but multinational banks use ways to circumvent the tax payments also with this new bank tax.

All essays in this dissertation have in common that the empirical analysis is based on administrative bank-level data provided for research by the German central bank. Although the size of the German banking sector is relatively small compared to large financial centers like the United Kingdom, the data are of exceptional quality as they comprise a full sample of all German banks and their foreign affiliates. Whereas previous literature had to rely on commercial bank datasets (e.g. Bankscope), I have access to comprehensive and detailed micro data that does not suffer from missing values or a potentially inconsistent data collection. Moreover, unlike datasets used in previous literature, it also provides data on foreign branches rather than only subsidiaries, showing that a large part of banks' business abroad is conducted in branches instead of legally independent subsidiaries. When regarding banks' internal debt structures in Chapter 2, I can even use bilateral internal debt data at the micro level, which allows the most precise identification of internal debt shifting.

All chapters in this thesis evaluate the effectiveness of tax instruments in the banking sector. In the following, I will outline a brief overview of the lines of argument and the results found in each chapter. All chapters are based on stand-alone papers and can be read separately. Chapter 1 is based on a co-authored paper.[2]

Chapter 1 uses these precise German micro data to explore how banks strategically locate their proprietary trading assets to low-tax jurisdictions. This is a novel and bank-specific profit shifting channel different from those that previous literature has identified for non-financial firms. The essay shows that a one percentage point lower corporate tax rate increases banks' fixed-income trading assets by 4.0% and trading

[2]Chapter 1 is co-authored with Prof. Dr. Dominika Langenmayr. To clarify that this is joint work, this essay uses the pronoun "we".

derivatives by 9.0%. This relocation of trading assets is not necessarily profit shifting, it could just be a relocation of real activity. However, we show that the increase of trading assets in low-tax jurisdictions is not accompanied by a relocation of traders – only book profits are shifted instead, whereas the real activity (traders that decide on the trading strategy) remains in high-tax countries. Therefore, the relocation of banks' trading assets is indeed a profit shifting channel, similar to the relocation of intangible assets in non-financial firms (see e.g. Dischinger and Riedel, 2011). Moreover, the essay conducts a back-of-the-envelope calculation of lost tax revenues due to this tax avoidance channel. Assuming a 2% return on trading assets, results imply a loss equal to 32% of tax revenues currently collected from the German banking sector. This chapter is based on joint work with Prof. Dr. Dominika Langenmayr, Catholic University Eichstätt-Ingolstadt (Langenmayr and Reiter, 2017).

In Chapter 2 I investigate how banks use internal debt relations to shift profits to lower taxed affiliates. By taking out loans from low-taxed branches and subsidiaries, multinationals can shift profits to these affiliates: The related interest payments are deductible from the tax base in the high-tax country and are taxed at lower rates in the low-tax country, generating a tax saving equal to the interest payment times the tax rate differential. With the regulatory data on German multinational banks I find that banks indeed use this internal debt shifting channel extensively. Comparing results to previous literature shows that banks engage more aggressively in this tax avoidance channel than non-financial multinationals do. One potential explanation for this finding is that some anti-profit-shifting regulations explicitely do not apply to the banking sector. Another potential reason is the general acceptance of high leverages in the financial sector, giving banks additional scope for internal debt financing. The extensive use of the internal debt shifting channel becomes even clearer when I correct for conduit entities that simply pass through internal debt: A ten percentage points higher corporate tax rate increases the internal net leverage by substantial 5.63 percentage points, corresponding to an 18% increase at the mean. In accounting for conduit debt I make a more general point on internal debt shifting literature, as results of previous studies on this tax avoidance channel are biased if the location of conduit entities is correlated with corporate tax rates. In my sample I find that mainly low-taxed bank affiliates hold conduit debt, explaining the under-estimation of internal debt shifting when not accounting for conduit entities.

The third chapter studies a new bank tax that was introduced in several countries as a consequence of the financial crisis. These bank levies should not only generate

additional tax revenues: They have the clear Pigouvian intention to reduce systemic risks in the banking sector by taxing risk-transmitting inter-bank liabilities. Inducing banks to reduce this tax base, the legislators seek to decrease inter-connectedness of banks and improve their capitalization. My essay exploits the design of the German bank levy introduced in 2011, which exempts banks below a certain threshold from levy payments and sets a progressive levy schedule for all banks above. In a difference-in-differences setting I compare levy-affected banks with non-affected banks below the exemption threshold and find that affected banks significantly decreased their relevant liabilities by about 7% to 9%. Furthermore, I do not find evidence for a substitution of inter-bank liabilities by unaffected customer deposits or equity. Together these results suggest that the risk and inter-connectedness of German core institutes has indeed decreased due to the introduction of the bank levy. I also show a corresponding decrease in individual banks' risk by applying the difference-in-differences estimator to two bank risk measures. However, in a second step I show that multinational banks circumvent also this new bank tax by exploiting a loophole in the bank levy law. As foreign subsidiaries of German banks are not subject to the levy, multinational banks can simply shift the affected funds to these affiliates. Comparing German bank subsidiaries in countries without bank levies with non-German banks, I find evidence for such a fund shifting. Moreover, I show that banks having potential subsidiaries to shift to, effectively do not reduce their group-wide inter-bank liabilities. With these banks holding 18% of total relevant liabilities, this loophole weakens the positive effect of reducing systemic risk in the banking sector.

To sum up, the chapters in this dissertation show that it is extremely difficult to effectively tax the financial sector. Closing the gap in the literature on profit shifting channels for corporate tax avoidance in the banking sector, I first show that banks engage in extensive profit shifting, rendering the standard corporate tax a rather inappropriate tax instrument for the financial sector. An alternative could be special bank taxes, like the German bank levy, which I also investigate in this dissertation. But again, results show that banks use their possibilities to avoid also this new bank tax. The banking sector therefore poses a great challenge for legislators to carefully design tax instruments for banks without loopholes, that ensure that the financial sector contributes to the public budget in a dimension that is adequate to its crucial role as the heart of the whole economy.

Chapter 1

Trading Offshore: Evidence on Banks' Tax Avoidance

1.1 Introduction

During the financial crisis of 2007-2008, bank bailouts burdened governments with enormous debts. The bailout of just one Irish bank, Anglo Irish, cost the Irish government € 25 billion, or 11.3% of GDP (Acharya et al., 2014). In this situation, many commentators asked whether banks pay their fair share in taxes. Anecdotal evidence indeed suggests that banks pay little tax: According to The Independent (2015), five of the world's biggest investment banks (JP Morgan, Bank of America Merrill Lynch, Deutsche Bank AG, Nomura Holding and Morgan Stanley) paid no corporate tax in the United Kingdom in 2014, despite some of them reporting profits of several hundred million U.S. dollars there. Yet despite the importance of the financial sector, there is little systematic evidence on this question, as most studies on corporate tax avoidance exclude the financial sector.

One reason for excluding the financial sector when studying profit shifting is that the business model of financial firms differs so substantially from other firms. For manufacturing and non-financial services, the literature has pointed out three main profit shifting channels: Internal loans, the manipulation of transfer prices, and the strategic relocation of intellectual property. Of these three, banks can primarily use internal

This chapter is based on joint work with Dominika Langenmayr (Langenmayr and Reiter, 2017).

loans to shift substantial amounts to low-tax countries.[1] At the same time, research has shown that internal debt is not the dominant profit shifting channel (Heckemeyer and Overesch, 2017). Thus, the question how financial firms shift profits is largely unanswered. To address this question, we propose a new and quantitatively important profit shifting channel specific to the financial sector: The strategic relocation of assets held for proprietary trading.

A second reason why few researchers have studied banks' tax avoidance is that most large datasets on multinational banks only cover subsidiaries, not branches. However, banks use branches extensively: About a quarter of foreign affiliates of the 100 largest banks worldwide are branches, and the choice between opening a subsidiary or a branch varies systematically with a country's tax rate (Cerutti et al., 2007). In this essay, we use a newly available regulatory dataset provided by the German central bank (the External Positions of Banks database). This dataset includes information on all foreign subsidiaries and branches of German banks. The data is of exceptional quality and provides a complete picture of the foreign activities of all German banks. We also confirm that our findings hold for banks headquartered outside Germany by using Bureau van Dijk's Bankscope dataset.

We propose that banks relocate assets held for proprietary trading to shift profits to low-tax countries. Proprietary trading is very profitable, so relocating these assets to low-tax jurisdictions lowers total tax payments substantially.[2] It thus has the potential to constitute a major profit shifting channel. At the same time, gains from proprietary trading are very mobile, especially as banks do not necessarily develop the trading strategy in the same country as where they carry out the trades.

Our results confirm that banks indeed relocate assets held for proprietary trading to countries with lower tax rates. Using variation within bank groups and over time, we show that a one percentage point lower tax rate increases fixed-income proprietary trading assets held in an affiliate by 4.0% on average, and trading derivatives by 9.0%. These results are robust to different specifications, e.g. using a selection model to control for the strategic placement of affiliates, and to using a completely different,

[1] To a limited extent, banks can also use the other two profit shifting channels. Banks may have some intellectual property (e.g. their brand name), and also set transfer prices (e.g. for fees or loans). However, the amounts shifted in these ways are small relative to other sectors (e.g. the intellectual property of Apple or Amazon, or the transfer pricing possibilities in a vertically integrated manufacturing firm).

[2] From 2009 to 2014, proprietary trading accounted on average for 32% of the after-tax profits of German banks (Deutsche Bundesbank, 2016a).

international dataset.

We find a tax semi-elasticity of -4.0 for fixed-income trading assets. Comparing this number to other estimates of tax semi-elasticities from the literature, it becomes clear that proprietary trading reacts especially strongly to taxation. According to the meta-study of Heckemeyer and Overesch (2017), the average tax semi-elasticity of pre-tax profits is -0.8. However, studies of specific methods of profit shifting have found decidedly higher tax semi-elasticities. For example, Karkinsky and Riedel (2012) document a semi-elasticity of -3.8 for patent applications; Dudar and Voget (2016) find a semi-elasticity of -6.2 for trademarks. These comparisons indicate that the tax sensitivity of assets held for proprietary trading is high, but comparable to other assets that firms relocate specifically in response to tax differentials. As gains from proprietary trading are large, the strategic relocation of proprietary trading constitutes a major profit shifting channel.

Does the relocation of proprietary trading actually constitute a profit shifting strategy? Or should we view it as a real response, similar to how firms relocate investments in response to taxation? In principle, both interpretations are possible. Banks can either move all activities related to trading (including, for example, the employees who set the trading strategy), or transfer only the book assets to lower-taxed affiliates. We interpret the second strategy as profit shifting. In our empirical study, we test if banks also increase employment in response to a tax-induced increase in proprietary trading. We find that a tax-induced increase in trading assets does not result in additional employment, confirming that the tax-induced relocation of proprietary trading is indeed a profit-shifting strategy.

We also document that the relocation of proprietary trading is a quantitatively important profit-shifting channel. Using our estimated semi-elasticities, we conduct a back-of-the-envelope calculation. Assuming a 2% return to proprietary trading, we find that the German tax authorities lose 32% of the tax revenue currently collected from banks due to this profit-shifting strategy alone.

Our essay contributes to two separate strands of literature. First, we contribute to the literature on the effect of taxation on the location of corporate activities and corporate profits (see e.g. Clausing, 2003; Desai et al., 2004; Desai and Dharmapala, 2006; Huizinga and Laeven, 2008; Djankov et al., 2010; Dischinger and Riedel, 2011; Dharmapala and Riedel, 2013; Dharmapala, 2014) by pointing out a novel profit-shifting channel. Most of this literature excludes the financial sector, but there are a few exceptions: Demirgüç-Kunt and Huizinga (2001) provide indirect evidence for profit

shifting by multinational banks.[3] Huizinga et al. (2014) show that corporate tax rates negatively affect foreign direct investment and pre-tax profits of banks. Heckemeyer and de Mooij (2017) study the influence of taxation on leverage for both banks and non-banks and find that on average, the marginal effect of taxation is similar in both groups. Gu et al. (2015) show that bank debt reacts to both corporate tax rates and within-firm tax differentials, indicating profit shifting by internal debt. Merz and Overesch (2016) analyze how various balance-sheet items of multinational banks respond to taxation. Their analysis also includes a regression on trading gains, where they find that these profits are particularly responsive to corporate tax rates. In contrast to our essay, Merz and Overesch (2016) do not differentiate between profit shifting and the relocation of real activities; nor can they exclude that other country characteristics correlated with tax rates drive the results.

Second, we also add to the literature on the determinants of global bank activities by describing how corporate taxation influences the location of proprietary trading assets. Previous papers focus on other country-level determinants of the banks international asset choice, such as expropriation risk (Dell'Ariccia and Marquez, 2010) and regulation (Buch, 2003; Houston et al., 2012). We also contribute to the more specialised literature on proprietary trading. Studying German equity trades, Hau (2001a) and Hau (2001b) show that foreign traders realize lower proprietary trading profits than domestic traders. Fecht et al. (2018) analyze the interaction between proprietary trading and the returns obtained by the bank for retail investors, showing that banks push underperforming stocks from their proprietary portfolios into the portfolios of retail customers. So far, this literature has not considered the impact of taxation.

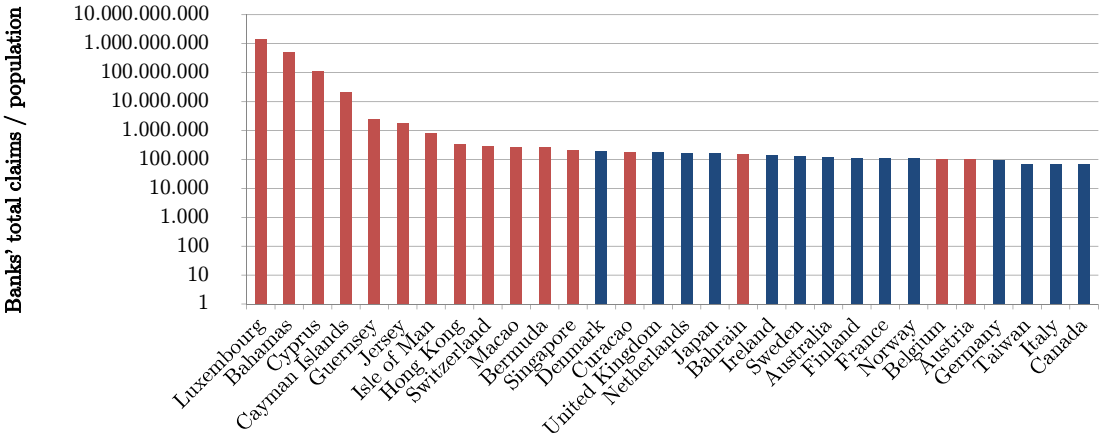
The following section provides some background on proprietary trading and the taxation of banks. Section 1.3 discusses our hypotheses and Section 1.4 describes the data. Section 1.5 provides evidence on fixed-income assets, and Section 1.6 on derivatives held for trading. Section 1.7 offers a back-of-the-envelope calculation of the magnitude of the effects. Section 1.8 concludes.

[3]They show that the profitability of foreign banks rises relatively little with their domestic tax burden, indicating that foreign banks do not pass the tax on to their consumers. One explanation for this result is that the banks themselves can avoid the tax by shifting profits abroad.

1.2 Background: Proprietary Trading and Tax Incentives

Banks are very active in tax havens (see Figure 1.1). However, Figure 1.1 tells us nothing about the kind of activities that banks carry out in these countries. In general, two criteria are important for moving a function to a low-tax country. First, the activity should be relatively mobile, so that the cost of relocating it are low. Second, it should be highly profitable, so that there is a large tax saving of moving it to the tax haven. One candidate for such an activity is banks' proprietary trading.

Figure 1.1: Bank Assets per Capita



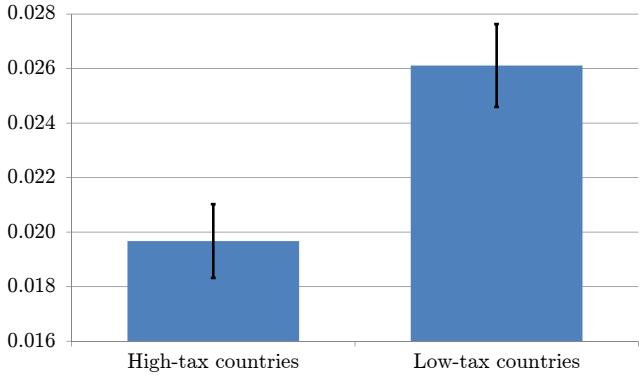
Banks' total claims per capita as of Q4/2015. Red bars indicate countries that Johannesen and Zucman (2014) classify as tax havens. Logarithmic scale on the vertical axis. Calculated from bank asset data from the Bank for International Settlements (2017) and population data from the International Monetary Fund (2018).

Proprietary trades are all trades in stocks, bonds, derivatives or any other financial instrument that a bank carries out with its own money (as opposed to the depositors' money). Many banks derive a large share of their profits from proprietary trading. In our international Bankscope sample, gains from proprietary trading account on average for 39% of banks' pre-tax profits; for German banks, Deutsche Bundesbank (2016a) reports that gains from trading account for 32% of after-tax profits. Proprietary trading thus meets the criterion of being highly profitable.

Proprietary trading activities are also highly mobile. Banks do not have to develop the trading strategy in the same location as where they carry out the trades. While some trading activities, especially high-frequency trades, profit from being close to stock exchanges, other trading activities can be commissioned from almost anywhere in the world. Thus, there is large scope for relocation in response to taxation.

Our main dataset includes data on assets held specifically for proprietary trading. In the following, we will call these assets "trading assets". Figure 1.2 shows the ratio of fixed-income trading assets to total assets for our sample of German multinational banks. It demonstrates that banks hold substantially more trading assets in low-tax affiliates than in high-tax affiliates.

Figure 1.2: Trading Assets as Share of Total Assets



Fixed-income trading assets relative to total assets in our sample of German multinational banks and their foreign affiliates (described in Section 1.4). High-tax countries are countries with a statutory corporate tax rate $\geq$ 30% (the German tax rate), low-tax countries are all other countries. Bars indicate 95% intervals. Source: Deutsche Bundesbank (2015a).

In the following, we will differentiate between "profit shifting" and the "real" relocation of proprietary trading. We will call the relocation of trading activities "profit shifting" if banks relocate few employees to the low-tax country, i.e. when the bank sets the trading strategy in a high-tax country and traders in the low-tax country only carry out the exact instructions they receive from abroad. In contrast, if a bank relocates a significant number of employees, we will classify this action as a relocation of real activities.

In some countries, commercial banking and proprietary trading have to be in separate legal entities. Germany, which is the home country of the banks in our main dataset, passed such a law in 2013. It became effective in July 2016. In principle, we expect that such laws do not affect the incentives to relocate proprietary trading to low-tax jurisdictions.[4] Moreover, our data ends in December 2015, more than half a year

[4]The law requires a bank in Germany to separate proprietary trading if its holds more than €100 billion trading assets on its balance sheet or if it has total assets of more than €90 billion of which at least 20% are trading assets. For a discussion of the German specialized banking law see Dombret et al. (2014).

before the law came into effect. Furthermore, the law affects only the largest banks. As a robustness check, we also aggregate the data over all affiliates of a bank group in a country to account for a potential shifting of trading assets between entities in anticipation of the new law, and find very similar results.

Each subsidiary of a German bank pays corporate tax on its profits in the country where it is active. As Germany has a territorial tax system, almost no additional tax is due on repatriated profits.[5] The same rules apply to foreign branches of German banks if Germany has a double taxation agreement with the host country. This is the case for almost all countries. Therefore, in most countries, taxes do not affect the choice between opening a subsidiary or a branch.

What other tax rules could be relevant? Controlled-foreign-corporation rules (CFC rules) come to mind. Such rules, often in place in high-tax countries, attribute passive income from foreign subsidiaries to the tax base of the parent company. However, in many countries, bank profits are exempt from CFC rules (Deloitte, 2014). German CFC rules, in particular, exclude banks under relatively loose conditions.[6] As all banks in our main dataset on the External Positions of German Banks are headquartered in Germany, we will not incorporate CFC rules in the following considerations.

In most countries gains from proprietary trading are usually taxed at the same rate as profits from other banking activities. Note, however, that a few countries have specific corporate tax rates on banks or apply other tax rates on capital gains of corporations. An example are Hong Kong and Singapore, both of which have a special zero tax rate for corporate capital gains. These tax rates apply also (but not only) to profits generated by the propriety trading activities of banks. In this essay, we use these specific tax rates when applicable. Appendix 1 gives an overview over both the tax rate that applies to banks' proprietary trading profits and the general corporate tax rate.

[5] In more detail, 95% of dividend payments to the German headquarter are exempt from taxation in Germany. Note that dividends on short-term assets in the bank's trading book would not be exempt from taxation in Germany; however, the majority-owned foreign subsidiaries we consider are part of banks' fixed assets and thus 95% exempt from taxation.

[6] German CFC rules completely exclude income from banking under the condition of a 'commercially organized business operation' in the foreign affiliate (see Förster and Schmidtmann, 2004; Ruf and Weichenrieder, 2012). According to a decision by the German Federal Fiscal Court, it is not even necessary that the affiliate has own employees or offices to fulfill this condition (BFH 13 Oct 2010, I R 61/09). In that case, a service contract with another affiliate was sufficient.

1.3 Hypotheses

Our essay aims to answer two questions: Do banks strategically relocate their proprietary trading to low-tax countries? And, if they do so, is this a profit shifting strategy or do they relocate real activities?

An extensive literature has shown that firms relocate activities in response to tax rate differentials (for a survey see Devereux and Loretz, 2013). However, most firms remain headquartered in high-tax countries, and face additional costs when they relocate activities away from their headquarter (Dischinger et al., 2014b). Therefore, when deciding which activities to relocate to low-tax countries, firms will take into account two factors: first, the cost of relocating the activity; and second, its profitability, which determines the potential tax savings.

As discussed in Section 1.2, proprietary trading meets these two criteria. Thus, in the first part of the essay, we test the following hypothesis:

Hypothesis 1 *Proprietary trading activities of banks are decreasing in the corporate tax rate.*

Banks can relocate proprietary trading in two ways: One possibility is to move all activities related to proprietary trading (such as the formation of trading strategy, the decision on individual investments and the actual trading) to a low-tax country. The other possibility is to relocate only the actual trading to the low-tax country, while the investment specialists, who set the investment strategy and decide in which specific securities to invest, remain in the headquarter or in other, specialised affiliates. As these investment specialists are well-educated, costly personnel, the tax incentive is to deduct their cost in the high-tax country. Thus, to minimize their tax burden, we expect that banks relocate proprietary trading activities in name only, while most of the real activity (i.e. decisions on trading strategy etc.) remains in high-tax countries. We thus propose the following second hypothesis:

Hypothesis 2 *The relocation of trading activities to low-taxed affiliates takes place without additional employees in low-tax countries.*

If this hypothesis holds, the relocation of proprietary trading would constitute a "profit shifting" strategy, similar to shifting profits by relocating patents in industrial firms.[7]

[7]For empirical evidence on the relocation of patents, see e.g. Karkinsky and Riedel (2012).

It is important to separate profit shifting strategies from the relocation of real activities (which would be the case if all trading activities were relocated), as the welfare implications of the two strategies may differ. While profit shifting erodes tax revenues in high-tax countries, it can also increase investment there as it lowers the cost of capital. Its overall effect on welfare in the host country is thus ambiguous (see Hong and Smart, 2010). In contrast, the welfare effect of the relocation of real activities is usually negative, as tax revenue and employment are lost. This conclusion holds even if banks' proprietary trading activities cause negative externalities, as these negative effects likely persist also when the bank relocates its trading activities to a tax haven. Thus, while a government might strategically choose to allow some profit shifting, it will not desire to allow the relocation of real activity.

1.4 Data and Descriptive Analysis

To test our hypotheses, we require detailed information on multinational banks. We obtain such data from a regulatory dataset of the German central bank. In a robustness test, we also use Bureau van Dijk's Bankscope dataset.

Our main data source is the External Positions of Banks database of the German central bank (Deutsche Bundesbank, 2015a). The Bundesbank collects this data for regulatory purposes as well as an input to calculate both monetary and balance of payment statistics. The database covers all German banks, including all majority-owned foreign subsidiaries and branches. We observe every foreign subsidiary and an aggregated value for each bank's branches in a country.[8] The sample consists of 106 internationally active bank groups in Germany, with foreign subsidiaries in 33 countries and branches in 46 countries. The three largest banks together have subsidiaries in 29 countries, and branches in 42 countries. The data is available on a monthly basis from December 2010 to December 2015. As reporting to the Bundesbank is mandatory, we observe the complete population of German banks.

To study whether the relocation of proprietary trading is a form of profit shifting or the relocation of real activity, we merge in employment data from the Microdatabase Direct Investment (MiDi), also provided by the Bundesbank. This dataset includes foreign subsidiaries and branches whose total assets exceed € 3 million. It is available

[8] We also observe information on the German headquarter. As Dischinger et al. (2014a) show that firms are reluctant to shift profits away from their headquarters, we do not use this information when estimating tax semi-elasticities.

on a yearly basis.[9] Moreover, to construct our control variables, we use country level information from various sources (see Appendix A.2 for details).

To test Hypothesis 1, we use two different dependent variables: Fixed-income assets held for proprietary trading, and derivatives held for proprietary trading. Both variables measure the current value of trading assets held in an affiliate.[10] We cannot use stocks held for trading, as the Bundesbank data does not differentiate between stocks held for trading and those held as liquidity reserve. Unfortunately, the data for derivatives are available only for a shorter time period (December 2013 to December 2015).

In which countries do German banks hold their trading assets? In Table 1.1, we list the top five countries in which German bank groups had the most proprietary trading assets in 2014.[11] Outside of the home market Germany, most trading assets are in countries with large financial sectors (e.g. the United Kingdom or the United States), but also in tax havens such as Singapore or the Cayman Islands.[12] In some of these countries, banks hold most of their proprietary trading assets in branches (e.g. in the United Kingdom or the Cayman Islands); in other countries, these assets are in legally independent subsidiaries (e.g. in Poland). Banks tend to hold more derivatives than fixed-income assets for proprietary trading.

The main drawback of the Bundesbank data is that the sample is relatively small, even though it covers the full population of German multinational banks. Moreover, one might worry about external validity, given that the dataset contains only banks headquartered in Germany. To address these concerns, we rerun our analysis using Bureau van Dijk's Bankscope dataset in Appendix 3. Large parts of the literature on the taxation and regulation of banks use this dataset (see e.g. Gu et al., 2015; Houston et al., 2012; Huizinga et al., 2014; Merz and Overesch, 2016).

Bankscope provides comprehensive information on balance sheets, income statements

[9]For a detailed description of this dataset, see Lipponer (2011).

[10]In line with international financial reporting standards, German banks have to assign trading assets their fair value. The lowest value principle (which is usually the mandatory accounting principle for assets in Germany) does not apply to bank assets held for trading.

[11]Due to the confidentiality requirements of the Bundesbank, we cannot list countries in which less than three German banks conduct proprietary trading.

[12]In the United States, a substantial part of trading assets is likely in affiliates in Delaware, where banks can also profit from various corporate tax benefits. For instance, seven of Deutsche Bank's eight securities trading firms in the US are based in Wilmington, Delaware (Deutsche Bank AG, 2014). Unfortunately we cannot observe the exact location of a bank affiliate within the US in our dataset. As a robustness check we also estimate equation (1) without affiliates in the US and find similar results.

Table 1.1: Top 5 Countries for Foreign Trading Activities in 2014

	Fixed-income trading assets			Trading derivatives		
#	Country	Total (in m€)	% held in branches	Country	Total (in m€)	% held in branches
1	United Kingdom	42,596	100	United Kingdom	259,500	100
2	United States	7,417	95	United States	203,800	100
3	Italy	2,589	23	Italy	61,513	100
4	Singapore	2,422	40	Singapore	6,621	100
5	Cayman Islands	1,493	100	Poland	1,419	0
	Total	67,498	91	Total	645,175	99

Data from External Positions of Banks database of Deutsche Bundesbank (2015a). Totals of fixed-income securities and derivatives that are held for trading by German multinational banks in foreign affiliates, in million euro. Countries in which less than three banks are active are not shown here due to confidentiality requirements.

and ownership for banks and bank subsidiaries worldwide. The main advantages of this dataset are that it covers banks headquartered anywhere in the world, and that it is available for a longer time period. However, Bankscope has substantial drawbacks regarding both the extent of coverage of affiliates, and the quality of the data. First, Bankscope has information only on subsidiaries but no information on branches. This is a major disadvantage: Table 1.1 confirms that in some countries, German banks hold their trading assets exclusively in branches (e.g. in the United Kingdom or the Cayman Islands). Thus, using a dataset that does not include branches may introduce selection problems. Second, the coverage – even of subsidiaries – in the Bankscope data is unclear. There are many missing values for total trading assets, and we do not observe all subsidiaries of multinational bank groups. For example, the Bundesbank database reports seven subsidiaries of German banks that are active in trading in Singapore. But in Bankscope there is only one German-owned bank active in Singapore, and there is no information on its trading assets.[13] Overall we prefer the Bundesbank data due to its comprehensive sample coverage and its excellent quality. Nevertheless we also use Bankscope as a consistency check for our results.

[13]The Bankscope data also do not report historical ownership, so our analysis implicitly assumes that ownership has not changed for the banks in our sample.

TABLE 1.2: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	p1	p50	p99	Frequ.
Fixed-income trading assets (million €)	16,793	255	2,401	0	0	2,910	M
Trading derivatives (million €)	6,460	2,721	28,600	0	0	56,000	M
Total assets (million €)	16,793	4,851	27,000	0	727	95,300	M
Corporate tax rate	16,793	0.241	0.103	0.000	0.250	0.400	M
Nominal GDP (million €)	16,793	121,626	235,432	197	35,523	1,175,961	Q → M
Inflation rate (%)	16,793	2.154	2.946	-1.399	1.818	11.468	M
GDP growth (%)	16,793	1.922	2.753	-4.426	1.829	9.436	Q → M
Regulation	16,793	1.349	0.681	1	1	3	-
Financial sector share	16,793	0.106	0.095	0.031	0.069	0.422	Q → M
Subsidiary dummy	16,793	0.280	0.449	0	0	1	M
Bank group total assets (million €)	16,793	345,000	503,000	29	65,200	1,410,000	M
Employees (yearly)	1,290	785	3478	0	64	16,314	A

Sample period from 12/2010 to 12/2015, except for trading derivatives, which are only available from 12/2013 to 12/2015. $M/Q/A$ indicate monthly, quarterly and annual frequency. We calculate monthly GDP from interpolated quarterly GDP values using the proportional Denton method as described in Bloem et al. (2001), and monthly GDP growth from these values. We derive the monthly financial sector share by cubic spline interpolation. For data sources see Appendix A.2.

Table 1.2 gives an overview over the descriptive statistics for the main variables in the Bundesbank dataset. Fixed-income trading assets amount on average to €255 million per foreign affiliate. There are significantly more derivatives held for trading (on average €2.721 billion per affiliate). As we observe derivatives only from 12/2013 to 12/2015, there are only 6,460 observations for trading derivatives, compared to 16,793 observations for the other monthly variables. On average, foreign affiliates of German banks have total assets of €4.8 billion.

A German bank group as a whole (including German headquarters) holds €46 billion of fixed-income assets, and €959 billion of derivatives for trading on average (in 2014). Across foreign affiliates the distribution of trading assets is relatively unequal, with the top decile holding 97.7% of fixed-income assets (in 2014; the share for derivatives is even higher). In fact, 33% of affiliates hold no trading assets.[14] Conditional on holding trading assets at all, the average affiliate has fixed-income trading assets worth €1,250 million, and trading derivatives worth €7,415 million (in 2014).

1.5 Evidence on Fixed-Income Trading Assets

1.5.1 Case Study

We first consider some illustrative evidence from the United Kingdom. The United Kingdom started a series of annual corporate tax rate cuts in 2011. In a first step, it cut the corporate tax rate from 28% to 26% in April 2011, and already announced further cuts (BBC, 2011). As the United Kingdom is the largest foreign country in which German banks hold trading assets (see Table 1.1), these tax rate cuts lend themselves to a case study.[15] In this case study, we track how fixed-income trading assets developed in the United Kingdom after the tax rate cut, compared to other countries.

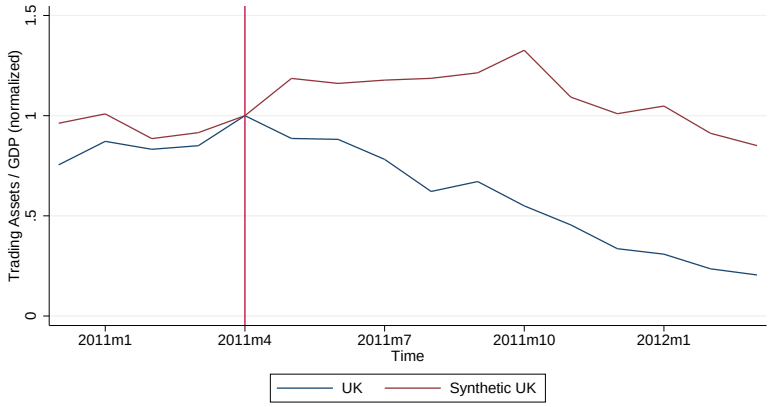
To investigate how proprietary trading in German bank affiliates in the United Kingdom responded to the tax rate cut, we evaluate the time trend in total fixed income trading assets relative to GDP held by German banks in the United Kingdom. As a counterfactual we construct a synthetic control country for the United Kingdom as

[14] If we exclude these affiliates from our analysis, we obtain similar results.

[15] A potential worry with this case study may be that London is such an exceptional location for banks that results from the United Kingdom are not representative. While this may be the case, it does fulfill the purpose of the case study in showing that trading assets respond to tax rate cuts. To ensure that the United Kingdom is not driving our results, we re-estimate the main regressions also without the United Kingdom (see below).

suggested by Abadie et al. (2010), based on trading assets/GDP in the pre-treatment period. In the donor pool there are all countries in which at least three German multinational banks have affiliates.[16] Figure 1.3 shows time trends in these variables for the United Kingdom and the synthetic control country. While trading assets in the United Kingdom increased after the tax rate cut in April 2011, the volume of trading assets in the synthetic control declined until the series went back to the common trend in September 2011.

Figure 1.3: Trading Assets/GDP in the UK and in a Synthetic UK

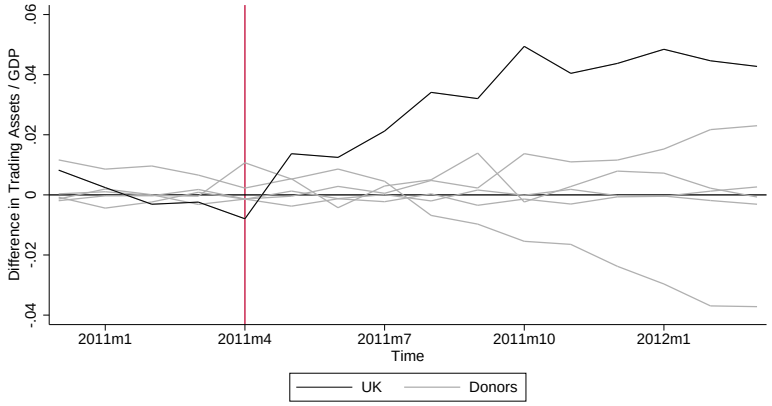


The red line shows the time trend in fixed-income trading assets / GDP of German bank affiliates in the United Kingdom. The blue line shows the time trend of the same variable of a synthetic control for the United Kingdom. Series are normalized (04/2011 = 1) due to confidentiality requirements. Source: Deutsche Bundesbank (2015a).

In Figure 1.4, we carry out a placebo test to show that the difference between the United Kingdom and its synthetic control is unlikely to arise by chance. In the placebo test, we run the same analysis using the other countries in the donor pool as treated countries. Due to the confidentiality restrictions of the Bundesbank, we can carry out this analysis only for countries in which more than three German bank groups have subsidiaries or branches. The dark line in Figure 1.4 again depicts the difference in trading assets/GDP between the United Kingdom and its synthetic control; the grey lines show the same analysis for the other countries in the donor pool. In these countries we cannot find a similar increase in trading assets relative to the respective synthetic control country, confirming that the higher levels of trading assets in the United Kingdom after April 2011 are likely caused by the lower tax rate.

[16]The resulting synthetic control country for the United Kingdom consists of 96% Hong Kong and 4% Singapore.

Figure 1.4: Impact on Trading Assets/GDP Relative to Synthetic Controls



The black line shows the time trend in the difference in fixed-income trading assets / GDP between German bank affiliates in the United Kingdom and affiliates in a synthetic United Kingdom. Grey lines are placebo tests for countries in the donor pool (Germany, Hong Kong, Poland, Singapore and the United States). Source: Deutsche Bundesbank (2015a).

This case study on the British corporate tax rate cut in April 2011 therefore illustrates our hypothesis that banks adjust the location of their proprietary trading activities in response to changes in taxation. We next provide broader evidence for this relationship.

1.5.2 Empirical Strategy

1.5.2.1 Test of Hypothesis 1

In our first hypothesis, we proposed that more trading takes place in low-tax affiliates. To test this relation, we look at the variation in tax rates that different affiliates of a multinational bank face. Accordingly, we estimate the following equation:

$$IHS(\text{Trading Assets}_{ijkt}) = \beta_0 + \beta_1 CTR_{jt} + \beta_2 X_{ijkt} + \delta_k + \gamma_t + \phi_j + u_{ijkt}. \quad (1.1)$$

The dependent variable, $IHS(\text{Trading Assets}_{ijkt})$ is the inverse hyperbolic sine of fixed-income trading assets held by affiliate i of bank-group k in country j as of year-month t. The inverse hyperbolic sine transformation can be interpreted just like the logarithmic transformation, but has the advantage that it is also defined at zero (and for

negative values).[17] The main explanatory variable of interest is CTR_{jt}, the statutory corporate tax rate of country j. We additionally use several control variables X_{ijkt}, discussed below. δ_k are bank-group fixed effects, γ_t are monthly time fixed effects, and ϕ_j are country fixed effects. If Hypothesis 1 holds, we should observe $\beta_1 < 0$, as banks prefer low-tax countries to conduct their proprietary trading.

We first estimate equation (1.1) without country fixed effects. This estimation has the advantage that countries with 0% corporate tax rates during the whole sample period also contribute variation to the estimation. Previous literature has shown that a lot of profit shifting is towards such zero-tax countries, and that shifting elasticities may be underestimated when ignoring these countries (Davies et al., 2018).

However, a potential threat to identifying a causal effect in these cross-country regressions is that country characteristics other than the tax rate determine a country's attractiveness for proprietary trading. To address this concern, we use two strategies.

First, we include country fixed effects in the main regression to control for time-constant country characteristics. Note, however, that our sample is relatively short, and identification in this specification is thus based on relatively few tax rate changes.[18] Second, we use a selection model, which explicitly estimates the attractiveness of each country for proprietary trading (discussed below). In addition, we employ several time-varying country-level control variables.

In particular, we control for the inverse hyperbolic sine of GDP as a proxy for country size, as larger countries also provide a larger market for raising funds that banks can use for proprietary trading. We also include inflation rates, as higher inflation can on the one hand discourage trading activities in a country because of higher risk premiums, and on the other hand make alternative capital investments at fixed nominal interest rates less attractive (lowering opportunity costs of proprietary trading). We control for GDP growth as countries that grow at higher rates offer more attractive markets for banks. We include the share of country j's financial sector in the gross value added to account for the attractiveness of financial centers as the location of proprietary

[17] The inverse hyperbolic sine transformation is $IHS(y) = \ln\left(y_i + \left(y_i^2 + 1\right)^{0.5}\right)$, which is approximately equal to $\ln 2y_i = \ln 2 + \ln y_i$ (except for very small values of y_i). It is suited for the transformation of dependent variables and allows consistent estimation of the regression equation (MacKinnon and Magee, 1990; Burbidge et al., 1988).

[18] In total, there are 52 changes in statutory tax rates in our sample. However, none of the tax havens in our sample changed its tax rate.

trading.[19] We also include an index on the regulation of securities activities based on the World Bank survey on bank regulation in 2011 (World Bank, 2011). It measures the extent to which banks may engage in underwriting, brokering and dealing in securities, and takes on values between 1 (unrestricted) and 4 (prohibited). As this regulatory measure is time-invariant, we include it only in the regressions without country fixed effects. Appendix A.2 provides detailed information on variable definitions and data sources.

To allow for a more precise estimation, we also include the inverse hyperbolic sine of total assets as a bank-level control variable to account for an affiliate's size. Moreover, we control for the inverse hyperbolic sine of the bank group's overall total assets. This variable absorbs time-variant shocks that influence the whole bank group, such as large indemnity payments. Moreover, we include a dummy describing whether an affiliate is a subsidiary (a separate legal entity) or a branch (an office of the parent company)

Our second strategy to control for the attractiveness of countries is to estimate a selection model using a two-stage estimator. We use the estimator proposed by Wooldridge (1995), which extends the Heckman (1976) selection model to panel data. We are able to do so as our sample includes *all* subsidiaries and branches of German banks.[20] This estimation strategy explicitly controls for banks strategically locating their subsidiaries in low-tax jurisdictions.[21] In more detail, we proceed as follows: In the first step, we estimate the selection model using a probit specification. As additional variables in the first stage we use the inverse hyperbolic sines of the total assets of the parent and the population of the host country. In the second step, we use the predictions from the probit regression to construct additional explanatory variables (the inverse Mills ratios interacted with monthly time dummies), which capture the likelihood that a bank group will have subsidiaries or branches in a particular location in the respective month. In the last step, we estimate our main model with these additional explanatory variables.

[19] We use the share of financial and insurance activities in total gross value added. This measure reflects the role of important financial centers: In 2014, for instance, it is 8% in the United Kingdom and 13% in Singapore, compared to 4% in Germany and 4% in France.

[20] Sample selection models are rarely used in the profit shifting literature, as this literature usually uses datasets that have incomplete samples (e.g. Orbis, Amadeus) or that are limited by size-based reporting requirements (e.g. MiDi). Huizinga et al. (2014) are an exception, they employ a Heckman selection model to estimate banks' pre-tax profit response to corporate tax rates.

[21] Huizinga and Voget (2009) show that international tax liabilities matter for M&A and thus for the structure of multinational firms.

1.5.2.2 Test of Hypothesis 2

Next, we test whether the relocation of proprietary trading is mostly a shifting of book profits or the result of the relocation of real activities. As an indicator for real activity we use employment in the affiliate.

Our second hypothesis predicts that an increase in trading activities in response to a tax rate decrease takes place without additional employees. To test this hypothesis, we use the following model:

$$IHS\left(\text{Employees}_{ijkt}\right) = \beta_0 + \beta_1 IHS(\text{Trading}_{ijkt}) + \beta_2 X_{ijkt} + \delta_k + \gamma_t + \phi_j + u_{ijkt}. \tag{1.2}$$

The dependent variable is now $IHS\left(\text{Employees}_{ijkt}\right)$, the inverse hyperbolic sine of the number of employees in bank affiliate i of bank group k in country j in year t. The other variables are as defined above. As we observe employees in a different dataset with annual frequency, we can test Hypothesis 2 only at the year level (thus γ_t are now year dummies). As we use country fixed effects, we only use variation in trading assets over time for identification, and not variation over subsidiaries. This ensures that we indeed look at potential relocations of trading assets. If Hypothesis 2 is true, we expect an insignificant coefficient for β_1. This would imply that rather than shifting real traders, banks shift only the bare execution of buying and selling to tax haven affiliates. If banks relocate real activities when they shift trading assets to low-tax countries, we should observe a positive and significant coefficient for β_1. Note, however, that insignificant results in these regressions may also indicate insufficient variation over time.

As more employees can also manage more proprietary trading assets, there may be a reverse causality problem. To address this, we use two instrumental variable estimators. First, we instrument $IHS\left(\text{Trading}_{ijkt}\right)$ with the statutory corporate tax rate. This allows us to isolate the variation in trading assets that comes from changes in corporate tax rates. While this instrument fits well with our tests of Hypothesis 1, one may worry that the corporate tax rate could also directly influence the number of employees. This issue is likely small, as hiring and firing employees takes time. Nevertheless, we also provide evidence with an alternative instrument, namely the sum of trading assets in the headquarter of affiliate i. Trading assets in the headquarter should not directly influence employment in a particular affiliate, but are related to the trading assets in the considered affiliate via the bank group's overall trading strategy.

Changes in country characteristics that correlate with employment and trading assets

are again another threat to identification. As before, we use several country-level controls to address this threat. We thus again control for the inverse hyperbolic sine of GDP, for the inflation rate, GDP growth, the share of the financial sector and an index on the regulation of securities activities.

1.5.3 Regression Results

In this section we present the regression results. Table 1.3 reports the test of the first hypothesis, where we regress trading assets on the tax rate. Table 1.4 shows the results regarding the second hypothesis, testing whether banks relocate employees along with proprietary trading. We bootstrap all standard errors and cluster them by bank group and country-month-year. This clustering accounts both for shocks that affect the bank group as a whole (e.g. negative press coverage) and for time-specific shocks in individual countries (such as new laws that affect all affiliates in the country).

1.5.3.1 Relocation of Proprietary Trading

In Table 1.3, we test the effect of statutory tax rates on fixed-income trading assets. In column (1) we report results for the specification without country fixed effects to use the full variation present in the sample. We find a significantly negative coefficient of -3.747. This coefficient indicates that a one percentage point lower corporate tax rate implies on average 3.747% more fixed-income assets held for proprietary trading.

Our main specification (column 2) includes country fixed effects to control for unobserved time-constant country characteristics. We find a similar coefficient (-3.997), significant at the 10% level. Column (3) reports the results of the selection model. We find a tax semi-elasticity of -3.658 for fixed-income trading assets. The inverse Mills ratios are significant on a 10% level for 32 of the 49 months in this sample, implying that there are selection effects.

One may worry that the United Kingdom alone is driving these results, as London is the most important banking location in Europe. Table 1 confirms this observation: German bank groups hold more trading assets in the United Kingdom than in any other foreign country. To address this issue, we re-estimate our regressions after dropping affiliates in the United Kingdom from the sample.[22] Results are very similar to the main regressions, with an estimated tax semi-elasticity for fixed-income trading

[22]The resulting sample includes 15,297 observations from 59 bank groups.

Table 1.3: Effect of Tax Rates on Fixed-Income Trading Assets

	(1)	(2)	(3)
Wooldridge (1995) selection model			✓
Corporate tax rate	-3.747***	-3.997*	-3.658***
	(-8.64)	(-1.68)	(-9.19)
IHS(Total assets)	0.547***	0.520***	0.525***
	(36.38)	(35.99)	(33.70)
IHS(Bank group total assets)	0.804***	0.605***	0.849***
	(9.06)	(7.54)	(9.82)
IHS(GDP)	0.248***	-1.275***	0.330***
	(6.82)	(-3.02)	(8.88)
Inflation rate	0.241***	-0.087***	0.225***
	(7.98)	(-5.80)	(7.03)
GDP growth	0.130***	0.068***	0.119***
	(9.59)	(4.82)	(7.75)
Financial sector share	1.328**	4.812	2.892***
	(2.12)	(1.03)	(4.36)
Regulation	0.983***		0.967***
	(15.13)		(15.68)
Subsidiary dummy	-0.208**	-0.135	-0.214**
	(-2.11)	(-1.06)	(-2.25)
Monthly time FE	Yes	Yes	Yes
Bank group FE	Yes	Yes	Yes
Country FE	No	Yes	No
Observations	16,793	16,793	16,793
R^2	0.425	0.547	0.426

Data from External Positions of Banks database of Deutsche Bundesbank (2015a). The dependent variable is the inverse hyperbolic sine of fixed-income securities held for trading. Appendix A.2 defines all variables. Monthly bank data for 12/2010-12/2015. t-statistics in parentheses, based on bootstrapped standard errors clustered by bank group and by country-month-year.

assets of -4.30 (t-statistic: -10.8) with bank group and time fixed effects, and -11.90 (t-statistic: -4.3) when additionally including country fixed effects. Estimating the selection model without affiliates in the United Kingdom yields a semi-elasticity of -4.08 (t-statistic: -9.72).

In all, while the implied tax semi-elasticities are large, similar magnitudes have been found in other profit shifting contexts, e.g. a tax semi-elasticity for patents of -3.8 (Karkinsky and Riedel, 2012).

1.5.3.2 Profit Shifting or Shifting of Real Activity?

In Table 1.4, we test whether the strategic relocation of trading assets is due to the shifting of real activities, or a "profit shifting" strategy where the actual activities continue to take place in high-tax countries. As described in Section 1.5.2.2, we now use the number of employees as the dependent variable. As this variable is only available at an annual basis, the number of observations in Table 1.4 is lower than in Table 1.3.

As we are interested in the employment effects of tax induced variation in trading assets, we use the corporate tax rate as an instrument for trading assets in columns (1) and (2). We first test the relationship in a specification without country fixed effects in column (1). Here, we find a weakly significant and positive coefficient for trading assets. As we use within bank group variation over different affiliates here, this confirms that generally more trading assets imply that more employees are needed to conduct this trading. However, to determine whether a tax-induced relocation of trading assets accompanies a shifting of the trading personnel, we include country fixed effects in column (2). We then use variation in trading assets induced by tax rate changes for identification. We now find an insignificant coefficient for trading assets, which would support Hypothesis 2. However, the first stage F-statistic indicates a weak instrument problem in regression (2). Likely, this is the case as we can use only annual data for this test. As only few countries changed their tax rates in the sample period, there is insufficient variation over time.

To address the weak instrument problem, we use an alternative instrument in columns (3) to (6).[23] This instrument is the inverse hyperbolic sine of total trading assets in the German headquarter of the bank group. Columns (3) and (4) present these results with and without country fixed effects. In both specifications, we now find an insignificant estimate for the effect of trading assets on employment. Moreover, with country fixed effects the estimated coefficient declines by about half. These estimates indicate that an increase in trading assets does not necessarily induce an increase in the number of traders.

In columns (5) and (6) we further analyse the relationship between trading assets and employment by splitting the sample into low-tax and high-tax countries. We find that there is no significant relationship in low-tax countries, but in high-tax countries the

[23] Another concern with the regressions in columns (1) and (2) may be that the corporate tax rate is not a valid instrument as it could be correlated with the error term. To test for this problem, we have estimated a reduced form regression of employees on the corporate tax rate and have not found a significant effect.

number of employees increases with the volume of trading assets. Hence, more trading assets imply more traders in high-tax countries, but not in low-tax countries.

Table 1.4: Effects on Real Activity (IHS of Employees)

	IV: Corporate tax rate		IV: Trading of the headquarter			
	All	All	All	All	Low-tax	High-tax
	(1)	(2)	(3)	(4)	(5)	(6)
IHS(Trading)	0.177*	0.212	0.128	0.067	0.080	0.171**
	(1.69)	(0.02)	(1.09)	(0.56)	(0.66)	(2.02)
IHS(GDP)	0.303***	-0.205	0.338***	-0.139	0.266**	0.750***
	(4.00)	(-0.03)	(3.65)	(-0.22)	(2.54)	(8.40)
Inflation rate	0.037	0.002	0.067	0.002	0.045	0.160**
	(0.53)	(0.00)	(0.84)	(0.05)	(0.55)	(2.44)
GDP growth	-0.042*	-0.000	-0.036*	-0.004	-0.027	-0.045
	(-1.93)	(-0.00)	(-1.71)	(-0.22)	(-1.38)	(-0.79)
Financial sector share	-2.984**	6.304	-2.494*	5.997	-4.237***	-22.454
	(-2.45)	(0.02)	(-1.80)	(0.58)	(-2.65)	(-1.62)
Regulation	-0.313**		-0.274**		-0.022*	-0.623**
	(-2.39)		(-2.24)		(-1.87)	(-2.24)
Subsidiary dummy	1.076***	1.038	1.099***	1.148***	1.207***	0.172
	(5.96)	(0.18)	(6.15)	(5.00)	(6.95)	(0.43)
Year & Bank group FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	Yes	No	Yes	No	No
First stage F	10.611	0.236	15.373	12.822	9.825	9.185
Observations	1,065	1,064	1,065	1,064	743	320
Centered R^2	0.386	0.514	0.422	0.578	0.458	0.466

Data from External Positions of Banks database of Deutsche Bundesbank (2015a,b). The dependent variable is the inverse hyperbolic sine of the number of employees. *All* indicates that the sample consists of all foreign affiliates of German banks. *Low-tax* refers to affiliates that face a lower tax rate than the German headquarter (30%) and *High-tax* refers to the other entities. *IHS(Trading)* is the inverse hyperbolic sine of fixed-income trading assets; in columns (1) and (2) it is instrumented by the statutory corporate tax rate and in columns (3) to (6) it is instrumented by the inverse hyperbolic sine of trading assets in the German headquarter. Yearly data from 2010 to 2015. t-statistics in parentheses, based on standard errors clustered by bank group and by country-year.

Taken together these results are in line with our second hypothesis and suggest that a shifting of trading assets does not lead to more employees, neither in high-tax countries nor in low-tax countries. As a robustness test, we also confirm these results using two different samples: First, the Bundesbank data without the United Kingdom, and second the international Bankscope dataset.

1.5.3.3 Robustness Test with Bankscope Data

As a robustness test, we also re-estimate our regressions using the Bankscope dataset (see Appendix 3 for details). Using this dataset, we find tax semi-elasticities of trading

assets between -6.7 and -8.2 using variation across countries. The estimated coefficients are larger than those in Table 1.3, indicating that German banks are less responsive to taxation than their international competitors, possibly because Germany has relatively strict banking regulation and anti-tax avoidance rules. Estimating the same regressions with country fixed effects, we continue to find negative coefficients, but statistically not different from zero. Likely, the estimated coefficients are not significant as there is little variation over time. The lower quality of the dataset may also explain why we loose significance.

We also test in the Bankscope sample whether real activities are relocated together with proprietary trading assets. Regressing a bank affiliate's personnel expenses on trading assets and using trading in all other affiliates of the bank group as the instrument, we find no significant effects for low-tax countries. For high-tax countries the effect is significant. These results again indicate that the relocation of proprietary trading should be interpreted as a profit shifting strategy.

In sum, the results using Bankscope data confirm our main results, even though the Bankscope dataset does not include information on branches, which hold a large share of trading assets. Appendix 3 discusses these results in more detail.

1.6 Descriptive Evidence on Trading Derivatives

So far we have considered fixed-income trading assets. From December 2013 onwards, the Bundesbank data also includes information on derivatives held for trading. As banks hold, on average, far more derivatives than fixed-income trading assets (see Table 1.2), we now provide some descriptive evidence that banks also relocate trading derivatives in response to tax rate differentials.

The data on derivatives is only available for December 2013 to December 2015, and there were only very few tax rate changes during this period. We thus cannot use country fixed effects. Instead, we present in Table 1.5 descriptive evidence using the cross-country variation (column 1) and the selection model (column 2).[24]

In both specifications, the estimated coefficient for the corporate tax rate is significant and negative. The results indicate tax semi-elasticities between -8.654 and -8.986. This suggests that derivatives may respond even more strongly to tax rate differentials

[24]In the selection model, 20 of the 25 inverse Mills ratios are significant, again suggesting that that selection effects matter in principle, despite the similar coefficients for the tax rate.

Table 1.5: Effect of Tax Rates on Trading Derivatives

	(1)	(2)
Wooldridge (1995) selection model		x
Corporate tax rate	-8.986***	-8.654***
	(-18.65)	(-15.88)
IHS(Total assets)	0.738***	0.735***
	(24.47)	(20.01)
IHS(Bank group total assets)	-0.315	-0.542***
	(-1.34)	(-5.62)
IHS(GDP)	0.641***	0.775***
	(11.85)	(13.39)
Inflation rate	0.162***	0.125***
	(5.04)	(3.98)
GDP growth	0.106***	0.099***
	(4.52)	(3.41)
Financial sector share	-6.626***	-4.149***
	(-7.05)	(-3.23)
Regulation	0.990***	0.957***
	(12.94)	(12.01)
Subsidiary dummy	-1.631***	-1.615***
	(-10.90)	(-9.38)
Monthly time FE	Yes	Yes
Bank group FE	Yes	Yes
R^2	0.565	0.568
Observations	6,460	6,460

Data from External Positions of Banks database of Deutsche Bundesbank (2015a). The dependent variable is the inverse hyperbolic sine of derivatives held for trading. Appendix A.2 defines all variables. Monthly bank data for 12/2013-12/2015. t-statistics in parentheses, based on bootstrapped standard errors clustered by bank group and by country-month-year.

than fixed-income trading assets do. Given that derivatives – as the more risky asset – should be more profitable than fixed-income trading assets, it is not surprising that they also respond strongly to profit shifting incentives.

As a robustness check, we again re-estimate this specification without bank affiliates in the United Kingdom. The estimated tax coefficient of -8.86 (t-statistic: -8.93) confirms that also our results on trading derivatives are not only driven by this important financial center.

1.7 Importance of Proprietary Trading as a Profit Shifting Channel

The estimated semi-elasticities in Section 1.5.3.1 and 1.6 imply substantial tax effects on trading assets. How much money do banks save through the relocation of trading assets? To answer this question, we conduct a back-of-the-envelope calculation of potential tax savings and apply the estimated elasticities on the observed data of trading assets. While such a back-of-the-envelope calculation has to rely on many assumptions and can deliver only a rough estimate, it allows us to get a feeling for the importance of the profit shifting channel discussed in this essay.

We proceed as follows: We take the estimated tax semi-elasticities in column (1) in both Table 1.3 and Table 1.5 and estimate the percentage change in trading assets if the affiliate had paid a tax of 30% (like the German headquarter).[25] We then multiply this percentage change with the actual level of trading assets in each affiliate.[26] We interpret the result as the amount of trading assets that are located in the affiliate for tax reasons. We then multiply these trading assets with an exogenously chosen trading profitability. Finally, we multiply these trading gains with the actual tax rate differential to the German headquarter's 30% to arrive at an estimate for the tax savings from the relocated trading assets. Summing up over all affiliates that are taxed at lower rates than the German headquarter gives an estimate of the taxes a bank saves via this profit shifting channel.

There are several potential problems with this approach. First, we apply our estimated semi-elasticities to non-marginal increases in the tax rate. Second, we do not account for the general equilibrium effects of a hypothetical tax increase in all affiliates that pay less tax than the German headquarter. Third, we do not know how profitable the proprietary trading activities are. To address this last point, we carry out the estimation with different assumed rates of return.

Table 1.6 summarizes the results of this back-of-the-envelope calculation. Assuming a constant profitability of 1% (a relatively conservative estimate), our calculations

[25]For better comparability, we use the estimated coefficient from the specification without country fixed effects also for fixed-income trading assets. As the coefficient is very similar, the results differ only slightly if we use the coefficient from the estimation with country fixed effects. Using the smaller coefficient from the regression without country fixed effects yields a slightly more conservative estimate.

[26]If our estimated semi-elasticities imply a decline by more than the total volume of trading assets held in the affiliate, we assume that the affiliate reduces its trading assets to zero.

suggest tax savings for 2015 of €450 million from the relocation of fixed-income trading assets and trading derivatives.[27]

The profitability of proprietary trading in the real world is certainly not constant over time. To approximate changes in profitability over time, we re-estimate the tax savings assuming that profitability equals the growth rate of the MSCI World Index. The right-hand part of Table 1.6 reports these results. As the return on the MSCI World Index was negative in 2011, we obtain a negative value for implied tax savings in 2011 (due to the missed deduction possibilities of trading losses in higher-taxed affiliates). For 2015, these calculations imply a total tax saving of about €368 million, or 4% of banks' tax payments (€8.4 billion; see Deutsche Bundesbank, 2016a).

Table 1.6: Implied Tax Savings in Million EUR

	Exogenous 1% profitability		MSCI World growth rate	
Year	Fixed-income trading assets	Trading derivatives	Fixed-income trading assets	Trading derivatives
2011	29.543		-2.576	
2012	27.928		31.727	
2013	23.579		39.269	
2014	25.486	262.952	40.148	429.510
2015	30.214	420.768	29.242	339.345

Calculated potential annual tax savings of German multinational banks by relocation of proprietary trading activities, assuming an exogenous profitability of trading assets of 1% on the left and a profitability corresponding to the monthly growth rate of the MSCI World Index on the right.

Several factors affect the development of these tax savings over time: First, the location of trading assets changes over time. Second, tax rate differentials change. Figure 1.5 illustrates how the implied potential tax savings per month evolve over time, assuming a constant 1% return. As data on trading derivatives begins only in 12/2013, the second panel captures a shorter time period. While the tax savings due to the relocation of fixed-income trading assets have remained relatively constant over time, the strategic location of trading derivatives has gained importance as tax avoidance channel: Between the start of 2014 and the end of 2015, the tax savings achieved by strategically locating derivatives held for trading in low-tax countries approximately doubled.

Tax rate cuts in other countries also contributed to the tax savings of German banks.

[27] With a 2% return on proprietary trading, the tax savings double.

Figure 1.5: Implied Monthly Tax Savings

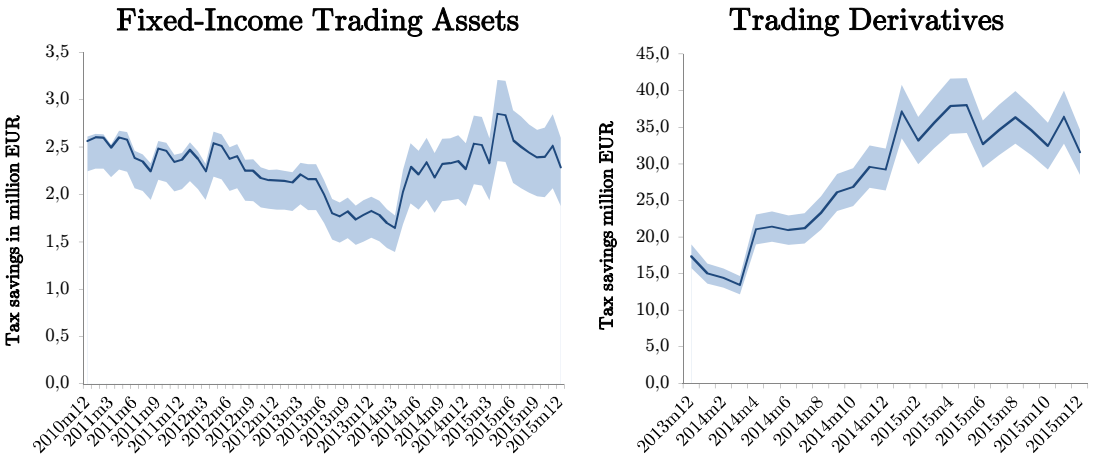


Illustration of implied monthly tax savings: If all lower taxed affiliates were taxed by 30%, our estimated semi-elasticities imply a decline in fixed-income trading assets and in trading derivatives in these affiliates. We calculate the implied tax savings assuming that these trading assets were held in the German headquarter instead and that they yield a constant rate of return of 1%. The shaded area illustrates the implied tax savings using the lower and upper bounds of the 95% confidence interval of the semi-elasticities estimated in Table 1.3.

For example, tax rate cuts in the United Kingdom in April in each year in the sample result in visible increases of the tax savings of German banks.

How much tax revenue does the German government forego due to banks' relocation of proprietary trading assets? To answer this question, we multiply the estimated trading gains with the average German tax rate of 30% (instead of the tax rate differential between Germany and the country where the trading assets are held). With a 1% average return on trading assets, the German government lost €1.3 billion in tax revenues in 2015, or about 16% of the total taxes paid by German banks. If the return to proprietary trading was 2%, these numbers double.

While these calculations present only a rough estimate and should thus be treated with caution, they nevertheless show that the strategic location of proprietary trading activities is a quantitatively important channel for tax avoidance in the financial sector.[28]

[28]Note that we can only calculate tax savings for two specific asset types. As banks can also use other asset types for proprietary trading (e.g. shares), total tax savings are likely higher.

1.8 Conclusion

In this essay, we analyze how banks relocate their proprietary trading in response to corporate taxation. With our preferred data on German multinational banks, we find in our baseline regressions that a one percentage point lower corporate tax rate increases fixed-income trading assets held in an affiliate in that country by about 4.0%, and trading derivatives by about 9.0%. Our results are qualitatively robust to estimation with more international data from Bankscope. Moreover, we find evidence that the increase mainly stems from an 'artificial' shifting of trading activities: Banks transfer only trading assets to lower-taxed affiliates, not employees.

Our results show that proprietary trading is very mobile. It responds very strongly to tax rate differentials. Thus, it is likely also highly responsive to non-tax incentives, e.g. regulatory differences. Regulators need to take these results into account: If a new regulation on proprietary trading only shifts activities abroad, it may not fulfill its aims. The high mobility of proprietary trading supports the call for an internationally harmonized banking regulation.

Future research could expand our work in several ways. First, it would be interesting to know more on the types of assets that banks hold for proprietary trading in low-tax countries. The Bundesbank data only provides information on fixed-income trading assets and on trading derivatives. The information offered in Bankscope on different types of trading-assets is also very sparse. Second, future work could address whether the shifting patterns change when a bank or its affiliates make losses.

Chapter 2

Avoiding Taxes: Banks' Use of Internal Debt

2.1 Introduction

The fight against profit shifting has been a major policy issue in recent years. The Organisation for Economic Co-operation and Development (OECD) estimates that profit shifting causes tax revenue losses amounting to 4% to 10% of global corporate income tax revenues (OECD, 2015). Facing this substantial impact on public treasuries, the member countries have continually implemented countermeasures proposed in the OECD/G20 action plan on base erosion and profit shifting (OECD, 2013) into national legislation. Nevertheless multinationals can still use various legal tax planning structures. In particular banks have vast opportunities to avoid corporate taxes: Oxfam (2017) shows that the European Union's top 20 banks report 26% of their profits in tax havens though employing only 7% of their total workforce there.

There is a substantial empirical literature studying profit shifting and the different channels multinationals can use to transfer profits to lower taxed affiliates, but virtually all of this literature has left out banks or not considered the special role of the financial sector. This is particularly striking when it comes to profit shifting via internal credit relations, which is one of the main channels for profit shifting. It is usually labeled debt shifting in the literature and works straightforwardly: A multinational group can shift its capital as equity to affiliates residing in low-tax countries or tax havens.

The idea for this chapter arose in discussions with Dominika Langenmayr. The chapter is based on Reiter (2017).

The low-tax affiliate then lends money to other, high-taxed affiliates. As the related interest payments are tax-deductible in the high-tax country, profits are shifted to the affiliate where they are taxed at a lower rate. The resulting tax saving equals the tax rate differential times the interest payment. While there is consistent evidence on internal debt shifting in non-financial sectors, to my knowledge there is no study that investigates the extent of internal debt shifting in the banking sector.

Banks are likely to use debt shifting more aggressively than other multinationals because of three reasons: First, leverages of banks are much higher than leverages of other companies. This additional debt capacity allows also for a more intensive use of internal debt. Second, several countries exempt banking income from their controlled-foreign-corporation (CFC) rules that should prevent profit shifting. Germany, for instance, does not use CFC rules towards banks if they meet some lax conditions. And third, as the profit maximizing optimization of financial transactions is a bank's core business, the expertise in tax planning is probably much greater in banks than in other multinationals. Whereas firms in other sectors often purchase tax advisory services from consultancy companies, banks already have a substantial tax planning expertise within the group.

In this essay I show that banks indeed use internal debt for profit shifting more aggressively than non-financial firms do. My analysis uses the External Positions of Banks database provided by the German central bank, a comprehensive administrative dataset of high quality to which all German multinational banks and their foreign subsidiaries and branches are obliged to report. I find significant evidence for internal debt shifting, with a ten percentage points higher corporate tax rate leading to an increase in the internal leverage of about 4.95 percentage points. This absolute response is more than twice the effect that Fuest et al. (2011) and Buettner et al. (2012) find for non-banks. These two studies are directly comparable to my work as they use an analogous setting and dataset. They find that a ten percentage points higher corporate tax rate increases internal leverages in non-banks by 1.77 to 2.14 percentage points. When relating these figures to the sample mean of internal leverages (42% in my sample, 23% and 28% in these previous studies on German non-banks), my results correspond to an increase by about 12%, compared to 7% to 8% for non-banks. These comparisons show that the financial sector uses internal debt shifting more aggressively than other sectors of the economy.

Moreover this essay discusses the use of conduit entities in internal debt financing. In such conduit entities loans are simply passed through without shifting any profits out

of the affiliate. There are three potential reasons why multinationals might use such conduit affiliates: The pass-through loans offer an additional profit shifting possibility by mispricing of the related interest rates. Second, the conduit entities might simply serve as financial hubs in internal financing. And third, passing loans through an additional affiliate also impedes the uncovering of the tax avoidance scheme, for instance by the media. However, classical debt shifting regressions use internal gross liabilities as proxy for the volume of internal debt shifting and therefore inaccurately measure debt shifting if the location of these conduit entities correlates with tax rates. In the sample of German multinational banks I show that conduit entities are systematically located in low-tax countries. To account for the potential bias, I use a new dependent variable that captures internal liabilities net of internal claims relative to total assets (if positive, zero otherwise). I show that taking account of this bias increases the sensitivity of internal debt to the tax rate further: The estimated tax coefficient rises whereas the sample mean of the internal-net-debt ratio is substantially lower at 28%. More precisely, a ten percentage points higher corporate tax rate raises this internal-net-debt ratio by 5.63 percentage points, which corresponds to an increase by 20% at the mean.

In accounting for conduit entities and subtracting conduit debt in the dependent variable, I furthermore make a more general methodological point on profit shifting literature: As also non-financial multinationals might use conduit affiliates in internal debt financing, previous regressions using the internal-gross-liabilities-to-total-assets ratio as dependent variable are potentially also affected by a biased estimation of internal debt shifting.

The literature on profit shifting has been so far almost exclusively confined to the non-financial sector. Fuest et al. (2011), Møen et al. (2011), Buettner et al. (2012), Buettner and Wamser (2013), Blouin et al. (2014) and Egger et al. (2014) find internal debt responses of non-financial multinationals using various econometric specifications or datasets. The work of Overesch and Wamser (2014) is the only study so far that uses bilateral internal debt data and finds significantly positive effects of the precise bilateral tax rate differential (which is probably the most precise measure for debt shifting incentives). The dataset used in this essay similarly allows a bilateral analysis, and I find much larger effects on internal leverages for German bank affiliates also at the bilateral level.

Moreover, some papers infer evidence for internal debt shifting from regressing overall-liabilities-to-total-assets ratios on the difference between the tax rate an affiliate faces

and the groups' average tax rate (e.g. Gu et al. (2015) for the banking sector and Huizinga et al. (2008) for multinationals in general). As they cannot distinguish between internal and external debt they also cannot break down this effect to internal debt shifting and the classical debt financing incentive generated by high tax rates due to the deductibility of interest expenses. Heckemeyer and Overesch (2017) also use data on overall liabilities and investigate whether the debt response to corporate taxes differs between banks and non-banks.

Some recent papers study tax-induced profit shifting in the banking sector. Merz and Overesch (2016) show in a worldwide sample of bank affiliates that corporate tax rates negatively affect reported pre-tax profits, indicating that banks indeed engage in profit shifting. However, they cannot identify precise profit shifting channels, but they find some suggestive evidence that internal debt shifting might play a role. Langenmayr and Reiter (2017) identify another potential channel by showing that banks shift profits through the relocation of proprietary trading assets to lower taxed affiliates.

The next section discusses relevant institutional issues and the role of conduit entities. Section 2.3 presents the empirical specification that I use for identification. In Section 2.4 I describe the dataset and provide descriptive evidence for debt shifting. Then Section 2.5 presents the regression results. Finally Section 2.6 concludes.

2.2 Debt Shifting in the Banking Sector

While there is consistent evidence in the literature on debt shifting by non-financial multinationals, the financial sector can use this tax avoidance channel even more strongly: The immaterial nature of the banking business and the institutional environment in many countries facilitate the use of large amounts of internal debt tailored to shift profits to lower taxed affiliates. This environment is outlined in the following section. Moreover, previous studies on debt shifting have not considered the role of conduit entities. As they are particularly important in the banking sector, Section 2.2.2 discusses their influence on the empirical identification of debt shifting.

2.2.1 Institutional Background

Financing in the banking sector relies heavily on debt, with banks usually having low stocks of equity relative to the amount of debt they use. The Bank for International

Settlements reports an equity-to-total-assets ratio of only 6.9% for banks worldwide in 2015 (Bank for International Settlements, 2017). German banks, constituting the sample in this essay, had on average an equity-to-total-assets ratio of only 7.0% in 2015, compared to 28.2% in the non-financial sector (Deutsche Bundesbank, 2016b). Berg and Gider (2017) find that mainly different asset risks can explain this capitalization gap between banks and non-banks. However, the seemingly higher debt capacity in the banking sector also provides additional scope for internal debt financing. Moreover, bank regulation does not require an upper limit on the use of debt financing so far. In course of Basel III, a compulsory minimum equity-to-total-assets ratio of 3% (with variable mark-ups for globally systemically relevant banks) should be implemented. Since January 1, 2015 banks have to disclose this ratio, the adoption as a mandatory requirement is planned to be introduced in 2018. Hence, so far there is no regulatory limitation to the use of internal debt.[1]

Apart from this, several countries implemented controlled-foreign-corporation (CFC) rules that add passive income (e.g. interest income) in low-taxed affiliates to the tax base of the parent company (see e.g. Ruf and Weichenrieder, 2012), allowing for a tax credit for the taxes already paid abroad. If binding, these rules would prevent debt shifting. However, some countries such as e.g. Japan, the United Kingdom and the United States completely or in large part exclude income from banking from being affected by CFC rules. Also Germany, the home country of all multinational banks in the sample used in this essay, completely excludes income from banking under the relatively loose condition of having a 'commercially organized business operation' in the low-tax country.[2] This exclusion of banks from CFC legislation in some major countries provides additional scope for debt shifting compared to multinationals in other sectors.

Another regulatory issue that might affect debt shifting in the banking sector is the implementation of bank levies in several countries in the aftermath of the financial crisis. In most countries also internal liabilities are subject to the levy, increasing the costs of debt shifting. Germany introduced a bank levy in 2011 with progressive tax rates. However, there is a levy exempt amount of 300 million euros and Buch et al.

[1]For a discussion of the Basel III compulsory minimum equity-to-total-assets ratio requirement see Dermine (2015).

[2]The German Federal Fiscal Court decided in 2010 that it is not even necessary that the foreign affiliate has employees or offices to fulfill the condition of a 'commercially organized business operation' (BFH 13 Oct 2010, I R 61/09); having a service contract with another affiliate is already sufficient.

(2016) show that 77% of all German banks are therefore exempt from levy payments. Comparing the relatively low bank levy rates (also in other countries, see Devereux et al. (2017) for an overview) to the potential tax savings from internal debt and the exemption of the majority of banks suggest that the German levy does not affect debt shifting substantially. Furthermore, since the adoption of European bank levy standards in 2015 there is even a special treatment that reduces bank levy rates on intragroup liabilities by half.

Taken together, the regulatory environment, the immaterial nature of the banking business, and the common high leverages in the financial sector suggest that banks use internal debt shifting more intensively than multinationals from other sectors do.[3]

2.2.2 The Role of Conduit Entities

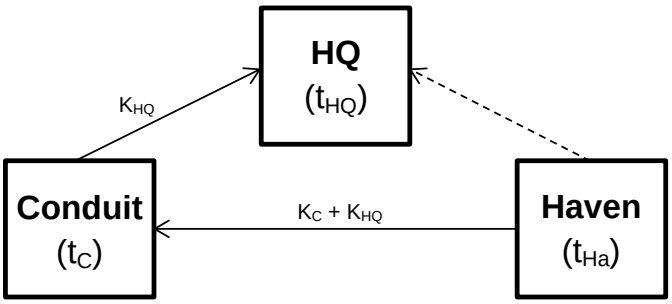
A threat to the empirical identification of internal debt shifting are conduit entities that simply pass through liabilities, by taking up a loan from a related affiliate and passing it as a loan to another affiliate. As in these conduit affiliates interest income from conduit claims offsets interest expenses due to conduit liabilities, using internal gross liabilities as proxy for profits shifted out through internal debt leads to biased estimates. Nevertheless, previous empirical studies on debt shifting have not considered the existence of conduit entities and its potential impact on the estimation of debt shifting so far.

This essay accounts for conduit entities in internal debt financing. I define conduit affiliates as entities that simply pass-through debt from one related affiliate to another affiliate. Figure 2.1 illustrates the simplest example of such an internal conduit debt scheme: The tax haven affiliate faces a corporate tax rate equal to t_{Ha} and lends K_C units of money to the conduit affiliate which is taxed by $t_C > t_{Ha}$. Through the related interest payments profits are shifted from the conduit affiliate to the tax haven affiliate. Moreover, also the headquarter wants to lend K_{HQ} from the tax haven affiliate. Instead of directly taking out a loan from the haven affiliate, it can pass-

[3]Formally, the negative inter-bank market rates that arose for certain funds in 2015 could reverse the debt shifting incentives as internal loans have to be priced according to the arm's length principle. Nevertheless, I do not expect that negative interest rates have substantially affected debt shifting behavior of multinational banks so far: Banks have some discretionary powers for overpricing internal loans and they might also choose longer term periods to justify higher interest rates. The sample period in my regressions is from June 2010 to December 2015. As a robustness check I also estimated my regressions excluding all observations in 2015 from the sample and arrived at very similar results.

through this loan via the conduit affiliate. In the headquarter the interest payments for K_{HQ} are tax-deductible. In the conduit entity the pass-through is completely tax-neutral (given that the loans are subject to the same interest rates) as interest expenses to the haven affiliate offset the interest income from the headquarter. In the tax haven affiliate interest income is taxed at rate $t_{Ha} < t_{HQ}$. Hence, from a tax perspective, taking out the loan through the conduit entity is equivalent to direct lending.

Figure 2.1: Conduit Affiliate in Internal Debt Financing



However, there might be some reasons why multinationals use such conduit entities in internal debt financing. First, additional debt streams offer additional scope for mispricing of internal loans. This form of transfer pricing is a profit shifting channel different from internal debt shifting and is not the subject of this essay. Second, passing internal debt through conduit subsidiaries can simply reflect real structures: the conduit entity can serve as a financial hub that plays the role of a capital coordinator for the group and distributes capital from tax havens to affiliates. This also allows to re-bundle debt, for instance by taking out loans from several low-taxed subsidiaries and distribute them to several high-taxed affiliates through the hub. Third, multinationals might also use conduit entities to conceal the real origin of internal loans. As tax avoidance schemes of several multinationals were recently addressed in the media, multinationals might be interested in making these schemes increasingly opaque, although they are legal.

How does the use of conduit subsidiaries affect the estimation of internal debt responses to tax rates? In the simple example in Figure 2.1, passing K_{HQ} through the conduit affiliate increases the internal debt levels of both the conduit affiliate and the headquarter. However K_{HQ} does not shift any profit out of the conduit affiliate. This double-counting of internal debt in conduit entities effectively assigns too high internal debt levels to these intermediary affiliates. If the location of the conduit entities is correlated with tax rates, this leads to a bias in classical debt shifting regressions

employed by previous literature. In Section 2.3.2 I elaborate on the sign of this bias.

Apart from internal debt shifting, some studies consider the use of conduit entities by multinationals in several contexts. Mintz (2004) models that multinationals give equity to a low-taxed conduit entity which then passes the capital as a loan to another higher-taxed affiliate. While the first transaction in most countries is not related with profit shifting (as dividends are usually largely tax-exempt), the loan shifts profits from the high-taxed affiliate to the lower-taxed conduit entity. Johannesen (2014) models how conduit entities can be used for cross-border hybrid instruments intended to avoid taxes. Mintz and Weichenrieder (2010) empirically investigate factors determining why multinationals might use intermediate entities for investing in their subsidiaries. In the same direction, Garcia-Bernardo et al. (2017) identify five countries that are most important for such passing-through of investments. Dyreng et al. (2015) find that U.S. multinationals systematically supply equity to their subsidiaries through conduit entities located in countries with low taxes on equity distributions. Literature on internal debt shifting so far has not considered the use of conduit entities.

2.3 Empirical Specification

This section develops the baseline empirical specification that is employed to estimate internal debt shifting, first with the classical dependent variable used in previous literature and afterwards with the new variable that accounts for conduit debt. In Section 2.3.3 I then adopt the empirical specification to bilateral internal debt data.

2.3.1 Baseline Model

Analogously to previous literature on internal debt shifting in non-financial sectors, I estimate the effect of corporate tax rates on internal leverages of affiliates, using variation in tax rates within a multinational bank group across countries and across time. Accordingly, the baseline regression equation writes:

$$\frac{InternalLiabilities_{ikt}}{TA_{ikt}} = \beta_0 + \beta_1 CTR_{ikt} + \beta_2 X_{ikt} + \gamma_t + \delta_k + u_{ikt} \tag{2.1}$$

where $InternalLiabilities_{ikt}$ are internal liabilities in affiliate i of bank group k in period t. TA_{ikt} are total assets. CTR_{ikt} is the statutory corporate income tax rate

affecting affiliate i and X_{ikt} is a vector of control variables described below. γ_t are time fixed effects, δ_k are bank group fixed effects and u_{ikt} is the error term. If multinational banks indeed shift profits via internal debt, I expect a positive estimate for β_1.

To capture the size of an affiliate, I include the inverse hyperbolic sine of total assets as a bank-specific control variable into X_{it}. Similar to the logarithmic transformation the inverse hyperbolic sine (IHS) allows to interpret the estimated coefficients as semi-elasticities, but unlike the logarithm it is also defined for zero and negative values.[4] As the magnitude of a bank group's engagement in a country and thereby also the use of internal debt might be influenced by macroeconomic variables, I further control for GDP growth, consumer price inflation rates and the inverse hyperbolic sine of the host country's nominal GDP. A further control is a country's share of the financial sector in its gross value added which should account for countries that act as important financial centers.

Moreover I include two regulatory variables that potentially influence a bank group's activities and financing decisions in a country: First I incorporate the minimum regulatory capital requirement for banks and second I control for the capital regulatory index that is provided by Barth et al. (2013) based on the World Bank (2011) survey on bank regulation. This index captures whether a country's capital requirement is adjusted for individual risk of banks, whether the regulatory capital is adjusted for certain market value losses, and whether certain funds may be used to capitalize a bank. It ranges from 0 to 10, with higher values indicating greater stringency of capital regulation. Another issue with the sample in this chapter is that all bank groups are headquartered in Germany. As profit shifting is found to be less intense out of headquarters (see Dischinger et al., 2014a), as a robustness check I also exclude all German headquarters from the sample and re-estimate the regressions. The results I find are very similar.

2.3.2 Accounting for Conduit Entities

As outlined in Section 2.2.2, the simple internal-liabilities-to-total-assets ratio also includes conduit liabilities that are only passed-through and hence do not reflect actual profit shifting. To solely capture internal debt that effectively shifts profits out of the respective affiliate, we have to subtract such pass-through loans: The ratio of internal

[4]The inverse hyperbolic sine (IHS) is defined as $\sinh^{-1}(x) = \log(x+(x^2+1)^{0.5})$. For a discussion of the advantages of transforming dependent variables by IHS see Burbidge et al. (1988).

debt net of pass-through loans divided by i's total assets is the appropriate measure for debt shifting out of affiliate i. A straightforward debt shifting regression with this ratio as dependent variable writes

$$\frac{InternalDebt^*_{ikt}}{TA_{ikt}} = \beta_0 + \beta_1 CTR_{ikt} + \beta_2 X_{ikt} + \gamma_t + \delta_k + u_{ikt} \quad . \tag{2.2}$$

Here $InternalDebt^*_{ikt}$ denotes internal debt net of pass-through loans. TA_{ikt} are total assets held in affiliate i of bank group k, CTR_{ikt} is the corporate tax rate, X_{ikt} is a vector of control variables and u_{ikt} is the error term. However, usual internal debt shifting regressions (like regression equation (2.1)) do not subtract pass-through loans in the dependent variable: The common dependent variable is $\frac{InternalLiabilities_{ikt}}{TA_{ikt}} = \frac{InternalDebt^*_{ikt}+e_{ikt}}{TA_{ikt}}$, where e_{ikt} is debt that is passed through to other affiliates. The regressions therefore estimate

$$\frac{InternalLiabilities_{ikt}}{TA_{ikt}} = \beta_0 + \beta_1 CTR_{ikt} + \beta_2 X_{ikt} + \gamma_t + \delta_k + u_{ikt} + \frac{e_{ikt}}{TA_{ikt}} \quad . \tag{2.3}$$

If the choice of the conduit affiliate's location is correlated with the corporate tax rate, there is a bias in the estimate for β_1 similar to the bias that arises with a systematic measurement error in the dependent variable. As pass-through debt always increases the amount of internal gross liabilities, the correlation between the dependent variable in equation (2.3) and $\frac{e_{ikt}}{TA_{ikt}}$ is positive by definition. Therefore, the sign of the bias is equal to the sign of the covariance between $\frac{e_{ikt}}{TA_{ikt}}$ (the 'left-out variable' here) and CTR_{ikt}:

$$\text{Cov}(CTR_{it}, \frac{e_{it}}{TA_{it}}) = \frac{1}{T}\frac{1}{N}\sum_{t=1}^{T}\sum_{i=1}^{N}(CTR_{it} * \frac{e_{it}}{TA_{it}}) - \overline{CTR} * \frac{1}{T}\frac{1}{N}\sum_{t=1}^{T}\sum_{i=1}^{N}(\frac{e_{it}}{TA_{it}}) \ , \tag{2.4}$$

where N is the number of affiliates, T is the number of sample periods and $\overline{CTR}$ is the sample mean of CTR_{it}. For the sake of brevity I drop the bank group indicator k from here, as it is fully included in the bank indicator i. In all subsidiaries that do not serve as conduit entities e_{it} is equal to zero. Therefore one can rewrite (2.4):

$$\text{Cov}(CTR_{it}, \frac{e_{it}}{TA_{it}}) = \frac{1}{T}\frac{1}{N}\sum_{t=1}^{T}\sum_{i=1}^{H}(CTR_{it} * \frac{e_{it}}{TA_{it}}) - \overline{CTR} * \frac{1}{T}\frac{1}{N}\sum_{t=1}^{T}\sum_{i=1}^{H}(\frac{e_{it}}{TA_{it}}) \ , \tag{2.5}$$

where subsidiaries $i = 1, ..., H$ (with $H \leq N$) serve as conduit affiliates. Rearranging gives:

$$\text{Cov}(CTR_{it}, \frac{e_{it}}{TA_{it}}) = \frac{1}{T}\frac{1}{N}\sum_{t=1}^{T}\sum_{i=1}^{H}\left[(CTR_{it} - \overline{CTR}) * \frac{e_{it}}{TA_{it}})\right] \tag{2.6}$$

Equation (2.6) is negative if the weighted average tax rate of conduit affiliates is lower than the average tax rate of all affiliates in the sample, with weights being equal to pass-through-debt-to-total-assets ratio $\frac{e_{it}}{TA_{it}}$. Hence if conduit entities systematically face lower tax rates than the average of affiliates, classical debt shifting regressions estimate a downward biased coefficient for the corporate tax rate. If conduit entities are, vice versa, located in higher taxed affiliates, there is an upward bias in estimates for β_1 in equation (2.3). As Section 2.4.2 shows, banks in my sample locate their conduit entities systematically in low-tax countries, resulting in a downward biased estimate for β_1 when using the classical dependent variable.

To account for the use of conduit affiliates in internal debt financing I additionally use internal net debt (relative to total assets) as dependent variable. This variable is defined as

$$IntNetDebt_{ikt} = \max(InternalLiabilities_{ikt} - InternalClaims_{ikt} \ ; \ 0) \ , \tag{2.7}$$

where $InternalLiabilities_{ikt}$ denotes affiliate i's internal liabilities and $InternalClaims_{ikt}$ are claims to related parties of bank group k in period t. Therefore the difference is the effective amount of internal debt that shifts profits out of affiliate i, accounting for the potential existence of conduit debt. If internal claims of an affiliate are larger than its internal liabilities, effectively no profits are shifted out via the internal debt channel and $IntNetDebt_{ikt}$ is zero. The empirical specification for estimation with the ratio of $IntNetDebt_{ikt}$ to total assets as dependent variable is equivalent to equation (2.1):

$$\frac{IntNetDebt_{ikt}}{TA_{ikt}} = \beta_0 + \beta_1 CTR_{ikt} + \beta_2 X_{ikt} + \gamma_t + \delta_k + u_{ikt} \quad . \tag{2.8}$$

The explanatory variables are as defined in Section 2.3.1. With internal debt shifting I expect a negative estimate for β_1 in equation (2.8). As argued above, the estimated tax rate coefficient is expected to be higher with internal net debt as dependent variable compared to internal liabilities if the conduit entities are located in low-tax countries, and to be lower if conduit affiliates are located in high-tax countries. As a robustness check I again re-estimate equation (2.8) with exclusion of German headquarters to account for the sample's idiosyncracy that all bank groups are headquartered in Germany.

Another issue is that country characteristics other than the corporate tax rate influence a bank affiliate's volume of internal net debt. To account for this, I conduct a robustness check by additionally including bank affiliate fixed effects into regression equation (2.8). I then only exploit corporate tax rate changes in the sample period to identify the tax effect on internal debt, measuring basically how banks adjust the volume of effectively profit-shifting debt to changes in the corporate tax rate.

2.3.3 Bilateral Regressions

Starting from June 2014, the External Positions of Banks database of the Deutsche Bundesbank (2015a) also splits up internal liabilities and internal loans by the country of the related affiliate from which the loan is taken or to which the loan is given. This allows to regress bilateral internal net debt on precise bilateral tax rate differentials that unambiguously identify the tax incentive to shift profits between two affiliates. For a subset of German non-financial multinationals Overesch and Wamser (2014) show a positive effect of such precise tax rate differentials on bilateral debt stocks. So far no study has used bilateral data for estimating debt shifting in banks. Here I use internal liabilities net of internal claims that affiliate i takes out from related affiliates in country j as my dependent variable:

$$IntNetDebt_{ijkt} = \max(InternalLiabilities_{ijkt} - InternalClaims_{ijkt} \; ; \; 0) \quad , \tag{2.9}$$

where $InternalLiabilities_{ijkt}$ are liabilities of affiliate i to other affiliates of the same bank group k in country j and $InternalClaims_{ijkt}$ are claims of affiliate i to related

affiliates in country j. I then estimate the following equation for the full sample of German multinational banks and their foreign affiliates:

$$\frac{IntNetDebt_{ijkt}}{TA_{ikt}} = \beta_0 + \beta_1(CTR_{ikt} - CTR_{jkt}) + \beta_2 X_{ikt} + \beta_3 Y_{jkt} + \gamma_t + \delta_k + u_{ijkt} \ . \quad (2.10)$$

The main variable of interest is $CTR_{ikt} - CTR_{jkt}$ which denotes the bilateral tax rate differential between the host country of affiliate i and the country of the internal creditor j. X_{ikt} is the same vector of control variables as above. Y_{jkt} contains the macroeconomic control variables also for the internal net creditor's country. γ_t are monthly time fixed effects and δ_k are bank group fixed effects. u_{ijkt} is the error term. Under the hypothesis that banks shift profits from higher taxed to lower taxed affiliates via internal debt I expect a positive estimate for β_1. Also in this bilateral setting I include bank affiliate fixed effects as a robustness check.

2.4 Data and Descriptives

2.4.1 Data

I use the External Position of Banks database of the Deutsche Bundesbank (2015a), a unique dataset provided by the German central bank on assets and liabilities in foreign affiliates of German multinational banks and in the respective German headquarters. As this is an administrative dataset to which all German banks with foreign activities are obliged to report monthly, it provides a complete and high quality sample of all German multinational banks. I observe separate records for all subsidiaries, whereas for branches I observe an aggregate figure per bank group and country.

As dependent variable I use internal liabilities held in an affiliate, and internal net debt which is calculated from internal liabilities and internal claims data. For estimation of equations (2.1) and (2.8) these variables are available from June 2010 to December 2015 on a monthly basis. More precise data on bilateral internal loans and liabilities, separated by the country of the internal counterpart, are available from July 2014 until December 2015. Although the sample period for this bilateral data is relatively short, the variation over affiliate/counterpart's-country-pairs and over time allows the estimation of equation (2.10) and an identification of the effect of precise corporate

tax rate differentials on bilateral internal net debt.

To control for an affiliate's size, I take the inverse hyperbolic sine of total assets as a bank-level control variable, which is also taken from the External Positions of Banks database. I collect the statutory corporate tax rates on a monthly basis from the Worldwide Corporate Tax Guides of Ernst & Young (2011, 2014). I take country-level controls from the International Monetary Fund's (IMF) International Financial Statistics, the World Development Indicators of the World Bank, the United Nations Conference on Trade and Development (UNCTAD) statistics and the online data center of the Organisation for Economic Co-operation and Development (OECD). For some countries I have to complement the data with information provided by national statistical offices (see Appendix B.1 for an overview of variables and data sources). As nominal GDP is only available quarterly, I transform it to monthly frequency with the proportional Denton method for flow series as described in Bloem et al. (2001). Also the share of the financial sector in a country's gross value added is only available with quarterly frequency and I transform it to monthly frequency by cubic spline interpolation. To calculate annual GDP growth rates with monthly frequency, I use interpolated GDP values. Minimum capital requirements are taken from the World Bank (2011) survey on bank regulation. Based on several other questions in this survey, Barth et al. (2013) provide an index on the stringency of capital regulation. As the World Bank provided the most recent version of the survey only in 2011, in my sample these two variables are constant over time. Table 2.1 shows the basic descriptive statistics of all variables.

2.4.2 Descriptive Analysis

Figure 2.2 illustrates the geographical distribution of German bank affiliates.[5] Most affiliates are located in Europe, probably due to the proximity to the home country and the common regulation in the European banking union that facilitates foreign activities. The most important foreign market for German banks is Luxembourg with 42 affiliates, followed by the United Kingdom with 32 affiliates (in 2013). Outside Europe the United States (20 affiliates) and Singapore (19 affiliates) are

[5]Note that in the External Positions of Banks database of the Deutsche Bundesbank (2015a) I observe all subsidiaries of German banks separately. However, I cannot distinguish between different branches of German banks in a country as there is only one aggregate observation per bank group, country and month for branches. I therefore count all branches of a bank group in a country as one single affiliate, whereas all subsidiaries are counted separately.

Table 2.1: Descriptive Statistics

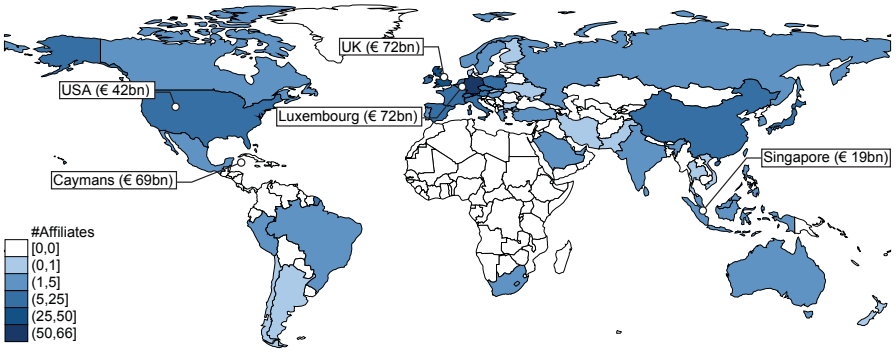
Variable	Obs.	Mean	Std. Dev.	Median	Frequ.
Aggregate data (06/2010-12/2015)					
Internal liabilities / Total assets	22,240	0.422	0.413	0.280	M
Internal net debt / Total assets	22,240	0.281	0.381	0.005	M
Total assets (in million €)	22,240	8,130	32,295	905	M
Statutory corporate tax rate	22,240	0.264	0.073	0.292	M
Nominal GDP (in billion €)	22,240	151	210	92	Q → M
Inflation rate (%)	22,240	1.930	2.515	1.654	M
GDP growth (%)	22,240	2.130	2.757	1.766	Q → M
Financial sector share	22,240	0.090	0.087	0.053	Q → M
Capital requirement	22,240	0.082	0.007	0.080	-
Regulatory index	22,240	6.954	1.732	8.000	-
Bilateral data (07/2014-12/2015)					
Bilateral internal net debt / Total assets	107,361	0.019	0.117	0.000	M
Corporate tax rate differential	107,361	0.022	0.100	0.021	M

Internal net debt are internal liabilities net of internal loans if positive and zero otherwise. *M* and *Q* indicate monthly and quarterly frequency, respectively. Quarterly nominal GDP is transformed to monthly frequency with the proportional Denton method for flow data. Monthly GDP growth is calculated from interpolated GDP values. *Financial sector share* denotes the share of the finance and insurance sector in a country's gross value added. Monthly frequency is calculated by cubic spline interpolation. *Regulatory index* is an index for the stringency of capital regulation in a country, ranging from 0 to 10 (higher values indicating greater stringency). Source: Deutsche Bundesbank (2015a)

the most important markets. Furthermore, Figure 2.2 illustrates the location of the top 5 countries for conduit debt, defined as the sum of each bank affiliate's $\min(InternalClaims_{it}; InternalLiabilities_{it})$ per country. First note that these most important conduit countries are distributed around the world, suggesting that they serve as regional hubs for different world regions in which German banks are active. Second, three of the five most important conduit countries (Cayman Islands, Luxembourg, Singapore) are classified as tax havens by both Dharmapala and Hines (2009) and Johannesen and Zucman (2014), and also the United Kingdom (the most important conduit country) offers a relatively low tax rate. This already suggests that in the sample of German multinational banks conduit entities tend to be located in low-tax countries. The high amount of conduit debt in the United States probably reflects the important role of this financial market. Note that also conduit entities in the United States may face only low effective tax rates as banks can locate their foreign affiliates in Delaware, a well known domestic tax haven in the United States.[6]

[6]I do not observe precise locations of bank affiliates in a country. Therefore this study assigns to each affiliate in the United States the relatively high US corporate tax rate, although affiliates might be located in a domestic tax haven such as Delaware. If influencing my results, this leads to an underestimation of internal debt shifting.

Figure 2.2: German Bank Affiliates and Top 5 Conduit Countries in 2013



Sum of conduit debt held by German bank affiliates in a country in parentheses (defined as $\min(InternalClaims_{it}; InternalLiabilities_{it})$ per affiliate). Calculated from data of the External Positions of Banks database of Deutsche Bundesbank (2015a).

For a further descriptive investigation of the use of internal debt, Table 2.2 ranks countries according to the mean of the internal-liabilities-to-total-assets ratios of German bank affiliates in the respective country in 2013. As expected there are several high-tax countries at the top: For instance in Japan (having a corporate tax rate of 38.0% in 2013) German bank affiliates were on average internally debt financed by 88.6%. Also internal leverages of German bank affiliates in France and Spain (two further high-tax countries) are on a relatively high level around 80%. Surprisingly also some tax havens appear in the ranking: In Hong Kong German bank affiliates have a similar internal leverage as in Portugal, despite the substantially lower corporate tax rate that would suggest that banks shift profits into affiliates in Hong Kong rather than out of them. The last column in Table 2.2 explains this finding: It reports for each country the average conduit share in internal debt that is passed through an affiliate (formally defined as the country average of $\min(\frac{InternalClaims_{it}}{InternalLiabilities_{it}}\ ;\ 1)$ in each affiliate). In Hong Kong on average 94.9% of internal liabilities are merely passed through the affiliates, whereas in Portugal the average conduit share is only 25.7%. Hence, even though German banks have similar internal leverages in both countries, the tax-effective internal-debt-to-total-assets ratio is substantially higher in Portugal. Also bank affiliates in Singapore and the Cayman Islands hold similar internal leverages as affiliates in high-tax countries (e.g. Italy) that can be explained with substantially larger conduit shares of internal debt.

Both Figure 2.2 and Table 2.2 suggest that the conduit affiliates in the sample of German multinational banks tend to be located in tax havens and low-tax countries, implying an underestimation of debt shifting with the classical dependent variable

Table 2.2: Intragroup Liabilities in 2013

Country	CTR	IntLiab/TA	Conduit share
Japan	38.0%	88.6%	20.8%
France	34.0%	83.8%	22.3%
Spain	30.0%	79.2%	7.7%
United Kingdom	23.0%	75.1%	43.8%
Greece	26.0%	74.4%	38.8%
Hong Kong	16.5%	72.6%	94.9%
Portugal	25.0%	70.9%	25.7%
Sweden	22.0%	70.7%	50.1%
Belgium	34.0%	69.6%	32.1%
Singapore	17.0%	67.0%	59.0%
Italy	40.7%	65.2%	13.1%
Cayman Islands	0.0%	63.2%	68.3%
United States	39.1%	61.1%	36.8%
China	25.0%	57.2%	16.1%
...			

Due to confidentiality reasons, only countries with at least 3 affiliates shown here. CTR denotes a country's statutory corporate income tax rate in 2013. Column 3 reports the average gross internal-liabilities-to-total-assets ratio of German bank affiliates in the respective country. Column 4 contains the average conduit share of internal debt, defined as the country average of $\min(\frac{InternalClaims_{it}}{InternalLiabilities_{it}}\ ;\ 1)$ in each affiliate. Source: Ernst & Young (2011, 2014) and External Positions of Banks database of Deutsche Bundesbank (2015a).

(the internal-liabilities-to-total-assets ratio). Regressing the conduit share of internal debt in an affiliate on the corporate tax rate and controlling for other macroeconomic variables (see regression results in the Appendix B.2) indeed leads to a significantly negative tax coefficient. Hence, in the sample used in this essay, the conduit entities are systematically located in low-tax countries. From a debt shifting perspective this assigns too high internal liabilities to low-taxed affiliates, leading to an underestimation of internal debt shifting with the classical internal-liabilities-to-total-assets ratio as dependent variable. I therefore expect a larger tax coefficient with the internal-net-debt-to-total-assets ratio as dependent variable.

2.5 Results

Table 2.3 shows the baseline estimation results for the determinants of the internal debt variables in affiliates and headquarters of German multinational banks. As in

previous studies on debt shifting, in column (1) the dependent variable is the ratio of internal liabilities to total assets. I find a significantly positive coefficient of 0.495 for the corporate tax rate, indicating that a 10 percentage points higher corporate tax rate means an increase in the internal liabilities to total assets ratio by about five percentage points. At the mean (42.2%) this corresponds to an increase by 12%. This effect of corporate tax rates on internal liabilities in the banking sector is quantitatively larger than previous studies estimated for other sectors, both in absolute terms and relative to the sample mean: Fuest et al. (2011) and Buettner et al. (2012) use an equivalent setting for data on German multinationals and find a coefficient for the corporate tax rate of only 0.177 and 0.214, respectively. In relative terms a 10 percentage points tax rate increase in these studies implies at the sample means (23% and 28%) an increase in the internal leverage by around 7% to 8%.

The greater impact of tax rates on internal debt in the financial sector even intensifies if I use internal net debt as the dependent variable in column (2). This variable reflects the effective amount of debt that shifts profits out of an affiliate. As shown in the previous section, the reason is that conduit entities in internal debt financing are mainly located in low-tax countries, resulting in a downward biased estimate of the tax coefficient when using internal gross liabilities as proxy for debt shifting. The tax coefficient in column (2) is 0.563, which is about 14% larger than the estimate in column (1). At the sample mean (28.1%) a 10 percentage points corporate tax rate increase implies an increase in the internal-net-debt-to-total-assets ratio by 20%. Previous literature has not analyzed the tax response of internal net debt, therefore comparability to non-financial sectors is limited in column (2). However, as also non-banks use conduit entities (e.g. internal financing hubs), accounting for conduit debt is an interesting extension for future research on debt shifting in non-financial sectors.

In column (3) I additionally include bank affiliate fixed effects. Qualitatively I can confirm that multinational banks shift profits through the use of internal debt, however the estimated coefficient is smaller. This may results from the fact that I now only use tax rate changes for identification, and that the bulk of these tax rate changes are relatively small tax cuts in high-tax countries. As tax havens (the potential destinations for profits) still offer a much lower tax rate, the qualitative tax incentive for internal debt structures often remains unchanged, resulting in relatively low adjustments to these changed tax rates. Still the estimated coefficient indicates a strong response of internal net debt to corporate tax rates: A ten percentage points rise in the tax rate implies an increase in the internal net debt ratio by 3.24 percentage points,

Table 2.3: Baseline Intragroup Debt Regressions

Sample:	All entities			Foreign affiliates		
Dep. var.:	$\frac{IntLiab}{TA}$	$\frac{IntNetDebt}{TA}$		$\frac{IntLiab}{TA}$	$\frac{IntNetDebt}{TA}$	
	(1)	(2)	(3)	(4)	(5)	(6)
CTR	0.495*	0.563**	0.324**	0.454*	0.510**	0.304*
	(0.271)	(0.225)	(0.155)	(0.266)	(0.214)	(0.159)
IHS(TA)	-0.023***	-0.016***	0.009***	-0.004	0.004	0.016***
	(0.007)	(0.001)	(0.003)	(0.007)	(0.006)	(0.003)
IHS(GDP)	0.017	-0.002	0.015	0.020	-0.001	0.028
	(0.015)	(0.012)	(0.023)	(0.014)	(0.011)	(0.023)
Inflation	-0.007*	-0.005**	0.000	-0.013***	-0.009***	0.000
	(0.004)	(0.003)	(0.001)	(0.004)	(0.003)	(0.001)
GDP growth	-0.009*	-0.008**	-0.001	-0.010***	-0.009***	-0.001
	(0.004)	(0.004)	(0.001)	(0.004)	(0.003)	(0.001)
Financial sector share	0.829***	0.078	1.424***	0.445	-0.302	1.574***
	(0.314)	(0.230)	(0.248)	(0.305)	(0.220)	(0.247)
Regulatory index	-0.018**	-0.004		0.003	0.018**	
	(0.009)	(0.008)		(0.008)	(0.007)	
Capital requirement	-0.142	1.056		-0.803	-0.092	
	(2.737)	(1.987)		(2.476)	(1.816)	
Monthly time FE	✓	✓	✓	✓	✓	✓
Bank group FE	✓	✓	✓	✓	✓	✓
Bank FE			✓			✓
R^2	0.355	0.327	0.795	0.398	0.477	0.777
Observations	22,240	22,240	21,961	16,451	16,451	16,260

Dependent variable is the ratio of internal liabilities to total assets in columns (1) and (4) and the ratio of internal net debt (internal liabilities net of internal claims if positive, zero otherwise) to total assets in the other columns. *Financial sector share* is the share of the banking and insurance sector in a country's gross value added. *Regulatory index* captures the stringency of capital regulation in a country, ranging from 0 to 10 (higher values indicating greater stringency). *Capital requirement* is the legal minimum capital requirement for banks in a country. Standard errors in parentheses, clustered by bank and by country-month. Regressions based on monthly data for 06/2010-12/2015 from the External Positions of Banks database of Deutsche Bundesbank (2015a).

corresponding to an increase by about 12% at the sample mean.

Columns (4) to (6) show the results of re-estimating the three specifications with exclusion of German headquarters. This accounts for the idiosyncrasy of the External Positions of Banks database that all headquarters reside in Germany, and Dischinger et al. (2014a) show that multinationals might be reluctant to shift profits away from headquarters. However I find smaller tax coefficients (0.454, 0.510 and 0.304) when excluding headquarters from my sample of German multinational banks. There are two potential explanations for this finding: First, banks might use debt shifting to substantially shift profits out of their German headquarters. This would be in line with Tørslov et al. (2017) who show that the share of corporate tax revenues lost due to profit shifting in Germany is the highest among all European countries. Second, headquarters partially finance their foreign affiliates with internal debt, leading to a 'base' stock of internal debt in these affiliates that does not respond to tax rates and leads to the smaller estimated responses in regressions (4) to (6).

Results on control variables furthermore show a small negative effect of an affiliate's size (measured in total assets) on the use of internal debt in the full sample without affiliate fixed effects, but estimates in the subsample of foreign affiliates are insignificant. When including affiliate dummies, the effect gets slightly positive. Inflation rates in the host country have a significantly negative impact on both the internal-gross-liabilities-to-total-assets ratio and the internal-net-debt ratio, perhaps reflecting higher risks. When including affiliate fixed effects, this effect vanishes. A negative effect also arises from GDP growth, possibly because banks do not shift funds away from affiliates in fast growing countries. As expected, the share of the financial sector in a country's gross value added has a significantly positive effect on the internal-gross-liabilities-to-total-assets ratio in regression (1). However, on the internal-net-debt ratio I can only find a positive effect when including bank affiliate fixed effects.

Table 2.4 shows results of the bilateral debt shifting regressions that allow to use the precise corporate tax rate differential as measure for the shifting incentive. For this tax rate differential a significantly positive effect on bilateral-internal-net-debt-to-total-assets of 0.033 arises in the baseline regression, and of 0.042 when including affiliate fixed effects. In the subsample of foreign affiliates these effects are even larger: In regression (3) a coefficient of 0.059 arises, meaning that a 10 percentage points higher corporate tax rate differential leads to an increase in the bilateral-internal-net-debt ratio by 0.59 percentage points. Compared to the sample mean (3.2% in foreign affiliates) this corresponds to an increase by 18%. This result is in line with

Table 2.4: Bilateral Regression Results

		Dep. var.:	$\frac{IntNetDebt_{ijt}}{TA_i}$			
		Sample:	All entities		Foreign affiliates	
			(1)	(2)	(3)	(4)
$CTR_{it} - CTR_{jt}$			0.033*	0.042***	0.059**	0.094***
			(0.018)	(0.007)	(0.026)	(0.010)
IHS(Total assets)			-0.009***	-0.008***	-0.005***	-0.008***
			(0.002)	(0.002)	(0.002)	(0.003)
IHS(GDP)	host country i		0.002	0.005	0.001	0.005
			(0.002)	(0.005)	(0.002)	(0.006)
	counterpart j		0.008***	0.006***	0.012***	0.012***
			(0.002)	(0.001)	(0.003)	(0.001)
Inflation rate	host country i		-0.002***	-0.000**	-0.002***	-0.000
			(0.001)	(0.000)	(0.001)	(0.000)
	counterpart j		-0.001***	-0.001***	-0.001***	-0.001***
			(0.000)	(0.000)	(0.000)	(0.000)
GDP growth	host country i		-0.001	-0.000	-0.001	-0.000
			(0.001)	(0.000)	(0.001)	(0.000)
	counterpart j		-0.001**	-0.001***	-0.002**	-0.002***
			(0.000)	(0.000)	(0.001)	(0.000)
Regulatory index	host country i		-0.000		0.001	
			(0.001)		(0.001)	
	counterpart j		0.004***	0.003***	0.007***	0.006***
			(0.001)	(0.000)	(0.002)	(0.000)
Capital requirement	host country i		0.453		0.397	
			(0.279)		(0.244)	
	counterpart j		-0.344***	-0.281***	-0.375**	-0.365***
			(0.107)	(0.023)	(0.184)	(0.035)
Financial sector share	host country i		0.077**	-0.142***	0.067*	-0.161**
			(0.038)	(0.053)	(0.039)	(0.063)
	counterpart j		0.031*	0.026***	0.045	0.037***
			(0.017)	(0.003)	(0.119)	(0.006)
Monthly time FE			✓	✓	✓	✓
Bank group FE			✓	✓	✓	✓
Bank FE				✓		✓
R^2			0.078	0.231	0.146	0.241
Observations			107,361	107,361	57,628	57,628

i indicates the affiliate and j the country of the internal counterpart to/from which loans are given/obtained. $\frac{IntNetDebt_{ij}}{TA_i}$ is the ratio of internal liabilities net of internal claims between affiliate i and affiliates of the same bank group in country j relative to total assets of affiliate i if positive, and zero otherwise. *Regulatory index* captures the stringency of capital regulation in a country, ranging from 0 to 10 (higher values indicating greater stringency). Standard errors in parentheses, clustered by bank-counterpart-pairs and country-month. Monthly bilateral bank data for 07/2014-12/2015 from the External Positions of Banks database of Deutsche Bundesbank (2015a).

banks shifting profits through internal debt from higher taxed to lower taxed affiliates. Moreover, this implied semi-elasticity also quantitatively confirms the 20% increase in internal net leverages (in response to a 10 percentage points corporate tax rate increase) which I find in Table 2.3. When controlling for affiliate fixed effects in column (4), the estimated coefficient increases even further to 0.094.

Note that in the bilateral debt regressions in Table 2.4 the estimated tax effect increases when including bank affiliate dummies, whereas with aggregate internal net debt as dependent variable in Table 2.3 the tax effect is smaller with bank affiliate dummies. This implies that internal net debt is highly responsive to changes in the internal counterpart's tax rate (the potential destination for profits), whereas banks do not respond equally strong to changes in the host country's tax rate.

Results on host country control variables of affiliate i are qualitatively similar to the estimates for aggregate debt data in Table 2.3. In bilateral regressions I also include macroeconomic control variables for the country from which the internal net debt is taken. For the internal counterpart's country I find a positive effect of the GDP that probably comes from the fact that German banks partially finance a stronger engagement in large countries through internal debt. Interestingly the capital requirement in the internal counterpart's country has a significantly negative effect on bilateral internal net debt: Additional claims have to be backed by additional equity to fulfill capital requirements, hence a higher capital requirement can discourage internal lending.

To summarize, both aggregate and bilateral internal debt regressions on German multinational banks indicate that banks engage in debt shifting. Moreover, the estimated effect in the banking sector is larger than previous studies estimated for non-financial firms, both absolutely and relatively to the sample average of internal debt ratios. This becomes even clearer when I correct for conduit entities: Since conduit affiliates are taxed lower than the sample average, using the internal-net-debt ratio as dependent variable leads to even larger estimated tax responses. Accounting for conduit debt is also a more general methodological issue that can be addressed by future empirical internal debt shifting studies on non-banks.

2.6 Conclusion

The immaterial nature of the banking business and the concentrated expertise in the optimal design of financial transactions suggest that the financial sector uses its

tax planning possibilities more aggressively than other sectors do. However, there are only few studies considering tax avoidance in the banking sector. Contributing to this literature, my essay is the first that investigates internal debt shifting in the financial sector. I find convincing evidence that banks engage in debt shifting, with a ten percentage points higher tax rate increasing the internal-net-debt-to-total-assets ratio by about 5.6 percentage points. At the mean this corresponds to an increase by 20%. Moreover, a comparison of my results to previous studies on non-financial firms suggests that banks use debt shifting more aggressively.

I furthermore show that it is important to account for conduit entities in internal debt financing, as with the classical measure for internal debt shifting results are downward biased. This is not only important in the context of internal debt shifting in the financial sector, but also for multinationals in general. Anecdotal evidence shows that also multinational enterprises in other sectors establish affiliates acting as internal banks (The Guardian, 2014). If these internal banks are mainly located in low-tax countries, previous studies have underestimated the extent of tax avoidance through the use of internal debt.

Chapter 3

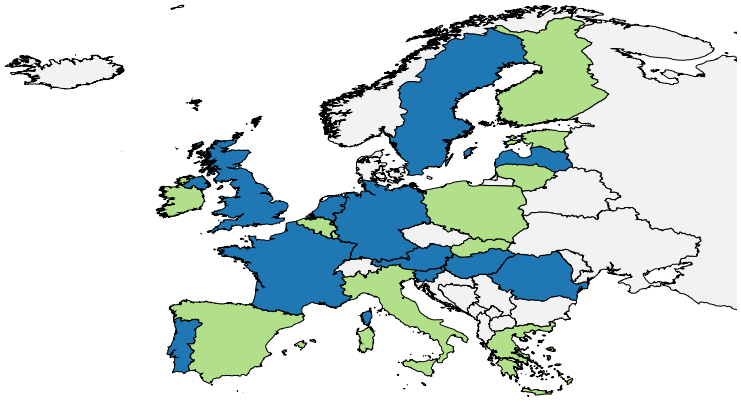
Taxing Transmitters of Distress: Evidence from the German Bank Levy

3.1 Introduction

In the wake of the financial crisis, governments in the U.S. and Europe have spent large sums bailing out ailing banks. To ensure that banks bear an adequate share in the costs of stabilizing the financial industry, several countries have introduced bank levies (see Figure 3.1 for European countries). Most recently Poland (February 2016) and Australia (July 2017) adopted a bank levy. Almost all of these levies raise the bulk of their revenues from a tax on some inter-bank liabilities held by affected banks. This design reflects the main aim of bank levies: They are intended to have a Pigouvian effect on banks' potentially risk-transmitting liabilities, thereby improving the stability of the financial sector and reducing its systemic risks.

Legislators aim at achieving these Pigouvian goals with bank levies through the combination of three effects: First, in several countries, levy revenues contribute to newly established bank restructuring funds that are used for bail-outs of troubled banks in the future and should prevent future financial crises. Second, by taxing inter-bank liabilities the legislator aims for a reduction of these potential transmitters of distress. With a reduction in the share of inter-bank debt also the potential impact of a bank's default on other banks decreases. And third, the intended reduction in debt also directly pushes each levy-paying bank to a more solid funding by increasing its equity

Figure 3.1: Countries with Bank Levies in Europe



European countries with bank levies that were in place by 2011 (blue) and by 2016 (green), including countries that participate in the European banking union and have thus introduced the European bank levy in 2015.

ratio.

This essay uses data on German banks to investigate whether bank levies can achieve these Pigouvian effects and therefore reduce systemic risks in the banking sector. For the first part of the analysis, I adopt a difference-in-differences estimator. The German bank levy is well suited for such an approach as it allows for a levy-exempt amount of €300 million in relevant liabilities (i.e. total liabilities net of equity and deposits). Beyond this threshold a progressive levy schedule applies. Almost all affected banks are in the first levy bracket (85.4% of affected banks) and the second levy bracket (5.0%) during the whole sample period, facing a marginal levy rate of 0.02% and 0.03%, respectively. For them I find a decrease in relevant liabilities after the introduction of the German bank levy of about 6% to 9% compared to non-affected banks.

Replacing relevant liabilities by non-affected funding (equity and customer deposits) might be an option for affected banks to avoid the levy without reducing their business volumes. Whereas an increase in equity would reinforce the intended Pigouvian effect, an increase in customer deposits weakens the positive effect of the reduction in uninsured inter-bank liabilities by replacing them with liabilities insured in a deposit insurance system. However, I do not find significant effects of the German bank levy on neither equity nor customer deposits. Taken together, these results suggest that the German bank levy indeed led to a reduction in balance sheet volumes and a better capitalization of affected banks. Estimating explicitly the effect on total assets shows that affected banks reduced their balance sheet volumes in the first levy bracket by about 3% and in the second bracket by about 7%.

The significant reduction in inter-bank liabilities suggests that the German bank levy succeeded in reducing these potentially distress-transmitting funds. Regarding the direct effect on an individual bank's funding risk, I consider equity-to-total-assets ratios and z-scores using the same difference-in-differences setting and confirm these findings. Equity ratios of affected banks in the first levy bracket significantly increase by about 0.2 percentage points compared to non-affected banks, corresponding to an increase by 3% to 4% at the pre-treatment mean of affected banks. The significant increase in z-scores of banks in the first levy bracket corroborates these findings, indicating a decrease in their probability of insolvency.

Apart from substitution by non-affected funds, another potential way to circumvent the German bank levy is only open to multinational banks: Foreign subsidiaries of German banks are not subject to the German bank levy. By shifting inter-bank liabilities (and the related activities) to these subsidiaries, banks can avoid levy payments without actually reducing their business volumes. Comparing foreign subsidiaries of German banks in countries without bank levies with matched non-German banks yields indeed an increase in relevant liabilities by about 19%. To assess the impact of this shifting on the overall reduction in inter-bank liabilities, I furthermore consolidate foreign subsidiaries into German core banks. I then find that multinational banks that have subsidiaries in countries without bank levies did not significantly reduce their overall relevant liabilities. By contrast, the estimated effect on banks that have no shifting possibility slightly intensifies when controlling for potential multinational shifters.

This essay contributes to the recent literature on the impact of bank levies on banks' behavior. Several papers study the incidence of bank levies: Buch et al. (2016) empirically examine the short term effects of the German bank levy and find that affected banks reduce lending to customers and pay higher deposit rates. Haskamp (2018) finds that German savings and cooperative banks also increased lending rates in response to the introduction of the bank levy, with spill-overs to banks not directly affected by the levy. Kogler (2016) models and empirically confirms these findings using bank-level evidence for 23 EU countries. Also Capelle-Blancard and Havrylchyk (2017) investigate the incidence of bank levies and find with data on the Hungarian bank levy that banks shift the burden partly to customers. Considering potential changes in the riskiness of banks due to the introduction of bank levies, a recent theoretical contribution by Diemer (2017) models different types of bank levies and finds that bank levies indeed can reduce banks' risk. Most closely related to my essay is the work by Devereux

et al. (2017) who study bank levies in several European countries using a multinational bank dataset. They show that equity-to-assets ratios in affected banks increased, but at the same time the average risk weight of assets also rose. This essay contributes to this literature by showing that bank levies indeed succeed in reducing banks' potentially risk-transmitting liabilities and their probabilities of insolvency, but banks also make use of possibilities to circumvent the levy.

Apart from direct taxes on banks' liabilities there is a substantial literature on the effect of corporate profit taxes on banks' use of debt. Several studies find that banks' leverages increase with corporate tax rates, reflecting the tax advantage of debt compared to equity (Gu et al., 2015; Schepens, 2016; Milonas, 2016). Reiter (2017) considers internal debt and shows that banks use intra-group lending to avoid corporate taxes by shifting profits to lower taxed affiliates. Merz and Overesch (2016) find broader evidence for profit shifting in response to corporate taxation. Langenmayr and Reiter (2017) show that particularly proprietary trading of banks is responsive to taxes.

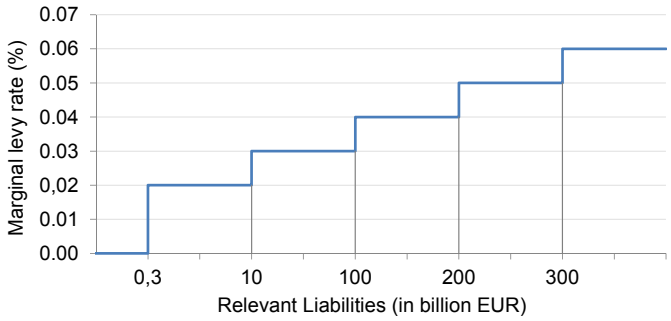
The remainder of this chapter is structured as follows: Section 3.2 outlines the institutional details and motives for the German bank levy. Section 3.3 explains the database. In Section 3.4 I develop the empirical strategy, which I apply to the data in Section 3.5. Section 3.6 considers fund shifting to foreign subsidiaries. Section 3.7 concludes.

3.2 The German Bank Levy

The German legislator designed the national bank levy as a tax on two components of banks' balance sheets: The first is a flat tax of 0.0003% on derivatives, both on the liability and the asset side. However, in terms of generated levy revenues this derivatives part is of minor importance. The bulk of revenues is generated by the second component that levies a progressive tax on total liabilities net of equity and customer deposits (as the latter are already insured in a deposit insurance system). The resulting tax base predominantly consists of securitized liabilities and liabilities to other banks and hence of funds that transmit distress in the banking sector: If one bank fails, it cannot pay back these inter-bank liabilities, potentially causing solvency problems also in creditor banks. The legislative proposal for the German bank levy explicitly identified these liabilities as reflecting a bank's systemic risk and its inter-connectedness, having transmitted distress during the financial crisis (Deutscher Bundestag, 2011).

As a first contribution, this essay investigates whether the German bank levy really achieved these intended Pigouvian effects on banks' use of inter-bank liabilities by exploiting the features of the levy schedule. Figure 3.2 shows the progressive levy schedule for the liability component. 77.1% of all German banks are not directly affected by the bank levy as there is a levy-exempt amount of €300 million. 85.4% of the banks that are not exempt from the second component are in the first levy bracket, having relevant liabilities of up to €10 billion and facing a marginal levy rate of 0.02%. Very large banks pay higher marginal levy rates, with a maximum of 0.06%. However, the legislator implemented a ceiling that caps total levy payments at 20% of a bank's after-tax profit. As a minimum, a bank has to pay 5% of the uncapped levy. The capped amount is carried forward up to two years.[1] The first levy payments were due in the fall of 2011. The relevant balance sheet for the calculation of bank levy payments is the final annual balance sheet of the previous year.

Figure 3.2: German Bank Levy Schedule



Marginal bank levy rates in Germany from 2011 to 2014, dependent on the levy base (liabilities relevant for the bank levy).

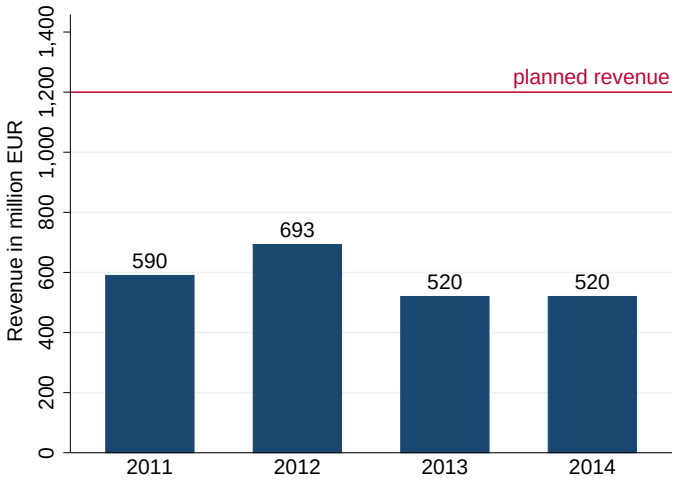
The setting of the German bank levy is well suited for investigating banks' funding responses to bank levies. In March 2010 the German government announced the introduction of a bank levy. After some controversial discussions, the parliament passed the law in December 2010 with the German bank levy act entering into force on January 1st, 2011. Whereas the tax base was basically already known by July 2010, banks did not know the exact levy rates until they were set in a separate regulation in July 2011. As a governing party initially brought a tax rate of 0.1% into the discussion, banks might have expected much higher rates than those that were eventually intro-

[1]The German bank levy law actually requires a bank to pay the capped amount up to five years after the levy originally was due. In a transition period till 2019 this limitation period is shortened to two years. As the German bank levy was replaced by the European levy in 2015, the five year limitation period actually never became effective.

duced (Börsen-Zeitung, 2010). This could potentially explain the relatively strong responses in the tax base I find for affected banks.

In the discussion preceding the introduction of the bank levy in Germany some concerns arose that multinational banks can partially circumvent the levy by relocating relevant liabilities to foreign subsidiaries.[2] As only banks holding a German banking license have to pay the levy, their foreign subsidiaries are not affected (whereas foreign branches usually are subject to the levy). As a further contribution, this essay investigates in Section 3.6 whether banks indeed engaged in such fund shifting.

Figure 3.3: Revenues from the German Bank Levy



German bank levy revenues and the initially planned revenue per year. Sources: Press releases of the Financial Markets Stabilization Agency (available on www.fmsa.de/en/press) and FAZ (2014).

Levy revenues feed the newly introduced bank restructuring fund that was thought to prevent future financial crises (having a target value of €70 billion). Figure 3.3 shows actual revenues generated by the German bank levy in the years when it was in place. With €520 million to €690 million per year, revenues remained far below expectations of the legislator who initially planned to take about €1.2 billion each year (FAZ, 2014). The main reason for this shortfall in levy revenues is that the government's calculations were based on pre-crisis balance sheets of banks (as of 2006). Moreover, particularly for the large commercial banks the levy cap was binding due to lower profits. But also the strategic responses of affected banks investigated in this essay contributed to the shortfall in levy revenues.

[2]Both media (n-tv, 2010) and the German parliament (Deutscher Bundestag, 2010, Drucksache 17/2627, p.9) discussed these loopholes for multinational banks.

Note that this study does not consider the European bank levy which has replaced the German national levy in 2015. German bank levy revenues accumulated by then (€2.3 billion) will remain in the German national restructuring fund which will exist in parallel with the newly introduced European Single Resolution Fund. However, the results of this chapter are also valuable for the assessment of the new European bank levy: The individual levy payment to the European Single Resolution Fund is still an increasing function of a bank's total liabilities excluding equity and covered deposits, although the calculation of individual banks' contributions is now more complex.

3.3 Data

The original data on individual levy payments from the Financial Markets Stabilization Agency (FMSA), which collects the levy, are not available for research. Nevertheless, the German central bank collects comprehensive and high quality data on all banks' balance sheet statistics that are accessible to external researchers (Deutsche Bundesbank, 2017b). This dataset contains all key balance sheet variables needed to calculate a banks' tax base for the liability component of the levy according to the following scheme:

$$
\begin{aligned}
\textit{Levy base} = \quad & \textit{Total Liabilities} \\
& - \textit{Equity} \\
& - \textit{Customer deposits} \\
& - \textit{Profit participation capital} \\
& - \textit{Fund for general banking risk}
\end{aligned}
$$

However, there is some minor imprecision in the calculation of levy bases from German central bank data: Profit participation capital with less than two years term to maturity is not subtracted from the levy base, but I cannot observe maturity in the data. Therefore I subtract the total amount of profit participation capital from the levy base. As its share in banks' balance sheets is negligible,[3] this imprecision should not severely affect the results. Moreover, liabilities to non-bank customers that are related parties are subject to the levy, but as I cannot distinguish related and unrelated customers, I also subtract them from the levy base here.[4] The threat of not

[3]Profit participation capital is on average 0.15% of total assets in the sample period, the share having less than two years term to maturity is therefore even lower (Deutsche Bundesbank, 2017a).

[4]Note that there is no problem if the related party is also a bank, because liabilities then correctly remain in the levy base.

subtracting liabilities to related non-banks is that banks that are subject to the levy (because liabilities to related non-banks place them above the exemption threshold) are incorrectly classified as non-treated. However, as these treated banks then would incorrectly be in the control group, this should work against the proposed effect.[5]

This essay uses monthly data around the introduction of the German bank levy in January 2011, covering a four year period from September 2009 to August 2013. To avoid discrete jumps in the data, I exclude banks that conducted a merger or acquisition in the sample period or that were not observed in all months. Moreover, I remove banks that are classified as *banks with special functions* (mostly development banks) from the sample as they are exempt from paying bank levies. Table 3.1 shows baseline descriptive statistics for the variables and the sample used in the next section. Note that data needed for the calculation of the z-score are only available at annual frequency (2009-2013), resulting in a lower number of observations.

Table 3.1: Baseline Descriptive Statistics

Variable	Obs.	Mean	Std. dev.	Median
Levy base (in €1,000)	61,776	637,825	3,339,968	77,203
Equity (in €1,000)	61,776	80,851	239,881	21,387
Deposits (in €1,000)	61,776	1,003,126	2,781,268	258,861
Total assets (in €1,000)	61,776	1,734,522	5,884,111	375,609
Return on assets (in %)	59,708	0.045	3.322	0.168
Equity/TA (in %)	61,654	6.503	6.489	5.608
Z-score	6,200	24.477	151.071	10.517

Sample period from 09/2009 to 08/2013. All variables at monthly frequency, except the z-score, which is at annual frequency. Data from the banks' balance sheet statistics of Deutsche Bundesbank (2017b). Data on banks' profits is matched from the profits and loss statements component of the Bundesbank database for the calculation of the return on assets; as for some banks information on profits is missing and/or total assets are zero, the number of observations for return on assets is lower. For variable definitions see Appendix C.1.

[5]For some liabilities (development loans towards banks and trust liabilities from development loans business) a reduced levy rate applies. I cannot distinguish between liabilities affected by regular bank levy rates and by reduced rates. However, the volume of liabilities affected by reduced rates should be rather small. Germany's second largest bank, DZ Bank, for instance reports a business volume in development loans equal to about 3% of total liabilities in 2014 (DZ Bank, 2016). Also reduced levy rates set the same qualitative incentive to reduce these liabilities, but the absolute response is probably smaller. Treating these reduced-rate liabilities as if they were taxed at the regular rates leads, if influencing results at all, to an underestimation of the regular bank levy effect.

3.4 Empirical Strategy

In the following, the essay investigates how banks responded to the introduction of the German bank levy. The design of the levy is well suited to employ a systematic difference-in-differences estimator, as there is a control group of non-affected banks below the levy exemption threshold of €300 million. Comparing banks below and above a threshold is analogous to the method used by Kleven et al. (2014) for evaluating preferential tax schemes for top-income earners. In the context of bank levies it was also applied by e.g. Buch et al. (2016) and Capelle-Blancard and Havrylchyk (2017).

3.4.1 Baseline Difference-in-Differences Estimator

In my setting the first treatment group are banks in the first levy bracket, facing a marginal levy rate of 0.02%. The second treatment group are all German banks in the second levy bracket (marginal levy rate of 0.03%). As control group for both treatment groups I use banks below the levy exemption threshold, having relevant liabilities up to €300 million (the exemption threshold) and being unaffected by the German bank levy. Table 3.2 shows descriptive statistics for these treatment and control groups. Most banks are in the control group of levy-exempt banks. Of those being not exempt, the majority is located in the first levy bracket. To be in one of the treatment and control groups, a bank has to be in the respective group during the whole sample period. This means that I delete 25 levy bracket switchers from my sample, as they are potential bunchers. If influencing results at all, deleting switchers might lead to an underestimation of the levy's effect. In a robustness check, I combine all banks above the levy exemption threshold to one single treatment group. This treatment group then also includes banks that switch between different levy brackets (but not between being exempt and paying the levy at all) and banks that are in higher levy brackets.

To systematically investigate the bank levy's treatment effect, I estimate the following difference-in-differences model:

$$\begin{aligned} ln(\text{Levybase}_{it}) = \quad & \beta_1 \, \text{Treated}_{1i} \cdot \text{Post}_t \\ & + \beta_2 \, \text{Treated}_{2i} \cdot \text{Post}_t + \gamma_i + \delta_t + \epsilon_{it} \end{aligned} \tag{3.1}$$

where i indicates banks and t is an index for year-month. The dependent variable is the natural logarithm of the tax base for the bank levy. $Treated_{1i}$ and $Treated_{2i}$ are

Table 3.2: Treatment and Control Groups

Variable	Control group	Alternative control group	1st levy bracket	2nd levy bracket	All levy-affected
Relevant liabilities (billion €)	0-0.3	0.15-0.3	0.3-10	10-100	≥ 0.3
Number of banks	1,014	41	258	15	302
Mean levy base (1,000 €)					
in 12/2009	73,497	221,340	1,342,433	29,600,000	6,782,707
in 12/2011	72,761	222,133	1,298,038	28,500,000	7,180,355
Equity/TA (%)					
in 12/2009	6.800	5.431	5.000	3.278	4.836
in 12/2011	6.779	5.470	5.276	3.421	5.102

The table shows descriptive statistics of banks in the control and treatment groups. The *control group* are all banks that have relevant liabilities below the levy exemption threshold of €0.3 billion during the full sample period (09/2009-08/2013). The *alternative control group* is a subsample of banks that are closer to this threshold (with relevant liabilities between €0.15 billion and €0.3 billion). Treatment groups are banks that are in the *1st levy bracket* and banks in the *2nd levy bracket* during the full sample period; in a robustness check I combine all banks above the exemption threshold to one single treatment group (*all levy-affected*). Source: banks' balance sheet statistics of Deutsche Bundesbank (2017b).

dummies equal to one if bank i is in the first or the second levy bracket, respectively. $Post_t$ is a dummy indicating the treatment period, being equal to one for January 2011 and all following months. The difference-in-differences methodology is very appealing in the context of this essay as it allows to control for several unobserved factors: γ_i are bank dummies, absorbing all time constant individual bank characteristics. All macroeconomic, regulatory and legislative shocks equally affecting all banks in a period are eliminated by including δ_t, capturing monthly time fixed effects. The remaining variation used for identification are therefore differences in levy base changes across German banks. ϵ_{it} is the error term. The sample for estimation of equation (3.1) consists of all banks being either levy-exempt or in the first or second levy bracket.

An obvious concern with this commonly applied approach is that treated and control banks systematically differ in size. However, as the next section shows, the assumption of parallel trends in the pre-treatment period is met in this setting. Moreover, as a robustness check, I restrict the control group in the analysis to banks having relevant liabilities between €150 million and €300 million. On the other side of the threshold, the relatively small banks in the first levy bracket are the treated banks that are most comparable to the control group. This is reflected by the pre-treatment trends in balance sheet items: as shown in Sections 3.5.1 and 3.5.2, trends for banks in the first levy bracket fit better to the control group than trends for banks in the second bracket.

The comparability to the control group is also one reason why this study does not investigate higher levy brackets in more detail. What adds to this is that there are

only four banks in total in these higher brackets, and showing figures resulting from data on less than three banks or being dominated by two banks violates Deutsche Bundesbank's confidentiality restrictions. As mentioned above, I conduct a robustness check by combining all levy brackets to a single treatment group.

3.4.2 Estimator for Alternative Funds

The direct effect of raising the costs for inter-bank liabilities and thereby reducing this tax base is probably not the only impact of a bank levy on a bank's funding decision. The reduction in debt may have several further effects: On the one hand, assuming that marginal revenues are a positive but declining function of invested assets, the reduction in funds (and related assets) leads to an increase in the marginal return of additional assets. On the other hand, the reduction in bank debt also means an improvement in a bank's capitalization rate (an increase in the equity-to-assets ratio), which theoretically translates into lower funding costs for customer deposits and equity. With a higher marginal return and lower marginal costs, a bank might increase both customer deposits and equity.

While the bank levy imposes an incentive to substitute inter-bank liabilities by equity and deposits, there are further aspects of the financing decision that make a switch to equity or deposits potentially unattractive. First, raising equity is more expensive than debt financing, as equity is subordinate to other liabilities. Shareholders thus demand higher risk premiums (see e.g. McGrattan and Prescott, 2003). Moreover, the cost of equity is not deductible from the corporate tax base whereas interest expenses for debt usually are, generating a tax advantage of debt as shown by Modigliani and Miller (1963). From a practical perspective, a switch is relatively difficult to implement, at least in the short term: An increase in equity by additional capital or retained earnings is not a plain management decision but usually requires approval by shareholders. Substituting inter-bank liabilities with retained earnings also conflicts with the finding of Brav et al. (2005) that it is a major objective of managers to maintain past dividend levels. Also a substitution by additional customer deposits is difficult in practice: Banks compulsorily have to insure customer deposits via the legal deposit insurance. On the one hand this reduces risk premiums banks have to pay to customers, but on the other hand banks have to pay a fixed insurance premium per euro of customer deposits, increasing costs of deposit financing again (for a discussion see Greenbaum and Thakor, 1987). Moreover, both customer deposits and equity are considerably less flexible, which increases potential costs of adjustment to changing market conditions.

Overall, it is therefore unclear how attractive it is for banks to substitute lower inter-bank liabilities.

To investigate whether levy-affected banks actually have substituted inter-bank liabilities by non-affected funds, in Section 3.5.2 I apply the difference-in-differences estimator outlined in equation (3.1) to equity and customer deposits.

3.4.3 Estimator for Risk Measures

Regarding a bank's funding risk, a substitution of inter-bank liabilities by equity would clearly strengthen a bank's capitalization rate and reinforce the Pigouvian effects found in Section 3.5.1. If inter-bank liabilities are instead substituted by customer deposits, the risk on the liability side of the balance sheet also decreases as customer deposits are insured in the legal deposit insurance scheme. Moreover, the positive effect on systemic risks in the banking sector remains as inter-connectedness of banks is reduced.

In Section 3.5.3 I finally apply the estimator in equation (3.1) to two common individual risk measures in the banking sector. The first captures a bank's funding risk by dividing equity by total assets. Second, I analyze the effect on the z-score, a measure for the probability of insolvency going back to Roy (1952), which is widely used in the banking literature (e.g. Laeven and Levine, 2009; Gropp et al., 2014; Schepens, 2016). It is calculated as the sum of the capital-to-assets ratio[6] and the return on assets, divided by the standard deviation of the return on assets.[7] Basically it measures the distance to insolvency by considering the volatility of a bank's profits and the capital that can absorb potential losses. The higher the z-score the lower is the insolvency risk.[8]

[6]Capital in the calculation of the z-score comprises equity and the bank's fund for general banking risk.

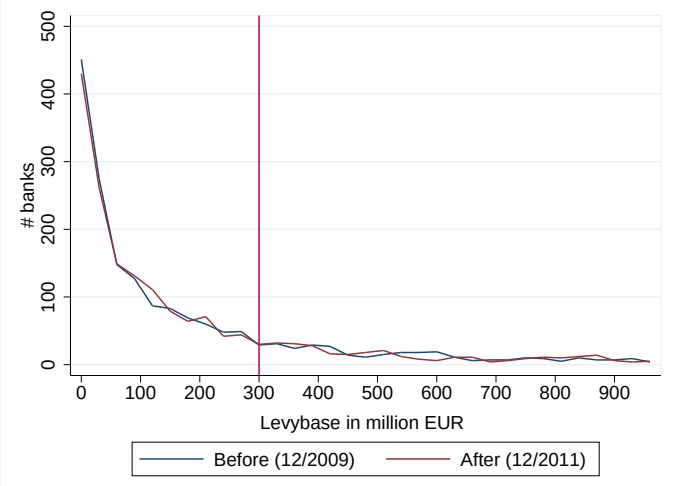
[7]See Lepetit and Strobel (2013) for a discussion of the z-score calculation in panel settings.

[8]It would also be interesting to study whether German banks adjusted their portfolio risk on the assets side of the balance sheet in response to the bank levy. Diemer (2017) models different types of bank levies and finds that a levy on liabilities can induce banks to behave more prudently. However, Devereux et al. (2017) find that European national bank levies have increased the average risk weight of assets and thus the portfolio risk (while decreasing the funding risk). Unfortunately, the Bundesbank database on German banks used here does not provide any information on a bank's assets risk; hence I cannot investigate how affected German banks adjusted their portfolio risk.

3.4.4 Threats to Identification

Bunching responses of banks could be a potential threat to identification: As there are kinks in the levy schedule, banks located in the range closely above the thresholds in the levy schedule could have strategically reduced their relevant liabilities. Figure 3.4 investigates this issue by examining the distribution of German banks over the levy base, both before and after the introduction of the German bank levy. It illustrates that the distribution remains relatively unchanged after the introduction of the bank levy. Most importantly, there is no excess mass below and no missing mass above the levy exemption threshold. Applying the bunching estimator for difference-in-differences settings developed by Kleven et al. (2014) confirms that there is no discontinuity at the levy exemption threshold. As there are only few banks per bin in higher ranges of the levy base, confidentiality requirements of the German central bank do not allow to show the distribution over the full range. However, applying the bunching estimator to the second kink in the levy schedule also does not show bunching evidence. For the range above €200 billion (the third kink in the levy schedule) there are only four banks, which makes a similar bunching analysis infeasible.

Figure 3.4: Distribution of Banks over the Levy base



Distribution of German banks over the tax base for the German bank levy. The bin size is €30 million. The red line indicates the first kink in the levy schedule at which the marginal levy rate increases from 0.00% to 0.02%. Source: Deutsche Bundesbank, banks' monthly balance sheet statistics.

Another potential threat to identification of the bank levy's effect with the difference-in-differences settings outlined above are other regulatory measures in the sample period that affect banks above and below the levy exemption threshold differently.

The European supervisory stress tests in 2010 and 2011 come to mind.[9] Of the 14 banks tested in Germany (in 2010, 12 banks in 2011), most are in the third or higher levy brackets which are not the main treatment group investigated here. Roughly calculating their levy bases using their publicly available 2010 annual reports[10] shows that only one screened bank is in the first levy bracket (Landesbank Berlin) and that this bank had a core capital ratio far beyond regulatory requirements, therefore not being seriously affected by the stress tests. In the second levy bracket, two of the fifteen banks are screened in the European stress tests in the sample period. As the bulk of stress tested banks is in higher levy brackets, potential banks' responses to stress tests should not severely influence my results, particularly not in the preferred treatment group of banks in the first levy bracket.

A further potential regulatory issue is the implementation of the Basel II.5 adjustments to capital requirements for trading positions and resecuritisations. In Germany this regulation entered into force in January 2012, one year after the introduction of the bank levy. Broader changes in capital requirements were announced in December 2010 with Basel III, but first measures were only implemented in 2013. Hence all these regulations only matter here if banks anticipated the adjustments years in advance, and only if they affected treated and control banks differently. However, it is not obvious why this should be the case - particularly when comparing banks in the first levy bracket to the alternative control group of banks having relevant liabilities between €150 million and the exemption threshold of €300 million. As these banks have very similar equity ratios (see Table 3.2), it is plausible that they were also exposed to the announcements of enhanced capital requirements in a similar way.

3.5 Funding Responses of Affected Banks

This section applies the estimation procedure described in Section 3.4 on banks' balance sheet data: First, I investigate whether banks respond with a reduction of the tax base. Afterwards, I consider whether banks substituted affected inter-bank liabilities with non-affected funds, namely equity and customer deposits.

[9] See Petrella and Resti (2013) for a discussion of the European bank stress tests.

[10] The banks' balance sheet statistics database of the Deutsche Bundesbank (2017b) is anonymized and does not provide bank names. For assessing the levy bracket of a particular bank I therefore have to rely on individual banks' publicly available balance sheets.

3.5.1 Direct Effect on the Levy Base

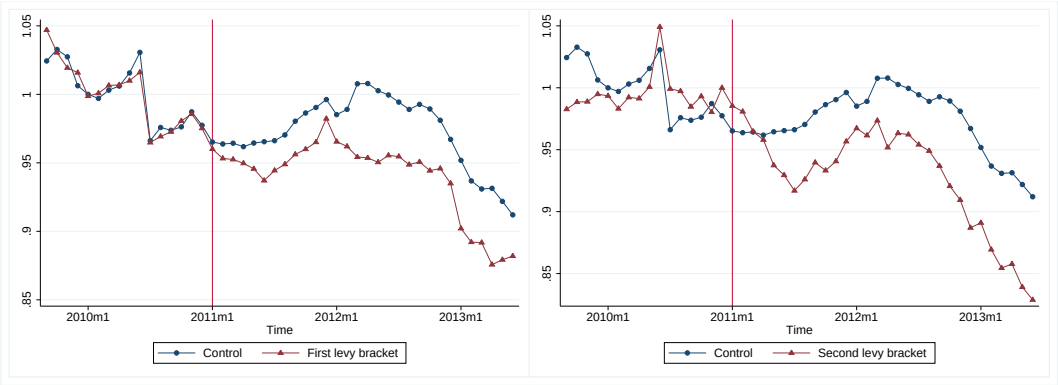
As a direct effect on the tax base, I expect that banks subject to the levy reduce their relevant liabilities, which should lead to more solidly financed banks, less inter-connectedness and hence a more stable financial sector. For the difference-in-differences estimator outlined in the previous section it is important that there is a common trend in the outcome during the pre-treatment period. The left panel of Figure 3.5 graphically compares the time trend in relevant liabilities of banks in the first levy bracket to the control group, the right panel analogously compares banks in the second levy bracket to the same control group. Particularly in the first levy bracket pre-treatment trends fit well to the control group, such that the common trends assumption is fulfilled. In the second levy bracket the time trend in relevant liabilities is also similar to the control group, even though the fit is not as good as for banks in the first treatment group. The obvious reason for this is that banks in the first levy bracket and in the control group are more similar in size and business models whereas banks in the second levy bracket are substantially larger than control banks. Another reason is that there are only 15 banks in the second levy bracket, which makes the time series more volatile.

Figure 3.5 also indicates first descriptive evidence for the intended Pigouvian effect of the bank levy. Relevant liabilities in both the first and the second levy bracket decrease after the introduction of the bank levy compared to the control group of non-affected banks. After a few months the time series then went back on a parallel trend again, with the gap between the control group and the treatment groups remaining quite stable.

Table 3.3 presents the results of applying the systematic difference-in-differences estimator outlined in Section 3.4.1 to the data. Consistent with Figure 3.5 the baseline results in column (1) show a significantly negative treatment effect in the first and the second levy bracket, with coefficients of -0.090 and -0.073. This corresponds to a reduction in relevant liabilities by about 8.6% in the first levy bracket and by about 7.0% in the second levy bracket.[11] This means that the estimated semi-elasticity is not larger in the second levy bracket despite the higher marginal levy rate. However note that the absolute response is much higher, as the share of relevant liabilities in banks' total assets is considerably larger in the second levy bracket (60% in 12/2010)

[11] As demonstrated by Halvorsen and Palmquist (1980), the percentage change in specifications with an explanatory dummy variable and a logarithmic dependent variable can be calculated from the estimated coefficient c according to $(\exp(c) - 1) * 100$.

Figure 3.5: Effect of the Bank Levy on Banks' Relevant Liabilities



Time trends in banks' relevant liabilities. The left figure compares banks in the first levy bracket (facing a marginal levy rate of 0.02%) to the control group of banks that are exempt from the bank levy. The right figure compares banks in the second levy bracket (facing a marginal levy rate of 0.03%) to the same control group. Series are normalized by the pre-treatment mean. The vertical line indicates the introduction of the German bank levy in January 2011. Source: Deutsche Bundesbank, banks' monthly balance sheet statistics.

than in the first bracket (34%).

Column (2) accounts for the fact that levy payments are capped at 20% of a bank's after-tax profit by excluding all observations from banks that are subject to the cap in the respective year. The cap particularly affects large banks, as in the first levy bracket only 8.9% to 11.6% (depending on the year in the sample period) of banks are capped, whereas 80% of banks in the second levy bracket are. For capped banks, incentives to reduce liabilities are lower. Nevertheless, I find virtually unchanged coefficients. The reason for the only small change is probably that banks cannot perfectly foresee their annual profit and whether the cap will be binding at the end of the year. An additional explanation is that the capped amount is carried forward up to two years. Note that the insignificance of the treatment effect in the second levy bracket might be due to the fact that there are now only three uncapped banks left, which might be insufficient for the identification of a significant effect.

TABLE 3.3: Baseline Regressions

	Dependent variable: *ln*(Levybase)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Treated}_1 \cdot \text{Post}$	-0.090***	-0.087***	-0.098***	-0.063***				
	(0.014)	(0.014)	(0.014)	(0.020)				
$\text{Treated}_2 \cdot \text{Post}$	-0.073**	-0.074	-0.067*	-0.033				
	(0.037)	(0.056)	(0.037)	(0.040)				
$\text{Treated} \cdot \text{Post}$					-0.077***	-0.065***	-0.097***	-0.061***
					(0.017)	(0.017)	(0.014)	(0.020)
ROA_{t-1}			3.030***	0.024			3.063***	7.283***
			(0.715)	(4.924)			(0.714)	(1.848)
Bank FE & monthly time FE	✓	✓	✓	✓	✓	✓	✓	✓
Control group	0-300m	0-300m	0-300m	150m-300m	0-300m	0-300m	0-300m	150m-300m
Only uncapped		✓				✓		
Observations	61,776	59,764	59,708	14,068	63,168	60,528	60,764	15,124
R^2	0.988	0.989	0.990	0.988	0.989	0.989	0.991	0.990

Dependent variable is the natural logarithm of relevant liabilities for the German bank levy. *Post* is a dummy equal to one for all months after 12/2010 (indicating the treatment period). $Treated_1$ is a dummy for banks in the first levy bracket (facing a marginal levy rate of 0.02%) and $Treated_2$ is a dummy for banks in the second levy bracket (marginal levy rate of 0.03%). *Treated* is a dummy that combines all levy brackets to a single treatment group, being equal to one if a bank has liabilities above the levy exemption threshold of €300 million. The control group are all banks below the threshold, except in columns (4) and (8) where the control group are banks with relevant liabilities between €150 million and €300 million. ROA_{t-1} is the annual lagged return on assets. In columns (2) and (6) all banks affected by the levy cap at 20% of after-tax profits are excluded. Robust standard errors clustered at the bank level in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

In another robustness check in column (3), I control for a bank's profitability by including the return on assets in the previous year (ROA_{t-1}, defined as after-tax profit divided by total assets) as explanatory variable. The estimated treatment effects are very similar to the baseline specification in column (1). The positive effect of ROA_{t-1} may reflect that more profitable banks are also more creditworthy, resulting in more borrowing. Column (4) provides a final robustness check by restricting the control group to banks with relevant liabilities between €150 million (corresponding to 50% of the exemption threshold) and the exemption threshold. I continue to find negative coefficients for the treatment indicators, although the effect is insignificant for the 15 banks in the second levy bracket.

In columns (5) to (8) I re-estimate these specifications without distinguishing between the different levy brackets. Here a bank is considered as treated simply if it is above the exemption threshold. Hence this treatment group now also includes banks in levy brackets above €100 billion and 25 banks that switch between different levy brackets during the sample period and were therefore dropped from the sample in columns (1) to (4). The estimated effects of the bank levy are very similar to the results in the previous specifications.

Taken together, I find strong evidence for a Pigouvian effect of the bank levy on the vast majority of banks in the first levy bracket. I also find a negative effect for banks in the second levy bracket, however there are only 15 banks in this second treatment group and the evidence is weaker.

3.5.2 Substitution by Equity and Deposits

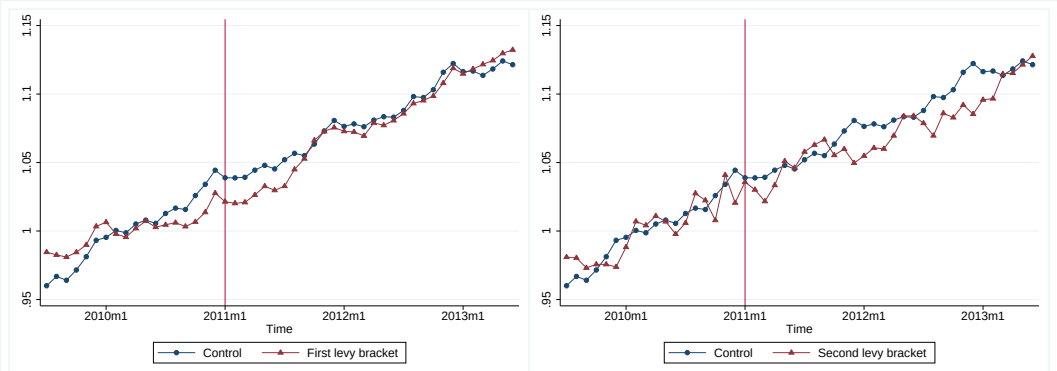
As the previous section has shown, the German bank levy reduced banks' relevant liabilities. However, for a further evaluation of the intended Pigouvian effect we have to investigate whether banks indeed reduced their business volume or whether they substituted affected liabilities by other non-affected funding options. The two potential balance sheet items to substitute with are customer deposits and equity.

To investigate the potential substitution in funding, this section applies the difference-in-differences estimator employed in the previous section to customer deposits and equity. To confirm the resulting change of banks' business volumes, I also investigate the effect on total assets. Figure 3.6a shows graphical evidence for customer deposits and Figure 3.6b for equity. For both balance sheet items, I find a generally positive trend, in the treatment and the control groups. Moreover, in all parts of Figure

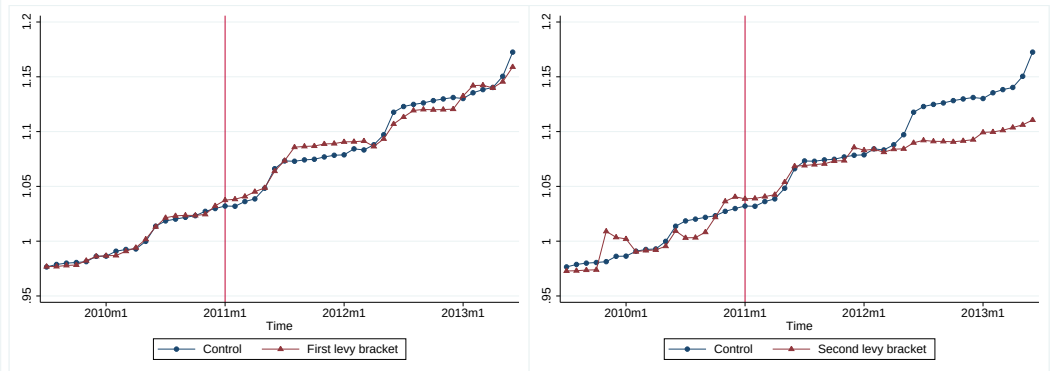
3.6 there is a parallel trend in treatment and control groups, as is required for the difference-in-differences estimator to be valid. However, there is no obvious treatment effect in customer deposits and equity after the introduction of the German bank levy in January 2011, indicating that there was no systematic substitution of inter-bank liabilities by equity and deposits.[12]

Figure 3.6: Trends in Banks' Non-Affected Liabilities

A: Effect of the bank levy on customer deposits



B: Effect of the bank levy on equity



Time trends in banks' customer deposits (Panel A) and equity (Panel B). The left figure compares banks in the first levy bracket (facing a marginal levy rate of 0.02%) to the control group of banks that are exempt from the bank levy. The right figure compares banks in the second levy bracket (facing a marginal levy rate of 0.03%) to the same control group. Series are normalized by the pre-treatment mean. The vertical line indicates the introduction of the German bank levy in January 2011. Source: Deutsche Bundesbank, banks' monthly balance sheet statistics.

[12]The time series on equity in Figure 3.6b shows that banks periodically increase equity in the mid of the year, when banks have held their annual general meetings and shareholders have decided about capital increases. However, the 15 banks in the second levy bracket strikingly deviate from this pattern in mid 2012 – as 80% of them are subject to the levy cap due to low profits in the after-treatment period, these banks probably also had not enough profits to increase their capital through retained earnings.

Table 3.4 shows regression results. For both customer deposits and equity, I do not find significantly positive effects as we would expect if banks switch to these unaffected liabilities. Estimated coefficients for the interaction term between the *Post* dummy and the treatment dummies for the first and the second levy bracket are statistically insignificant in all specifications. These results on potential substitution funds therefore suggest that banks did not systematically elude bank levy payments by replacing inter-bank liabilities with deposits or equity. This also means that there is no additional strengthening of banks' equity bases that would have reinforced the intended Pigouvian effect of the bank levy found in the previous section.

As both customer deposits and equity are relatively inflexible, banks might not respond with a discrete increase in these balance sheet items, but change their strategy of generating funds. Such a strategy change towards equity and deposits would translate into an increase in the growth rates of these funds, but does not immediately lead to a significant increase in their levels. To test this issue, in Appendix C.2 I apply the difference-in-differences estimator also to growth rates of customer deposits and equity. Again I do not find evidence for a switch to alternative funds, with most treatment indicators being insignificant. I only find a weakly significant negative effect on equity growth of banks in the second levy bracket. As a negative effect is clearly not in line with a strategy change towards equity funding, it may reflect that these banks had relatively low profits that were available for increasing equity – 80% of banks in the second levy bracket are affected by the levy cap due to low profits.

Together with the results from the previous section, these findings suggest that levy-affected banks respond by a decrease in their business volume. To test this explicitly, I apply the difference-in-differences estimator to the natural logarithm of banks' total assets. Results in columns (7) to (9) of Table 3.4 confirm that banks in the first levy bracket reduced their relevant liabilities by 2.7% to 3.4% compared to the control group of non-affected banks, whereas banks in the second bracket reduced their liabilities by 6.7% to 7.8%. The absolute and relative differences of these effects compared to the percentages changes estimated for the levy base in Table 3.3 reflect the different shares of relevant liabilities in total assets: The larger banks in the second levy bracket are financed considerably more by inter-bank liabilities than the smaller banks in the first levy bracket.

TABLE 3.4: Regressions on Customer Deposits, Equity and Total Assets

	Dep. var.: *ln*(Customer deposits)			Dep. var.: *ln*(Equity)			Dep. var.: *ln*(Total assets)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{Treated}_1 \cdot \text{Post}$	-0.004	-0.012	-0.014	-0.012	-0.009	0.008	-0.033***	-0.035***	-0.027***
	(0.016)	(0.009)	(0.010)	(0.010)	(0.008)	(0.010)	(0.009)	(0.007)	(0.009)
$\text{Treated}_2 \cdot \text{Post}$	-0.019	-0.012	-0.014	0.002	0.003	0.022	-0.081***	-0.076***	-0.069**
	(0.028)	(0.028)	(0.028)	(0.039)	(0.039)	(0.040)	(0.027)	(0.027)	(0.028)
ROA_{t-1}		1.570	-5.455		-0.225	4.834		0.803**	-0.887
		(1.180)	(10.401)		(0.215)	(4.386)		(0.392)	(5.617)
Bank FE & monthly time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Control group	0-300m	0-300m	150m-300m	0-300m	0-300m	150m-300m	0-300m	0-300m	150m-300m
Observations	61,341	59,561	14,020	61,004	59,704	14,064	61,776	59,708	14,068
R^2	0.988	0.994	0.992	0.997	0.998	0.996	0.997	0.998	0.996

Dependent variables are the natural logarithms of customer deposits in columns (1) to (3), of equity in columns (4) to (6) and of total assets in columns (7) to (9). *Post* is a dummy equal to one for all months after 12/2010 (indicating the treatment period). $Treated_1$ is a dummy for banks in the first levy bracket (facing a marginal levy rate of 0.02%) and $Treated_2$ is a dummy for banks in the second levy bracket (marginal levy rate of 0.03%). The control group are all banks below the levy exemption threshold of €300 million, except in columns (3), (6) and (9) where the control group are banks with relevant liabilities between €150 million and €300 million. ROA_{t-1} is the lagged return on assets. Robust standard errors clustered at the bank level in parentheses. *** and ** indicate significance at the 1% and 5% levels, respectively.

As a robustness test, Appendix C.3 shows results for these regressions on alternative funds and total assets with combining all banks above the exemption threshold to one single treatment group. Similarly, there is no significant treatment effect on customer deposits and equity in all but one specification. In column (2), I find a weakly significant coefficient, however as it is negative it also does not suggest a substitution of levy-affected funds by equity. The effects on total assets confirm previous findings of a decrease by about 3.1% to 4.2%.

3.5.3 Effect on Risk Measures

As shown in the previous sections, German banks indeed decreased the tax base in response to the introduction of the bank levy in 2011. As there is no effect on customer deposits and equity, the decline in inter-bank liabilities should translate into more solidly financed banks and a positive effect on bank risk measures. This section investigates the effect of the German bank levy on two risk measures: the equity-to-assets ratio and the z-score.

Table 3.5 shows regression results of the difference-in-differences setting. As directly implied by the previous results, I find positive effects on equity-to-total-assets ratios of banks in the first levy bracket in columns (1) and (2). Estimates indicate that the bank levy increased the equity-to-total-assets ratios by about 0.16 to 0.2 percentage points. At the pre-treatment mean of banks in the first levy bracket (5.0%) this corresponds to an increase by 3% to 4%. In line with these results, I find that z-scores of banks in the first levy bracket have increased after the introduction of the German bank levy by 2.948 compared to the control group of non-affected banks. Note that I can only use annual data for the z-score regressions, as the required information on profits is only available on a yearly basis. When restricting the control group to banks with relevant liabilities between €150 million and €300 million, a similar positive coefficient arises. This means that after the introduction of the German bank levy the probability of insolvency of affected banks in the first levy bracket indeed has declined. As Hannan and Hanweck (1988) and Boyd et al. (1993) point out, the z-score measure Z allows to calculate an upper bound for the probability of insolvency p according to $p \leq Z^{-2}$. Applying this formula to the z-score in December 2009 implies an average pre-treatment mean of the insolvency probability in the first levy bracket of 0.089%. The estimated effects in columns (3) and (4) imply a reduction at the mean to 0.076%, i.e. roughly a 15% decrease.

However, for banks in the second levy bracket I find no significant evidence for positive effects on banks' risk, neither with the equity-to-total-assets ratios nor with the z-scores. Reasons for this may again be the small number of banks in the second levy bracket and that banks in the second levy bracket are substantially larger than banks in the control group. If I combine all treatment groups to one single treatment group I find very similar results for the bank levy effects on equity ratios in columns (3) and (4). I also continue to find positive effects on banks' z-scores in columns (7) and (8), however, they are now considerably larger than for the first treatment group and insignificant. This hints to a large volatility of profits in the very large banks that influences results here.

Table 3.5: Regressions on Risk Measures

	Dep. var.: Equity/TA (%)				Dep. var.: Z-score			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treated_1 \cdot Post$	0.205**	0.161**			2.948**	2.857**		
	(0.105)	(0.070)			(1.414)	(1.416)		
$Treated_2 \cdot Post$	0.117	0.072			0.127	0.035		
	(0.127)	(0.101)			(60.998)	(61.177)		
$Treated \cdot Post$			0.186*	0.146**			5.559	5.467
			(0.104)	(0.069)			(3.793)	(3.802)
Bank FE & time FE	✓	✓	✓	✓	✓	✓	✓	✓
Control group	0-300m	150m-300m	0-300m	150m-300m	0-300m	150m-300m	0-300m	150m-300m
Observations	61,654	15,031	63,046	16,464	6,200	1,445	6,305	1,550
R^2	0.932	0.905	0.932	0.897	0.992	0.992	0.987	0.987

Dependent variable is the equity-to-total-assets ratio in columns (1) to (4) and the z-score in columns (5) to (8). Monthly data in columns (1) to (4) and annual data in columns (5) to (8). *Post* is a dummy equal to one for all months after 12/2010 (indicating the treatment period). $Treated_1$ is a dummy for banks in the first levy bracket (facing a marginal levy rate of 0.02%) and $Treated_2$ is a dummy for banks in the second levy bracket (marginal levy rate of 0.03%). *Treated* is a dummy that combines all levy brackets to a single treatment group, being equal to one if a bank has liabilities above the exemption threshold of €300 million. The control group are all banks below the levy exemption threshold of €300 million, except in columns (2), (4), (6) and (8) where the control group are banks with relevant liabilities between €150 million and €300 million. Robust standard errors clustered at the bank level in parentheses. ** and * indicate significance at the 5% and 10% levels, respectively.

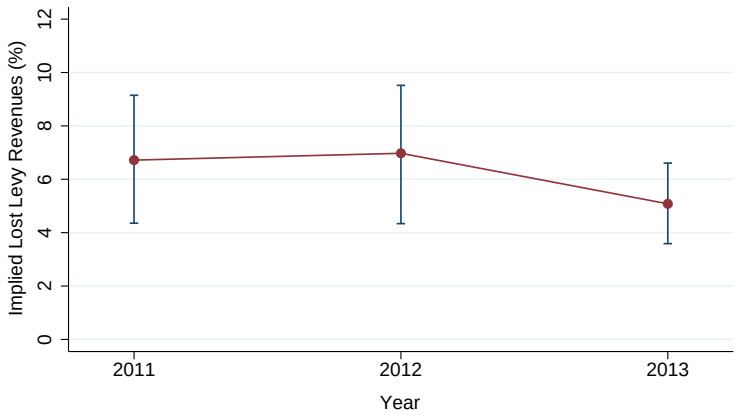
3.5.4 Implications for Levy Revenues

The decrease in affected banks' levy bases directly implies a decrease in the government's levy revenues. The revenue losses are not completely identical to the levy base effects estimated in Table 3.3 because of two reasons: First, if banks had not decreased their levy base, they might have been in a higher levy bracket with higher levy rates,

implying an even stronger effect on levy revenues. Second, if banks had not reduced their levy bases, more banks would have been subject to the levy cap equal to 20% of the bank's after-tax profit, inhibiting the effect on levy revenues.

To get a feeling for the implied levy revenue losses due to the banks' responses, I conduct a back-of-the-envelope calculation using the results of the baseline regression in column (5) of Table 3.3. I first calculate two out-of-the-sample predictions of each bank's *ln*(Levybase): One is a prediction with the actual data in my model, giving the predicted log levy bases of my model. The second is calculated by setting the treatment indicator to zero, giving a hypothetical value in case that the bank levy would not have been introduced. By taking the exponential of these predicted values, I arrive at an out-of-the-sample-prediction for the actual levy base and the hypothetical levy base that banks would have had without the bank levy.[13] Then I divide the difference between these two predictions by the predicted actual levy revenues and arrive at a percentage value describing how much higher levy revenues would have been if banks had not adjusted their levy bases.

Figure 3.7: Implied Effect on Bank Levy Revenues



Lost bank levy revenues due to the reduction in relevant liabilities as share of predicted actual revenues. Lost revenues are calculated as the difference between levy revenues implied by an out-of-the sample prediction for regression (5) in Table 3.3 with the treatement indicator set to zero, and levy revenues implied if the treatment indicator is equal to one in the treatment period. Bars show 95% confidence intervals implied by the regression. Source: Deutsche Bundesbank, banks' monthly balance sheet statistics (December data).

[13] As Bårdsen and Lütkepohl (2011) show, using the exponential of the log forecast yields reasonable predictions for the levels of a variable.

Figure 3.7 illustrates results for this procedure using December data for the treatment years in my sample (as December data are the relevant data for the calculation of bank levy payments). The bars illustrate a confidence interval, resulting when using the upper and lower boundaries of the 95% interval of the treatment coefficient in column (5) of Table 3.3 when calculating predictions of the hypothetical levy bases. The point estimates imply that levy revenues would have been 5.1% (in 2013) to 7.0% (in 2012) higher without adjustments in the levy bases. Applying these estimates to the actual levy revenues illustrated in Figure 3.3 shows that levy revenues would have been up to €46 million higher. This means that banks' balance sheet adjustments explain only a relatively small share of the gap between actual and planned bank levy revenues. The major part of the revenue shortfall is due to the fact that the legislator based its predictions on pre-crisis balance sheets, in which banks had higher profits and the levy cap was therefore binding for a smaller share of banks than was true after the crisis.

Note that the calculated implied levy revenue loss here is a rather conservative estimate, as I implicitly assume that banks' profits would remain unchanged. In fact the foregone funds would have created additional profits which increased levy caps and thereby revenues. I also do not consider potential adjustments in the derivative component of the bank levy. Moreover, the effect that the reduction in banks' systemic risk has on state budgets is probably of much higher importance: As shown in Section 3.5.3, affected banks' insolvency risk decreases on average by about 15%, reducing expected costs for potential bank bail-outs in the future.

3.6 Shifting to Foreign Subsidiaries

The previously presented results suggest that the German bank levy indeed had the intended Pigouvian effect on affected banks' balance sheets. However, multinational banks have the possibility to partially circumvent the bank levy as the law does not affect legally independent foreign subsidiaries of German banks. By reducing relevant liabilities in their German entities and foreign branches and increasing them (and the related activities) in foreign subsidiaries, multinational banks can avoid bank levy payments without actually reducing overall liabilities. This section examines whether German multinational banks used this possibility to avoid levy payments. Therefore, I look at potential destinations for the fund shifting by evaluating the evolution of relevant liabilities in non-affected foreign subsidiaries of affected German bank groups. Then, I estimate how this weakens the positive effects found in the previous sections.

3.6.1 Data and Empirical Strategy

If levy-affected German multinational banks indeed have shifted liabilities in response to the introduction of the German bank levy in 2011, we should observe an increase in liabilities in the potential destination entities, namely in their foreign subsidiaries in countries without bank levies. In line with the previous sections, the straightforward way to evaluate this hypothesis would be to compare foreign subsidiaries of levy-affected German banks with foreign subsidiaries of non-affected German banks. However, the problem with this approach is that almost all German banks with foreign subsidiaries have relevant liabilities of at least €300 million and are thus affected by the bank levy, leaving us without an appropriate control group for the foreign subsidiaries of levy-affected banks.

As an alternative, I compare subsidiaries of German banks with matched non-German banks. All data are taken from Bankscope, an international banks balance sheet statistics database from Bureau van Djik. Bankscope data have several drawbacks compared to the administrative data on German banks used in the previous sections. First, variables in Bankscope are only available with annual frequency, therefore this part of the analysis is conducted on a yearly basis. Second, Bankscope does not provide a full sample of all German bank subsidiaries. As the Bundesbank data show, there are 50 foreign subsidiaries of German banks in countries that do not have a bank levy by 2011 and are therefore potential destinations for fund shifting. In Bankscope I can only observe 37 of them, indicating a 74% coverage of affected subsidiaries. And third, Bankscope data is less detailed than Bundesbank data. This means that I cannot calculate levy bases of bank subsidiaries as precisely as in the previous sections. Thus, I use total assets minus equity and customer deposits as dependent variable here, which is a reasonably good approximation of the actual tax base for the bank levy.[14]

To get a set of control banks that is comparable to the foreign subsidiaries of German banks and that exhibits a parallel pre-treatment trend in the outcome variable, I conduct a two-stage matching procedure along the lines of Schepens (2016). In the first stage, I conduct a within-country matching for each country without a bank levy (by 2011) in which German banks have foreign affiliates. Therefore, I first estimate a logit regression with data from the pre-treatment year 2009. The sample consists

[14] According to aggregate reports on German banks from Deutsche Bundesbank (2017a), the approximation for the levy base used in this section is, on average, only 1.1% higher in the sample period than the actual levy base (as calculated in the previous sections).

of all German bank subsidiaries and non-German banks[15] from Bankscope in the considered country for which I observe all relevant variables during the full period under consideration. I remove all bank subsidiaries whose parent resides in a country with bank levies from the donor pool, as they might also have a shifting incentive and are therefore also potentially treated.

The dependent variable in the matching equation is a dummy equal to one for German banks and zero for non-German banks. In line with the matching equation employed by Schepens (2016), explanatory variables are the natural logarithms of the levy base, equity and deposits and the contemporaneous and the lagged growth rates of the levy base (to match non-German banks that have parallel trends in liabilities). Then, I calculate predicted probabilities of the logit model and match to each German bank subsidiary its three nearest non-German neighbors from the same country (with replacement).

This procedure is repeated for all countries. As in some countries Bankscope does not provide a sufficient donor pool of non-German banks, I then do a second round matching which is not restricted to banks within the same country to get the missing matches.[16] To ensure that banks from similar countries are matched, I now include country level explanatory variables (natural logarithms of GDP and population) in the matching equation. The resulting sample of this two round matching procedure consists of 37 German bank subsidiaries and 111 matched non-German banks. 68% of all matched banks come from the within-country matching round, the remainder is matched in the second round.

I then use this sample to systematically investigate the shifting hypothesis by estimating the following equation:

$$ln(\text{Levybase}_{ijt}) = \beta_0 + \beta_1 \text{ German}_{ij} \cdot \text{Post}_t + \beta_2 X_{jt} + \gamma_{ij} + \delta_t + \epsilon_{ijt} \tag{3.2}$$

where j indicates countries, i is a bank index and t indexes years here. $German_{ij}$ is a dummy equal to one for foreign subsidiaries of German multinational banks (the potential destinations for funds) and zero for all matched non-German banks. $Post_t$

[15]Ownership information in Bankscope is incomplete and I cannot identify with certainty whether a bank is a subsidiary of a foreign bank or a domestic bank. To get a sufficiently large donor pool for the matching procedure, I therefore use the full set of non-German banks, both domestic and foreign-owned.

[16]Countries in which a second round matching is necessary are Albania, Armenia, Bosnia and Herzegovina, Brazil, Czech Republic, Democratic Republic of Congo, Ecuador, Honduras, Ireland, Netherlands, Nicaragua and Turkey.

indicates the treatment period after the introduction of the bank levy. X_{jt} is a vector of country level control variables and consists of the GDP growth rate, the inflation rate and the statutory corporate tax rate. γ_{ij} and δ_t capture bank and year fixed effects, respectively, and ϵ_{ijt} is the error term.

In a robustness check, I only use one bank (the nearest neighbor) per German bank subsidiary as control group. Results are presented along with the baseline results in the next section. In Appendix C.4, I conduct two further robustness checks on the matching procedure: First, I exclude growth rates from the matching equation and match only on the levels of the levy base, equity and deposits in the first pre-treatment period. This accounts for the potential concern that matching on growth rates mechanically produces parallel pre-treatment trends. Although results in this setting are somewhat weaker, I still find shifting evidence. The second robustness check considers the sample: Instead of Bankscope I use comprehensive and precise Bundesbank data on foreign subsidiaries of German banks and compare them to a control group of matched German domestic banks that are not affected by the bank levy. With the drawback that this setting suffers from limited comparability of treatment and control groups, results again confirm the shifting hypothesis.

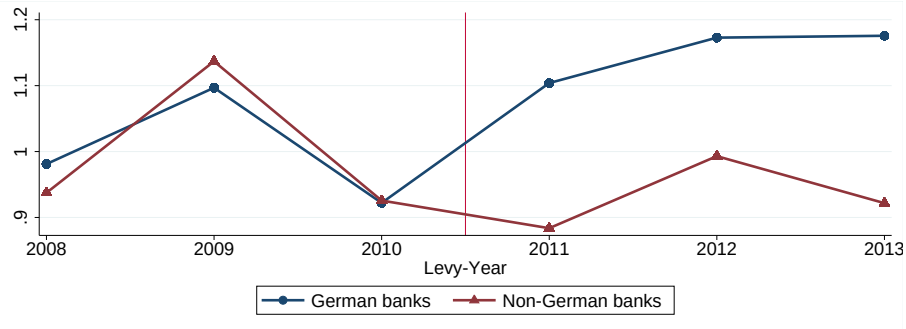
3.6.2 Results on Fund Shifting

Figure 3.8 shows some first graphical evidence for the shifting hypothesis: Prior to the introduction of the German bank levy there is a similar trend in relevant liabilities of German bank subsidiaries in non-levy countries and the matched set of control banks. Beginning with balance sheets relevant for the levy in 2011,[17] relevant liabilities in foreign subsidiaries of German banks increased compared to the control group of non-German banks, which is in line with the shifting hypothesis examined here.

Panel A of Table 3.6 presents the corresponding regression results on the levy base. I find a positive coefficient of 0.177 for the interaction term between *German* and *Post* in column (1) which is significant on the 3% level, in line with the prediction of the fund shifting hypothesis. This estimate indicates an increase of the levy base due to the German bank levy by about 19% compared to the matched non-German banks. When controlling for country characteristics in column (2), the estimated treatment effect remains very similar at 0.162. Restricting the control group to only one nearest

[17] The relevant balance sheet for the levy is the balance sheet of December in the previous year. Therefore, levy bases e.g. for the first levy year 2011 are calculated with balance sheet data from 12/2010.

Figure 3.8: Trends in Foreign Subsidiaries' Relevant Liabilities



Time trend in levy bases of banks in countries without bank levies. The blue line shows relevant liabilities of German bank subsidiaries in these countries. The red line depicts relevant liabilities of matched non-German banks. Series are normalized by the pre-treatment mean. The vertical line indicates the introduction of the German bank levy. Data: Bankscope.

neighbor per German bank subsidiary in columns (3) and (4) confirms this finding with even larger coefficients.

Panel B of Table 3.6 reports results of the same regressions for the equity-to-total-assets ratio. Results mirror the findings on relevant liabilities: Equity ratios in German bank subsidiaries declined after the introduction of the German bank levy compared to the matched non-German banks. However, the coefficient is significant only in the one-to-one matching sample in columns (3) and (4).

Overall, the results show that German multinational banks indeed increased their liabilities in non-affected foreign subsidiaries, thus deteriorating their capitalization after the introduction of the German bank levy. Therefore, the analysis provides evidence that German banks indeed shifted their liabilities abroad, as was feared by some members of the German parliament.

3.6.3 Influence on Baseline Results

The shifting of inter-bank liabilities to foreign subsidiaries weakens the positive effect of the German bank levy on the capitalization of the core banks found in Section 3.5.1. Abstracting from adjustments in the portfolio risk of affected banks, the shifting means that German entities become less risky whereas the default risk of foreign subsidiaries increases. However, the risk is now separated from the core institute and a potential default of the foreign subsidiary affects the German parent only up to the investment it made into the subsidiary in terms of equity and internal loans. Apart from this weakened positive effect on the riskiness of multinational banks, there is still the unaffected

Table 3.6: Regressions on Fund Shifting

Panel A: Levy base regressions

	Dep. var.: *ln*(Levybase)			
	(1)	(2)	(3)	(4)
German · Post	0.177**	0.162**	0.231**	0.224**
	(0.083)	(0.081)	(0.110)	(0.098)
GDP growth		-0.054		-0.280
		(0.299)		(0.456)
Inflation rate		-0.015*		-0.014
		(0.008)		(0.011)
Corporate tax rate		3.368***		3.725
		(1.135)		(2.745)
Bank FE & year FE	✓	✓	✓	✓
# of matched control banks per treated bank	3	3	1	1
Observations	1,036	1,036	518	518
R^2	0.954	0.955	0.940	0.940

Panel B: Equity ratio regressions

	Dep. var.: Equity/TA (%)			
	(1)	(2)	(3)	(4)
German · Post	-0.873	-0.807	-2.036*	-1.929*
	(0.826)	(0.937)	(1.110)	(1.109)
GDP growth		0.751		6.053
		(3.446)		(4.597)
Inflation rate		0.052		-0.026
		(0.096)		(0.115)
Corporate tax rate		-17.101		-47.827*
		(13.062)		(27.667)
Bank FE & year FE	✓	✓	✓	✓
# of matched control banks per treated bank	3	3	1	1
Observations	1,036	1,036	518	518
R^2	0.802	0.802	0.783	0.781

Dependent variable is the natural logarithm of relevant liabilities for the German bank levy in Panel A, and the equity-to-total-assets ratio (in %) in Panel B. The sample comprises 37 foreign subsidiaries of levy-affected German banks in countries without bank levies and matched non-German banks. Three matches per German bank, except in column (3) where I use only one nearest neighbor per German bank as control. *German* is a dummy equal to one for subsidiaries of German banks and zero for non-German banks. *Post* is a dummy indicating the treatment period in which the bank levy was in place. Annual data for 2007 to 2013 from Bankscope. Robust standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

positive effect on the capitalization of banks without subsidiaries in non-levy countries that cannot engage in fund shifting. To investigate to which extent fund shifting influences the overall effect on inter-bank liabilities, this section consolidates data including foreign subsidiaries of German banks and re-estimates regression equation (3.1), investigating a potential treatment effect heterogeneity between multinational and non-multinational banks. By including a dummy for whether a bank has foreign subsidiaries in countries without bank levies, I can distinguish effects of the levy on banks without shifting possibility from effects on banks that can shift liabilities to foreign subsidiaries.

Table 3.7 presents the results. Column (1) shows that consolidating foreign subsidiaries does not considerably affect the baseline result found in Table 3.3: The estimated treatment effect is basically unchanged. In column (2), I add an interaction term between the treatment indicator and the variable $Multi$, a dummy equal to one if the bank is multinational and has foreign subsidiaries in non-levy countries. The coefficient for $Treated \cdot Post$ now measures the pure effect of the bank levy on banks that do not have a shifting possibility.

The results suggest an absolutely larger treatment effect of -8.1% on these banks, compared to the overall effect of -7.5% in column (1). This means that the shifting possibility of multinational banks reduces the average effect by about 7%. Regarding multinational banks that have potential subsidiaries to shift to, the t-test in the last line of column (2) (testing the null hypothesis $Treated \cdot Post + Treated \cdot Post \cdot Multi = 0$) shows that there is no significant effect on their consolidated levy base. Columns (3) and (4) repeat the analysis with controlling for the core banks' profitability and find very similar results. When restricting the control group to banks with levy bases between €150 million and €300 million, I confirm the effect already found with the data on the core institutes in Table 3.3. When interacting with the $Multinational$ dummy, I again find that the absolute effect increases for banks without a shifting possibility. There is also no significant effect on consolidated levy bases of potential shifting banks.

In columns (7) to (10) of Table 3.7 I find analogous results for banks' equity-to-total-assets ratios. When distinguishing between multinational and non-multinational banks in columns (8) and (10), the positive effect of the bank levy on banks' equity ratios increases slightly. By contrast, the effect on consolidated equity ratios of banks with potential shifting subsidiaries is not significant.

TABLE 3.7: Regressions with Consolidation of Foreign Subsidiaries

	Dep. var.: *ln*(Levybase)						Dep. var.: Equity/TA (%)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Treated · Post	-0.078***	-0.085***	-0.098***	-0.108***	-0.062***	-0.072***	0.182*	0.191*	0.137**	0.147**
	(0.017)	(0.017)	(0.014)	(0.014)	(0.020)	(0.020)	(0.104)	(0.105)	(0.068)	(0.071)
Treated · Post · Multi		0.099**		0.128***		0.126***		-0.141		-0.137
		(0.041)		(0.040)		(0.040)		(0.145)		(0.146)
Multi	0.213*	0.138	0.229**	0.133	0.232**	0.137	2.255***	2.361***	2.215***	2.318***
	(0.110)	(0.115)	(0.105)	(0.109)	(0.096)	(0.101)	(0.709)	(0.730)	(0.700)	(0.719)
ROA_{t-1}			3.063***	3.063***	7.295***	7.216***				
			(0.714)	(0.714)	(1.860)	(1.867)				
Bank FE & Time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Control group (million €)	0-300	0-300	0-300	0-300	150-300	150-300	0-300	0-300	150-300	150-300
Observations	63,168	63,168	60,764	60,764	15,124	15,124	63,046	63,046	16,423	16,423
R^2	0.989	0.989	0.991	0.991	0.990	0.990	0.932	0.932	0.896	0.896
Treat. effect multi. (p-val.)		0.713		0.613		0.197		0.751		0.956

Dependent variables are the natural logarithm of the levy base in columns (1) to (6) and the equity-to-total-assets ratio in columns (7) to (10). *Post* is a dummy equal to one for all months after 12/2010 (indicating the treatment period). $Multi$ is a dummy indicating whether a bank is a multinational bank having foreign subsidiaries in countries without bank levies. $Treated$ is a dummy equal to one for banks affected by the German bank levy because of having relevant liabilities above the exemption threshold of €300 million. The control group are all banks below the levy exemption threshold of €300 million, except in columns (5), (6), (9) and (10) where the control group are banks with relevant liabilities between €150 million and €300 million. ROA_{t-1} is the lagged return on assets. The last line reports p-values of testing the null hypothesis $Treated \cdot Post + Treated \cdot Post \cdot Multi = 0$. Robust standard errors clustered at the bank level in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Taken together, the results suggest that the German bank levy succeeded in reducing the potentially risk-transmitting inter-bank liabilities in German core institutes. However, multinational banks use their possibility to circumvent the levy by relocating affected liabilities to non-affected foreign subsidiaries, weakening the overall effect. As multinational banks with potential shifting subsidiaries held 18% of total relevant liabilities (in 12/2009), the quantitative effect of this way to circumvent the bank levy is considerable.

3.7 Conclusion

More and more countries have introduced bank levies as part of their efforts to prevent future financial crises. Additional to the revenue motive, these levies have a Pigouvian intention as they are thought to reduce potentially risk-transmitting inter-bank liabilities and make banks more stable. This chapter exploits the design of the German bank levy by comparing levy-affected banks with banks that are below the exemption threshold using a difference-in-differences methodology. I find evidence for a direct negative effect of the bank levy on relevant inter-bank liabilities, implying that bank levies indeed reduce potentially risk-transmitting funds and thereby systemic risks in the financial sector. As a result, business volumes of affected banks decreased and capitalization and funding risk improved. However, I also find evidence that multinational banks shifted affected funds to non-affected foreign subsidiaries. For banks having this possibility, the negative effect on inter-bank liabilities vanishes. Since the distress of large multinational banks is a particular threat to the stability of the whole banking sector, it is important to close this loophole.

The results of this analysis are not only relevant for the German case considered here, but also for the newly introduced European bank levy. The Single Resolution Board now imposes levies without exempting smaller banks or setting caps, and the levy payment is still a positive function of liabilities net of equity and deposits. This means that all European banks subject to the bank levy now have an incentive to lower their relevant liabilities and to shift funds to non-European subsidiaries to lower their levy payments.

Conclusion

This dissertation has considered the taxation of the financial sector, investigating empirically the effectiveness of different tax instruments in the banking sector. Two of the three essays look at ways how banks avoid corporate tax payments, the third essay evaluates banks' responses to bank levies – a new bank-specific tax instrument introduced after the financial crisis.

All essays have in common that they empirically examine legal ways for banks to circumvent the considered tax instrument. Chapter 1 has shown that banks strategically locate the highly profitable business unit of proprietary trading to low-taxed affiliates. As they do not correspondingly relocate their traders, this tax avoidance channel can be classified as profit shifting rather than a relocation of real activity. In Chapter 2 I investigate the extent to which banks engage in internal debt shifting, presumably the most important of the classical profit shifting channels identified in previous literature on non-financial sectors. Results show that banks shift substantially more profits via internal debt than non-banks do. This extensive profit shifting evidence renders the standard corporate tax a rather ineffective instrument for taxing the multinational financial sector. Chapter 3 analyzes a new bank-specific tax instrument: By taxing inter-bank liabilities, bank levies cannot only generate additional revenues, but they can also achieve the Pigouvian goal of reducing potentially risk-transmitting funds. But again I find that banks having a possibility to circumvent the levy make use of this levy avoidance channel.

All these results show that it is a special challenge for policymakers to effectively tax the financial sector. Regardless of whether the tax has a Pigouvian intention or a purely fiscal objective, banks use their available channels to avoid tax payments. These strong avoidance reactions to taxation are inherent to the nature of the banking business: Major parts of it are highly internationally mobile and can be transferred to other countries without actually shifting customers or employees. Moreover, banks are inherently experts in the profit-maximizing optimization of financial transactions.

Whereas other multinationals have to buy tax-planning advisory services from external consulting firms, banks already have a substantial knowledge within the firm. It is self-evident that they use his knowledge also for their own accounts.

In the light of this great potential for tax avoidance, it is surprising that legal regulations on corporate taxation are very lax in the financial sector. For instance, several countries exclude banks from being affected by their controlled-foreign-corporation rules that should prevent profit shifting (e.g. the United States and Germany). In the case of bank levies, some of the countries that have introduced a levy do not tax foreign subsidiaries. As found in Chapter 3, this enables multinational banks to shift funds to these non-affected affiliates.

Peralta et al. (2006) provide an explanation for these lax regulations: Countries may deliberately choose not to prevent profit shifting, as it allows policymakers to tax domestic banks at higher rates, and at the same time to attract highly mobile, large international banks. This dilemma can only be tackled with international cooperation in the taxation and regulation of banks. Also the Organization for Economic Co-operation and Development (OECD) has recognized the special role of the financial sector and has updated its action plan on base erosion and profit shifting with a special passage covering the challenges that the financial sector poses to the legislator (OECD, 2016). Although the specific proposals of the action plan are vague, the results of my thesis suggest that the fundamental idea of international harmonization is necessary to ensure that banks contribute an adequate share to the public budget, reflecting the risks they pose to the whole economy.

Appendices

A Appendix to Chapter 1

A.1 Corporate Tax Rates on Bank Profits

Table A.1: Corporate Tax Rates (CTR) Affecting Banks' Trading Gains in %

Country	2011		2014	
	CTR general	CTR banks	CTR general	CTR banks
Argentina	35	35	35	35
Australia	30	30	30	30
Austria	25	25	25	25
Belgium	34	34	34	34
Brazil	34	40	34	40
Bulgaria	10	10	10	10
Canada	28	28	26.5	26.5
Cayman Islands	0	0	0	0
Chile	20	20	20	20
China	25	25	25	25
Curaçao	34.5	34.5	27.5	27.5
Czech Republic	19	19	19	19
Denmark	25	25	24.5	24.5
Finland	26	26	20	20
France	34.43	34.43	34.43	34.43
Germany	30	30	30	30
Greece	20	20	26	26
Hong Kong	16.5	0*	16.5	0*
Hungary	19	19	19	19
India	32.44	32.44	33.99	33.99
Indonesia	25	25	25	25
Iran	25	25	25	25
Ireland	12.5	12.5	12.5	12.5
Italy	31.4	32.15	31	31.7
Japan	40.69	40.69	35.64	35.64
Jersey	0	10	0	10
Korea	24.2	24.2	24.2	24.2
Luxembourg	28.8	28.8	29.22	29.22
Malaysia	25	25	25	25
Malta	35	35	35	35
Mauritius	15	15	15	15
Mexico	30	30	30	30
Netherlands	25	25	25	25
New Zealand	28	28	28	28
Norway	28	28	27	27
Pakistan	35	35	33	33
Peru	30	30	30	30
Philippines	30	30	30	30
Poland	19	19	19	19
Portugal	25	25	23	23

Table A.1: Corporate tax rates (CTR) affecting banks' trading gains, continued

Country	2011		2014	
	CTR general	CTR banks	CTR general	CTR banks
Qatar	10	10	10	10
Russian Federation	20	20	20	20
Saudi Arabia	20	20	20	20
Singapore	17	0*	17	0*
Slovakia	19	19	22	22
South Africa	34.55	34.55	28	28
Spain	30	30	30	30
Sri Lanka	28	0*	28	0*
Sweden	26.3	26.3	22	22
Switzerland	21.17	21.17	21.15	21.15
Taiwan	17	17	17	17
Thailand	30	30	20	20
Turkey	20	20	20	20
Ukraine	23	23	18	18
United Arab Emirates	0	20	0	20
United Kingdom	26	26	21	21
United States	39.19	39.19	39.08	39.08
Vietnam	25	25	22	22

Tax rate data from Ernst & Young (2011, 2014) and KPMG (2016). CTR denotes statutory corporate tax rates. * indicates special tax rates applying to corporate capital gains such as gains from proprietary trading, not only to banks. Countries listed are all countries in which German banks have affiliates.

A.2 Variable Definitions

Table A.2: Variable Definitions and Sources

Variable	Definition	Source
Bundesbank Data		
Fixed-income trading assets	Bonds and debt securities held for trading	Deutsche Bundesbank (2015a)
Trading derivatives	Absolute sum of derivatives with positive and negative fair value that are held for trading	Deutsche Bundesbank (2015a)
Total assets	Total external assets held in the affiliate	Deutsche Bundesbank (2015a)
Bank group total assets	Total assets in all affiliates and in the headquarter of a bank group	Deutsche Bundesbank (2015a)
Employees	Number of employees in the affiliate	Deutsche Bundesbank (2015b)
Subsidiary dummy	=1 if foreign affiliate is a separate legal entity	Deutsche Bundesbank (2015a)
Bankscope Data		
Trading assets	Total trading assets at fair value	Bankscope
Total assets	Total assets of the affiliate	Bankscope
Personnel expenses	Annual personnel expenses	Bankscope
Country-level variables		
Corporate tax rate	Statutory tax rate applicable to bank profits in the form of corporate capital gains	Ernst & Young (2011, 2014)
GDP	Nominal gross domestic product, interpolated from quarterly to monthly values using the proportional Denton method (Bloem et al., 2001)	IMF, OECD*
Inflation rate	Consumer price inflation rate	IMF*
GDP growth	Annual growth rate of real GDP	IMF*
Financial sector share	Share of the banking and insurance sector in a country's gross value added, monthly values interpolated using cubic spline interpolation	OECD*
Regulation	Index on the regulation of securities activities (securities underwriting, brokering, dealing, and all aspects of the mutual fund industry); unrestricted = 1, permitted with limits = 2, tight restriction = 3, prohibited = 4	Barth et al. (2013)
Country average wage	Average wage in current prices	OECD*

Data sources marked with a * are complemented by data from national statistical offices available online.

A.3 Analysis with Bankscope Data

To show that our results also hold in a more international sample, we also test both hypotheses using Bureau van Dijk's Bankscope data. As noted in Section 3.3, Bankscope has several problems regarding its coverage. A major disadvantage is that it does not cover branches.

We use Bankscope data from 2002 to 2014.[1] We consider a bank a subsidiary if the parent bank owns more than 50% of its shares. We use only unconsolidated data and eliminate central banks and governmental credit institutions from our sample. After dropping all observations with missing or negative total assets, loans or trading assets, 3,744 firm-year observations remain. The sample covers 971 subsidiaries, which belong to 667 bank groups. Table A.3 presents the basic descriptives for this dataset.

Table A.3: Descriptive Statistics for Bankscope Data

Variable	Obs.	Mean	Std. Dev.	p1	p50	p99
Trading assets (million USD)	3,744	1,500	15,490	0	4	28,390
Total assets (million USD)	3,744	21,490	105,400	37	2,425	310,000
Corporate tax rate	3,744	0.324	0.093	0.000	0.373	0.400
Nominal GDP (billion USD)	3,744	7,896	7,222	16	3,545	17,351
Inflation rate (%)	3,744	2.259	2.169	-0.666	1.957	9.297
GDP growth (%)	3,744	1.882	2.960	-2.861	1.787	10.169
Regulation	3,744	2.060	0.956	1	2	3
Financial sector share	3,744	0.065	0.022	0.031	0.067	0.110
Personnel expenses (million USD)	3,480	211	1,325	1	28	3,510
Country average wage (USD)	3,480	46,774	21,139	2,509	52,438	94,881

Data from Bankscope database of Bureau van Dijk (2014). All variables on annual frequency for 2002 to 2014.

As the Bankscope dataset is not complete and is missing information on foreign branches, we cannot exactly identify which bank groups are active internationally and which are not. We thus run our regressions on two subsamples: First, we use the full sample, which also includes purely domestic banks (sample I). Second, we restrict the sample to banks that either have at least one subsidiary in a foreign country within the Bankscope data, or are themselves a subsidiary of an internationally active bank group (sample II). As Bankscope does not have full coverage of all affiliates, this sample selection step implies that we also drop some banks that were, in fact, multinational.

[1] Note that Bankscope is no longer available. Bureau van Dijk replaced it with Orbis Bank Focus at the end of 2016. Orbis Bank Focus contains only three years of historical data for most banks and has similar coverage issues as Bankscope.

Table A.4 presents the estimation results, testing Hypothesis 1 in Panel A and Hypothesis 2 in Panel B. In Panel A, we regress the inverse hyperbolic sine of overall trading assets on the corporate tax rate and a set of control variables. Columns (1) and (2) show the results for sample I, and columns (3) and (4) for the smaller sample II. We find that a 1%-point decrease in the tax rate increases trading assets by 8.2% in sample I, and by 6.7% in sample II.[2] In columns (2) and (4), we report results including country fixed effects. The point estimates are negative also in these regressions, but not significant. This is likely because there is little variation in the tax rates, and almost no variation in tax havens.[3]

Due to the lack of sufficient variation in tax rates, we also cannot use the corporate tax rate as an instrument for trading assets when testing Hypothesis 2. The corporate tax rate is a weak instrument in all settings. Thus, we instrument the trading assets of an affiliate by the total volume of trading assets in all other affiliates of the same bank group. These results are reported in Panel B of Table A.4.[4] The dependent variable in these regressions is the inverse hyperbolic sine of personnel expenses. As we now observe only personnel expenses, not the number of employees, we additionally control for the average wage in the country. We find that the volume of trading assets does not significantly affect personnel expenses in low-tax countries (countries with a lower tax rate than the headquarter of the affiliate). By contrast, in high-tax countries we find again significantly positive effects of trading assets on personnel expenses both with and without country fixed effects. In total, these results again confirm Hypothesis 2.[5]

[2]The fact that we find a smaller coefficient in sample II indicates that some banks that are only in sample I react strongly to tax rates. Likely, these banks use branches in other countries.

[3]Only for 379 (out of 3744) observations the tax rate changes, and most of those are in Italy (131), the United Kingdom (76) and Bulgaria (24); in tax havens, there is only one observation with a tax rate change (in Curaçao).

[4]Panel B shows results only for sample I. Using sample II, we find very similar results.

[5]Unfortunately, the first stage F-statistics indicate a weak instrument problem in the regressions for low-tax countries. As we have no other plausible instrument available, we nevertheless report these results and acknowledge that the instrumental variable estimations are likely biased.

TABLE A.4: Regressions with Bankscope Data

Panel A: Effects on proprietary trading

	Sample I		Sample II	
	(1)	(2)	(3)	(4)
Corporate tax rate	-8.182***	-3.900	-6.731**	-10.641
	(-3.18)	(-0.49)	(-2.23)	(-1.21)
Controls	Yes	Yes	Yes	Yes
Year & Bank group FE	Yes	No	Yes	No
Country FE	No	Yes	No	Yes
R^2	0.847	0.596	0.621	0.420
Observations	3,744	3,744	1,393	1,393

Panel B: Effects on real activity (sample I only)

	IV: Trading others			
	Low-tax	High-tax	Low-tax	High-tax
	(1)	(2)	(3)	(4)
IHS(Trading)	-0.051	0.305***	-0.021	0.294***
	(-0.01)	(5.46)	(-0.00)	(5.49)
Controls	Yes	Yes	Yes	Yes
Year & Bank group FE	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	Yes
First stage F	2.051	167.781	2.621	182.044
Observations	976	2,428	973	2,428
Centered R^2	0.783	0.548	0.867	0.573

Data from Bankscope database of Bureau van Dijk (2014). The dependent variable in Panel A is IHS(Trading assets), and in Panel B IHS(Personnel expenses). Control variables are IHS(Total assets), IHS(GDP), inflation, GDP growth, financial sector share and regulation in Panel A and IHS(GDP), inflation, GDP growth, financial sector share, subsidiary dummy, IHS(country average wage) and regulation in Panel B. Sample I includes all banks, sample II is a sub-sample of banks that have at least one foreign subsidiary within the Bankscope dataset. Yearly bank data for 2002-2014. t-statistics in parentheses, based on bootstrapped standard errors clustered by bank group and by country-year.

B Appendix to Chapter 2

B.1 Variable Definitions

Table B.1: Variable Definitions and Sources

Variable	Definition
Bank-level variables from Deutsche Bundesbank (2015a)	
Internal liabilities (*IntLiab*)	Liabilities to affiliates of the same bank group
Internal claims	Claims to affiliates of the same bank group
Internal net debt (*IntNetDebt*)	Volume of internal liabilities that effectively shift profits out of an affiliate, defined as $\max(IntLiab - InternalClaims; 0)$
Total assets (*TA*)	Total external assets held in the affiliate
Conduit debt	Internal liabilities that are effectively passed through an affiliate, because being opposed to internal claims of the same amount; defined as $\min(InternalClaims; IntLiab)$
Conduit share	Share of internal liabilities that are passed through an affiliate, defined as $\min(\frac{InternalClaims}{IntLiab}; 1)$
Country-level variables	
Corporate tax rate (CTR)	Statutory corporate tax rate affecting banks (Source: Ernst & Young, 2011, 2014)
GDP	Nominal gross domestic product, proportional Denton method (Bloem et al., 2001) used to interpolate from quarterly to monthly values (Source: IMF, OECD*)
Inflation rate	Consumer price inflation rate (Source: IMF*)
GDP growth	Annual growth rate of real GDP (Source: IMF*)
Financial sector share	Share of the banking and insurance sector in a country's gross value added, monthly values interpolated using cubic spline interpolation (Source: OECD*)
Capital requirement	Minimum regulatory capital requirement for banks (Source: World Bank, 2011)
Regulatory index	Index on capital regulation, capturing whether capital requirements are adjusted for individual risk of banks, whether the regulatory capital is adjusted for certain market value losses and whether certain funds may be used to capitalize a bank; ranging from 0 (low stringency) to 10 (high stringency) (Source: Barth et al., 2013)

Data sources marked with a * are complemented by data from national statistical offices.

B.2 Conduit Share Regressions

Table B.2: Regressions on Affiliates' Conduit Shares

Dep. var.:	Conduit share in internal debt		
	(1)	(2)	(3)
CTR	-0.550***	-0.527***	-0.347***
	(0.048)	(0.047)	(0.044)
IHS(TA)	-0.005***	0.006***	-0.001
	(0.001)	(0.001)	(0.001)
IHS(Population)	-0.032***	-0.034***	-0.037***
	(0.003)	(0.003)	(0.003)
Inflation rate	0.018***	0.022***	0.016***
	(0.001)	(0.001)	(0.001)
GDP growth	0.011***	0.015***	0.006***
	(0.001)	(0.001)	(0.001)
Financial sector share	0.407***	0.387***	0.361***
	(0.062)	(0.062)	(0.059)
Headquarter	0.379***	0.372***	0.468***
	(0.009)	(0.009)	(0.010)
Regulatory index	-0.029***	-0.028***	-0.025***
	(0.002)	(0.002)	(0.002)
Capital requirement	-3.091***	-3.580***	-5.598***
	(0.489)	(0.487)	(0.445)
Monthly time FE		✓	✓
Bank group FE			✓
R^2	0.127	0.147	0.345
Observations	19,754	19,754	19,754

Dependent variable is the share of conduit debt in total internal liabilities as defined by $\max(\frac{InternalClaims_{it}}{InternalLiabilities_{it}}\ ;\ 1)$. $IHS(TA)$ is the inverse hyperbolic sine of affiliate i's total assets. *Financial sector share* is the share of the banking and insurance sector in a country's gross value added. *Headquarter* is a dummy indicating whether affiliate i is a German headquarter. *Regulatory index* captures the stringency of capital regulation in a country, ranging from 0 to 10 (higher values indicating greater stringency). Standard errors in parentheses. Monthly bank data for 06/2010-12/2015 from the External Positions of Banks database of Deutsche Bundesbank (2015a).

C Appendix to Chapter 3

C.1 Variable Definitions

Table C.1: Variable Definitions and Sources

Variable	Definition
Bank-level variables from Deutsche Bundesbank (2017b):	
Total Liabilities	Balance sheet total of a bank
Equity	Equity capital of a bank
Customer deposits	All liabilities to non-banks (customers)
Profit participation capital	Profit participation capital of a bank
Fund for general banking risk	Reserves for general banking risks
Levy base	Tax base for the German bank levy, calculated as *Total Liabilities - Equity - Customer deposits - Profit participation capital - Fund for general banking risk*; when using Bankscope data, the levy base is approximated by *Total Liabilities - Equity - Customer deposits*
Return on assets (ROA)	Profits after taxes divided by balance sheet total, annual variable (December)
Equity/TA	Equity-to-total-assets ratio of a bank in %
Z-score	Measure for the probability of insolvency of a bank going back to Roy (1952), calculated as *(Capital/Total Assets + ROA) / sd(ROA)* where *Capital = Equity + Fund for general banking risk* and *sd(ROA)* is the standard deviation of a bank's return on assets in the sample period
Treated_1	Dummy variable equal to one if the bank is in the first levy bracket in the whole sample period, having a levy base between €300 million and €10 billion and facing a marginal levy rate of 0.02% in the treatment period
Treated_2	Dummy variable equal to one if the bank is in the second levy bracket in the whole sample period, having a levy base between €10 billion and €100 billion and facing a marginal levy rate of 0.03% in the treatment period
Treated	Dummy variable equal to one if the bank is above the levy exemption threshold of €300 million in the whole sample period
Post	Dummy variable equal to one from January 2011 when the German bank levy was introduced, indicating the treatment period

Table C.1: Variable Definitions and Sources, continued

Variable	**Definition**
German	Dummy variable equal to one if the bank is a foreign subsidiary of a German multinational bank and zero if it is a non-German bank
Multi	Dummy variable equal to one if the bank group is multinational and has foreign subsidiaries in countries that have not introduced bank levies by the end of 2011
Country-level variables from Ernst & Young (2011, 2014), IMF and national statistical offices:	
Corporate tax rate	Statutory tax rate applicable to bank profits
GDP	Nominal gross domestic product
GDP growth	Annual growth rate of gross domestic product
Inflation rate	Consumer price inflation rate
Population	Population of a country

C.2 Growth Rates of Equity and Deposits

Table C.2: Regressions on Growth Rates of Equity and Deposits

Panel A: Separate treatment groups

	Dep. var.: Annual growth rate of customer deposits (%)			Dep. var.: Annual growth rate of equity (%)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Treated}_1 \cdot \text{Post}$	87.409	-1.041	-14.514	0.962	0.092	-0.126
	(77.263)	(21.718)	(15.635)	(1.982)	(0.509)	(0.452)
$\text{Treated}_2 \cdot \text{Post}$	80.102	14.497	-2.778	-1.346	-3.146*	-3.136*
	(71.192)	(14.338)	(3.902)	(2.347)	(1.891)	(1.832)
Control for ROA_{t-1}		✓	✓		✓	✓
Bank & time FE	✓	✓	✓	✓	✓	✓
Control group	0-300m	0-300m	150m-300m	0-300m	0-300m	150m-300m
R^2	0.047	0.092	0.171	0.049	0.279	0.503
Observations	61,335	59,558	14,020	61,147	59,708	14,068

Panel B: Combined treatment groups

	Dep. var.: Annual growth rate of customer deposits (%)			Dep. var.: Annual growth rate of equity (%)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Treated} \cdot \text{Post}$	-53.171	3.051	-12.784	0.494	-0.711	-0.695
	(159.340)	(20.119)	(14.897)	(1.895)	(0.632)	(0.601)
Control for ROA_{t-1}		✓	✓		✓	✓
Bank & time FE	✓	✓	✓	✓	✓	✓
Control group	0-300m	0-300m	150m-300m	0-300m	0-300m	150m-300m
R^2	0.043	0.093	0.166	0.049	0.272	0.385
Observations	62,714	60,614	15,076	62,539	60,764	15,124

Dependent variables are the annual growth rates of customer deposits in columns (1) to (3), and of equity in columns (4) to (6). *Post* is a dummy equal to one for all months after 12/2010 (indicating the treatment period). $Treated_1$ is a dummy for banks in the first levy bracket (facing a marginal levy rate of 0.02%) and $Treated_2$ is a dummy for banks in the second levy bracket (marginal levy rate of 0.03%). *Treated* is a dummy that combines all levy brackets to a single treatment group, being equal to one if a bank has liabilities above the exemption threshold of €300 million. The control group are all banks below the levy exemption threshold of €300 million, except in columns (3) and (6) where the control group are banks with relevant liabilities between €150 million and €300 million. ROA_{t-1} is the lagged return on assets. Robust standard errors clustered at the bank level in parentheses. * indicates significance at the 10% level.

C.3 Equity and Deposits Regressions with Combined Treatment Group

Table C.3: Combined Treatment Group Regressions on Equity, Deposits and Total Assets

	Dep. var.: *ln*(Customer deposits)			Dep. var.: *ln*(Equity)			Dep. var.: *ln*(Total assets)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treated · Post	-0.004	-0.012	-0.013	-0.012	-0.015*	0.005	-0.031***	-0.043***	-0.033***
	(0.016)	(0.009)	(0.009)	(0.010)	(0.008)	(0.010)	(0.011)	(0.008)	(0.009)
ROA_{t-1}		1.587	-5.358		-0.171	8.298***		0.842**	6.239***
		(1.175)	(10.518)		(0.239)	(1.259)		(0.400)	(0.951)
Bank FE & monthly time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Control group	0-300m	0-300m	150m-300m	0-300m	0-300m	150m-300m	0-300m	0-300m	150m-300m
Observations	62,709	60,617	13,348	62,396	60,760	15,124	63,168	60,764	15,124
R^2	0.988	0.994	0.994	0.997	0.998	0.996	0.996	0.998	0.996

Dependent variables are the natural logarithms of customer deposits in columns (1) to (3), of equity in columns (4) to (6) and of total assets in columns (7) to (9). *Post* is a dummy equal to one for all months after 12/2010 (indicating the treatment period). *Treated* is a dummy equal to one for banks affected by the German bank levy because of having relevant liabilities above the exemption threshold of €300 million. The control group are all banks below the levy exemption threshold of €300 million, except in columns (3), (6) and (9) where the control group are banks with relevant liabilities between €150 million and €300 million. ROA_{t-1} is the lagged return on assets. Robust standard errors clustered at the bank level in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

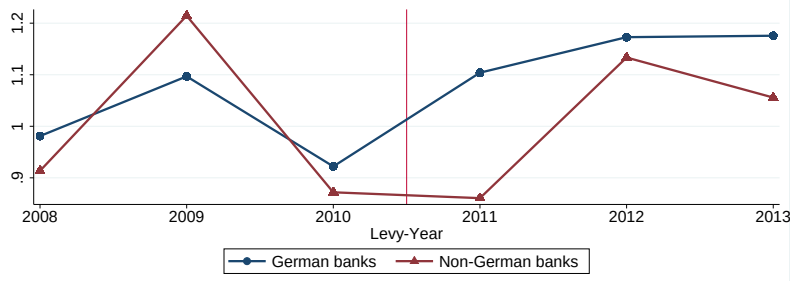
C.4 Robustness Tests on Fund Shifting Regressions

This section provides robustness tests for the fund shifting hypothesis tested in Section 3.6, both on the econometric specification and on the sample: First, I test whether the results hold with alternative matching variables that do not include growth rates of the dependent variable. Second, I switch to data on foreign subsidiaries provided by Deutsche Bundesbank (2017b) and use German domestic banks as alternative control group. Results are largely robust to these checks.

C.4.1 Alternative Matching Variables

One concern with the matching procedure suggested by Schepens (2016) is that the parallel pre-treatment trend is produced mechanically by including the contemporaneous and the lagged growth rates of the dependent variable into the matching equation. As a first robustness test, I therefore change the matching variables: Here I only match on the levels of the levy base, equity and deposits in the first pre-treatment year in the sample (2008) and do not include any growth rates or multiple periods that may mechanically push the resulting time series to a parallel trend.[1] All other specifications are as explained in Section 3.6.

Figure C.1: Trends in Subsidiaries' Liabilities with Alternative Matching



Time trend in levy bases in countries without bank levies. The blue line shows relevant liabilities of German bank subsidiaries in these countries. The red line depicts relevant liabilities of matched non-German banks. Series are normalized by the pre-treatment mean. The vertical line indicates the introduction of the German bank levy. Source: Bankscope.

Figure C.1 illustrates the time trends of levy bases in the treatment group and the matched control group. Not surprisingly, the pre-treatment fit is not as good as when including growth rates into the matching equation. However, qualitatively there are

[1] In the second round matching I still include *ln*(GDP) and *ln*(Population) into the matching equation to ensure that banks from similar countries are matched.

still the same pre-treatment trends in the treatment and control groups, and they still diverge with the introduction of the German bank levy: From 2010 to 2011 the levy base in German bank subsidiaries increased whereas it slightly decreased in the matched non-German control banks.

Table C.4 presents regression results with this alternatively matched control group. The treatment effect in the baseline specifications with three matches per German bank in columns (1) and (2) is positive, but smaller than in Table 3.6 and insignificant. When restricting the control group to the best match for each bank in columns (3) and (4), I again find similar significant effects as estimated in Table 3.6. Results on equity ratios in columns (5) to (8) consistently show a -1.5 percentage point effect of the levy that is significant in two of the four regressions.

C.4.2 German Control Banks

A second robustness check regards the quality of the Bankscope sample. Instead of matching non-German banks as control group for foreign subsidiaries of German banks, I here match to each foreign subsidiary in countries without bank levies a German domestic bank that is not affected by the bank levy (because being below the exemption threshold). The advantage of this approach is that I can use precise and complete data on all 50 potential destination subsidiaries of German banks from the balance sheet statistics database of the Deutsche Bundesbank (2017b). However, the comparison of foreign subsidiaries of multinational banks to German domestic banks might be problematic as they are active in potentially very different markets.

The matching procedure is analogous to the one employed in Section 3.6: In a first stage, I estimate a logit regression for the last pretreatment period with a dummy equal to one for foreign subsidiaries as dependent variable. Again in the spirit of Schepens (2016), matching variables are the natural logarithms of equity, customer deposits, the contemporaneous and two annual lags of the levy base and the contemporaneous and three lagged semiannual growth rates of the levy base. Based on the predicted probabilities I then match to each foreign subsidiary in non-levy countries a German control bank.

Figure C.2 graphically shows average levy bases in these treatment and control groups. The fit of the time trends is not as good as in the baseline setting in Section 3.6, as levy bases in matched German domestic banks are more volatile. But still there is a gap after the introduction of the German bank levy in 2011, which graphically indicates

Table C.4: Regressions on Fund Shifting with Alternative Matching

Panel A: Levy base regressions

	Dep. var.: *ln*(Levy base)			
	(1)	(2)	(3)	(4)
German · Post	0.053	0.056	0.188*	0.186*
	(0.088)	(0.087)	(0.111)	(0.111)
GDP growth		-0.316		-0.472
		(0.320)		(0.485)
Inflation rate		-0.007		-0.012
		(0.007)		(0.010)
Corporate tax rate		3.950**		4.250
		(1.669)		(2.413)
Bank FE & year FE	✓	✓	✓	✓
# of matched control banks per treated bank	3	3	1	1
Observations	1,036	1,036	518	518
R^2	0.953	0.953	0.945	0.946

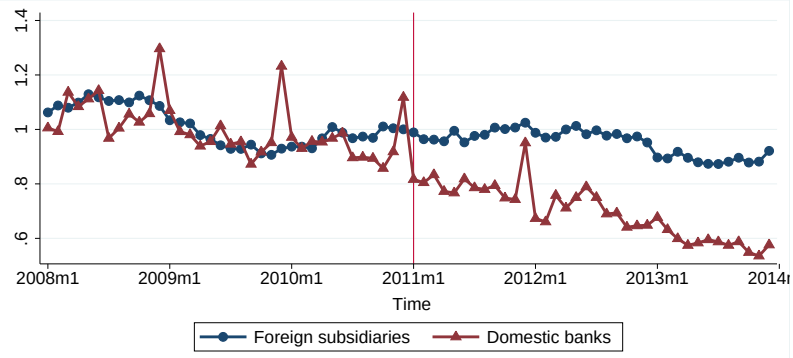
Panel B: Equity ratio regressions

	Dep. var.: Equity/TA (%)			
	(1)	(2)	(3)	(4)
German · Post	-1.524*	-1.565*	-1.545	-1.522
	(0.915)	(0.912)	(1.421)	(1.418)
GDP growth		2.581		7.307
		(3.345)		(6.208)
Inflation rate		-0.003		-0.022
		(0.071)		(0.128)
Corporate tax rate		-55.199***		-58.759*
		(17.455)		(30.879)
Bank FE & year FE	✓	✓	✓	✓
# of matched control banks per treated bank	3	3	1	1
Observations	1,036	1,036	518	518
R^2	0.774	0.776	0.720	0.723

Dependent variable is the natural logarithm of relevant liabilities for the German bank levy in Panel A, and the equity-to-total-assets ratio (in %) in Panel B. The sample comprises 37 foreign subsidiaries of levy affected German banks in countries without bank levies and matched non-German banks. Three matches per German bank, except in column (3) where I use only one nearest neighbor per German bank as control. *German* is a dummy equal to one for subsidiaries of German banks and zero for non-German banks. *Post* is a dummy indicating the treatment period in which the bank levy was in place. Annual data for 2007 to 2013 from Bankscope. Robust standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

that there was fund shifting.

Figure C.2: Trends in Subsidiaries' Liabilities with German Control Banks



Time trend in levy bases of German bank subsidiaries in countries without bank levies (blue line) and the control group of matched German domestic banks (red line). Series are normalized by the pre-treatment mean. The vertical line indicates the introduction of the German bank levy. Source: Deutsche Bundesbank, banks' monthly balance sheet statistics.

In a second step, I repeat the fund shifting regression estimated in Section 3.6 using this sample. Table C.5 presents results. I find again a significantly positive treatment effect of 0.278 on levy bases, and 0.211 when including macro-economic control variables. These estimates are in line with the results found in Section 3.6, with coefficients being even larger. In column (3) I again find a correspondingly negative treatment effect on equity ratios, however when including country level control variables in column (4) it gets absolutely smaller and insignificant.

Taken together, these robustness tests confirm the finding in Section 3.6 that German multinational banks used their possibilities to circumvent the bank levy by relocating affected inter-bank liabilities to foreign subsidiaries in countries that have not introduced a levy.

Table C.5: Regressions on Fund Shifting with German Control Banks

	Dep. var.: *ln*(Levy base)		Dep. var.: Equity/TA (%)	
	(1)	(2)	(3)	(4)
Foreign Subsidiary · Post	0.278***	0.211***	-0.988***	-0.126
	(0.028)	(0.032)	(0.362)	(0.419)
GDP growth		0.001		0.142***
		(0.004)		(0.049)
Inflation rate		-0.009*		0.108
		(0.006)		(0.072)
Corporate tax rate		0.185		4.105
		(0.366)		(4.792)
Bank FE & year FE	✓	✓	✓	✓
Observations	13,584	12,562	13,584	12,562
R^2	0.898	0.901	0.815	0.816

Dependent variable is the natural logarithm of relevant liabilities for the German bank levy in columns (1) and (2), and the equity-to-total-assets ratio (in %) in columns (3) and (4). The sample consists of foreign subsidiaries of levy affected German banks in countries without bank levies and matched German domestic banks. *Foreign Subsidiary* is a dummy equal to one for foreign subsidiaries of German banks and zero for matched German domestic banks. *Post* is a dummy equal to one for all months after 12/2010 (indicating the treatment period). Monthly data for 2008 to 2013 from Deutsche Bundesbank (2017b). Robust standard errors in parentheses. *** and * indicate significance at the 1% and 10% levels, respectively.

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