# Trading Offshore: Evidence on Banks' Tax Avoidance*

Dominika Langenmayr
KU Eichstätt-Ingolstadt
and CESifo

Franz Reiter
University of Munich

March 2017

**Abstract**

Little is known about how banks shift profits to low-tax countries. Because of their specific business model, banks use different profit shifting channels than other firms. We propose a novel and bank-specific method of profit shifting: the strategic relocation of proprietary trading to low-tax jurisdictions. Using regulatory data from the German central bank, we show that a one percentage point lower corporate tax rate increases banks' proprietary fixed-income trading assets by 2.2% and trading derivatives by 6.3%. This increase does not arise from a relocation of real activities (i.e. traders); instead, it stems from the relocation of book profits.

**Keywords:** Profit Shifting, Multinational Banks, Corporate Taxation, Proprietary Trading

**JEL Classification:** H25, G21, F21

---

*We thank Mihir Desai, Tom Gresik, Andreas Haufler, Ken Okamura, Martin Simmler, Hans-Werner Sinn, John Vella and participants of the 2nd MaTax meeting in Mannheim, the 6th Doctoral Meeting of the Oxford University Centre for Business Taxation, and of seminars in Augsburg and Munich for helpful comments and suggestions. Dominika Langenmayr visited Oxford University Centre for Business Taxation while working on this paper; she is grateful for their hospitality. She also gratefully acknowledges financial support from the German Research Foundation (LA 3565/1-1) and the Bundesbank. Franz Reiter gratefully acknowledges financial support from the Egon-Sohmen-Foundation. We also thank Deutsche Bundesbank for granting access to the External Position of Banks database.

# 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, Drechsler, and Schnabl, 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.

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 loans to shift substantial amounts to low-tax countries.[1] At the same time, research has shown that internal debt is not a quantitatively very important 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, Dell'Ariccia, and Peria, 2007). In this paper, 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

[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).

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 proprietary trading to shift profits to low-tax countries. Proprietary trading is very profitable, so relocating it 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 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 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 2.2% on average, and trading derivatives by 6.3%. We also document that banks are reluctant to shift profits away from headquarters. 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, international dataset.

In all regressions, we find tax semi-elasticities ranging from -2.2 to -9.31. Comparing these results 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 make up about a third of banks' profits (Bundesbank, 2016), 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

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

set the trading strategies), or transfer only the book assets to lower-taxed affiliates. The second strategy is usually interpreted 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 an increase in proprietary trading assets results in additional employment in relatively highly taxed affiliates, but not in low-taxed affiliates. This finding confirms that the tax-induced relocation of proprietary trading is indeed a profit-shifting strategy.

We also document that taxes are a quantitatively important determinant of the location of trading assets. Using our estimated semi-elasticities we conduct back-of-the-envelope calculations on the implied potential tax savings. Assuming a conservative 1% return to proprietary trading, the German government lost tax revenues corresponding to about 16% of total German tax revenue paid by banks in 2015.

Our paper contributes to three separate strands of literature. First, it adds to the literature on the determinants of global bank activities by describing how corporate taxation influences the location of proprietary trading assets. Previous literature focusses on other determinants of the banks international asset choice, such as expropriation risk (Dell'Ariccia and Marquez, 2010) and regulation (Buch, 2003). Second, 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, Hackethal, and Karabulut (2017) 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 on proprietary trading.

Third, we also contribute to the literature on the effect of taxation on the location of corporate activities and corporate profits (for a survey see Devereux and Loretz, 2013) 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, Voget, and Wagner (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

[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.

marginal effect of taxation is similar in both groups. Gu, de Mooij, and Poghosyan (2015) show that bank debt reacts to both corporate tax rates and within-firm tax differentials, indicating profit shifting by internal debt. Most closely related to our paper is Merz and Overesch (2016), who 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 paper, Merz and Overesch (2016) do not differentiate between profit shifting, the relocation of real activity, or a change in the amount or profitability of the proprietary trading activities.

The following section provides some background on proprietary trading and the taxation of banks. Section 3 discusses our hypotheses and presents the identification strategy. Section 4 describes the data sets. Section 5 discusses our main results, using the Bundesbank data; Section 6 confirms our results using the Bankscope data set. Section 7 concludes.

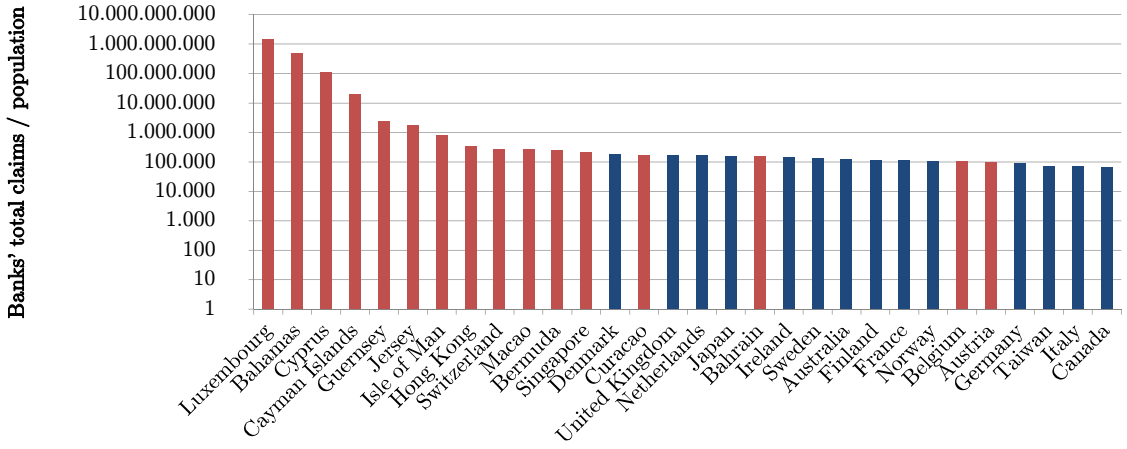
# 2 Background: Proprietary Trading and Tax Incentives

Banks are very active in tax havens, as Figure 1 shows. However, Figure 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.

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 (see Figure 2). In our international Bankscope sample, gains from proprietary trading account on average for 39% of banks' pre-tax profits. It 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 trading, profit from being close to

FIGURE 1: Banks are very active in tax havens




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 (2016).

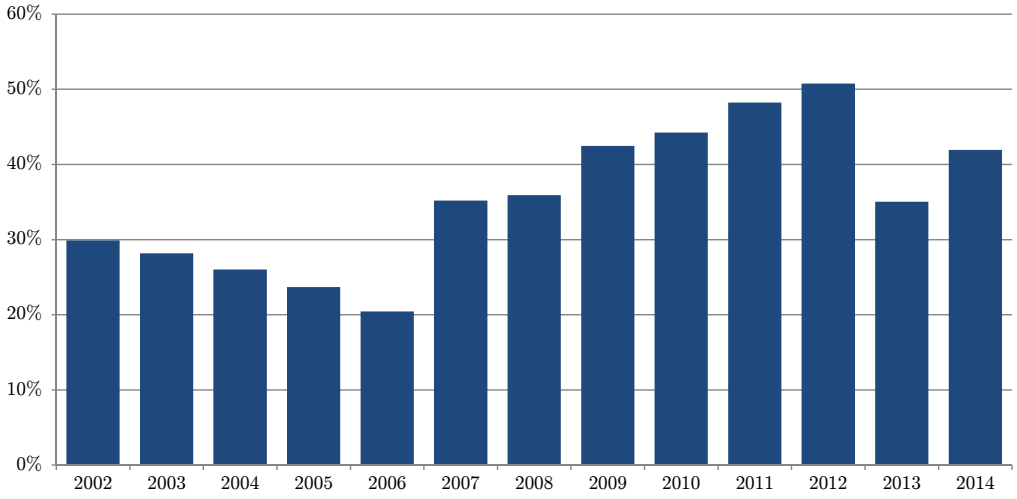
stock exchanges, other trading activities can be commissioned from almost anywhere in the world. Thus, there is large scope for relocation in response to taxation.

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 data set, 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. Moreover, our data ends in December 2015, and the law only came into effect in July 2016. Furthermore, the law affects only the largest banks.[4] As a consistency 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

[4]It 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, Liebig, and Stein (2014).

FIGURE 2: Mean trading gains as share of pre-tax-profits




Trading gains relative to pre-tax profits for banks in our Bankscope sample (described in Section 4). Source: Bankscope

the new law, and find very similar results.

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 paper, 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.

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.[5] All banks in our main dataset on the External Positions of German Banks are headquartered in Germany. Thus, we will not incorporate CFC rules in the following considerations.

[5]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.

# 3 Research Design

In the following, we will develop the hypotheses for the empirical test and discuss our empirical strategy.

## 3.1 Hypotheses

Our paper aims to answer two questions: Do banks strategically relocate their proprietary trading in 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, Knoll, and Riedel, 2014). 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.

Proprietary trading meets these two criteria. It is highly mobile, as it is possible to separate the trading activities from the determination of the trading strategy. And it is highly profitable, as the example of German banks shows: In the five years up to 2014, proprietary trading accounted on average for 32% of their after-tax profits (Bundesbank, 2016).[6] Thus, in the first part of the paper, 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

[6] In our Bankscope sample, which includes banks headquartered worldwide, the corresponding figure is 39%.

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** *An increase in trading activities in response to a tax rate decrease takes place without additional employees.*

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] 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.

## 3.2 Econometric Approach

We now outline our empirical approach before turning to the description of the data.

### 3.2.1 Test of Hypothesis 1

Our first empirical specification tests whether more proprietary trading activities take place in low-tax affiliates. To do so, we look at the variation in tax rates that different affiliates of a multinational bank face. Accordingly, we estimate the following equation to test Hypothesis 1:

$$IHS(\text{Trading Assets}_{ijkt}) = \beta_0 + \beta_1 CTR_{jt} + \beta_2 X_{ijkt} + \delta_k + \gamma_t + u_{ijkt}. \quad (1)$$

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

The dependent variable, $IHS(\text{Trading Assets}_{ijkt})$ is the inverse hyperbolic sine of 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).[8] 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. $\delta_k$ are bank-group fixed effects, and $\gamma_t$ are monthly time fixed effects. If Hypothesis 1 holds, we should observe $\beta_1 < 0$, as banks prefer low-tax countries to conduct their proprietary trading.

A potential threat to our identification strategy is that country characteristics other than the tax rate determine a country's attractiveness for proprietary trading. To address this concern, we would ideally add country fixed effects to our regression (and we will do so in robustness tests). However, the inclusion of country fixed effects also poses a challenge to identification, as we then only use the information on affiliates in countries with tax rate changes. While there are 52 changes in statutory tax rates in our sample, *none* of the tax havens in which German banks hold trading assets changed its tax rate. Thus, the specification with fixed effects excludes exactly the countries to which we think that banks strategically relocate their proprietary trading business.[9] Therefore, in our main specification we do not use country fixed effects and instead employ several 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 lo-

[8]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 $y_i$). See Burbidge, Magee, and Robb (1988) for more information.

[9]As Germany also did not change its tax rate during the sample period, there is also no change in the incentive to shift profits away from the German headquarter.

cation of proprietary trading.[10] To control for the regulatory environment, we 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). Appendix 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 variables absorbs time-variant shocks that influence the whole bank group, such as large indemnity payments. Moreover, we include dummies describing whether an affiliate is a subsidiary (a separate legal entity) or a branch (an office of the parent company). The omitted category are the German headquarters.

A further potential issue is that bank affiliates are not distributed randomly, but that banks strategically locate their subsidiaries in low tax jurisdictions.[11] Huizinga, Voget, and Wagner (2014) therefore employ a Heckman selection model to estimate banks' pre-tax profit response to corporate tax rates. As our sample includes *all* subsidiaries and branches of German banks, it is ideally suited to use a two-stage estimator addressing this selection issue.[12] We use the estimator proposed by Wooldridge (1995), which extends the Heckman (1976) selection model to panel data. In more detail, we first 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.

[10]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.

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

[12]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).

### 3.2.2 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:

$$IHS\left(\text{Employees}_{ijkt}\right) = \beta_1 CTR_{jt} + \beta_2 IHS(\text{Trading}_{ijkt}) + \beta_3 CTR_{jt} * IHS(\text{Trading}_{ijkt}) + \beta_4 X_{ijkt} + \delta_k + \gamma_t + u_{ijkt}. \quad (2)$$

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 $\gamma_t$ are now year dummies). If a higher volume of trading in an affiliate is also associated with more personnel conducting these activities, we expect a positive estimate for $\beta_2$. However, if Hypothesis 2 is true, we would rather expect a small, insignificant coefficient for $\beta_2$ and a positive estimate for $\beta_3$. Such results would indicate that an increase in trading assets is associated with an increase in the number of employees in high-taxed but not in low-taxed affiliates. It would imply that rather than shifting real traders, banks shift only the bare execution of buying and selling to tax haven affiliates.

Again, country characteristics that correlate with employment, trading assets and the tax rate are the biggest 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. We also present results with country fixed effects.

At the bank level, we control for other assets (i.e. total assets minus trading assets) in bank $i$'s affiliates in country $j$, as additional employees are necessary to attend customers. Moreover, we include dummies for branches and subsidiaries again, and the inverse hyperbolic sine of the overall total assets of the bank group.

As a robustness check, in a further regression we interact trading assets with both a dummy for tax havens and a dummy for non-havens in order to investigate the different

effects of trading activity on the number of employees. Moreover, we split our sample into tax havens and non-haven countries and estimate the effect of trading assets on the number of employees in the two subsamples separately. We classify countries as tax havens if Johannesen and Zucman (2014) consider them as such. If Hypothesis 2 is true, we should see a statistically significant and positive coefficient for trading assets for non-haven countries and an insignificant coefficient close to zero for tax havens.

# 4 Data and Descriptive Analysis

To see whether banks relocate trading assets to shift profits to low-tax jurisdictions, we require detailed information on multinational banks. To estimate our model, we use regulatory data from the German central bank. In a robustness test, we also use Bureau van Dijk's Bankscope data set.

Our main data source is the External Positions of Banks database of the German central bank (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 branches and subsidiaries. We observe the German headquarter, all foreign subsidiaries and an aggregated value for each bank's branches in a country. The sample consists of 106 internationally active bank groups in Germany, with a total of 108 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 June 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 at a yearly basis.[13] Moreover, to construct our control variables, we use country level information from various sources (see Appendix 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

[13]For a detailed description of this data set, see Lipponer (2011).

measure the current value of trading assets held in an affiliate.[14] 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)

On average, German banks hold €41 billion of fixed-income assets, and €894 billion of derivatives for trading (in 2013). The distribution of these assets across affiliates is relatively unequal, with the top decile holding 96.9% of fixed-income assets (96.8% of derivatives). On average, a bank affiliate holds €298 million in fixed-income assets for proprietary trading, and €5,622 million in derivatives for proprietary trading.

In which countries do German banks hold their trading assets? In Table 1, we list the top ten countries in which German bank groups had the most proprietary trading assets in 2013.[15] 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.[16] 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 Luxembourg). Banks tend to hold more derivatives than fixed-income assets for proprietary trading. However, derivatives are more concentrated in the home market Germany.

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, in Section 6 we rerun our analysis using Bureau van Dijk's Bankscope dataset. Large parts of the literature on the taxation and regulation of banks use this dataset (see e.g. Gu, de Mooij, and Poghosyan, 2015; Houston, Lin, and Ma, 2012; Huizinga, Voget, and Wagner, 2014; Merz and Overesch, 2016).

[14] 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.

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

[16] 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 data set. As a robustness check we also estimate eq. (1) without affiliates in the US and find similar results.

Table 1: Top 10 countries for trading activities in 2013

| | Fixed-income trading assets | | | Trading derivatives | | |
|---|---|---|---|---|---|---|
| # | Country | Total (in m€) | % held in branches | Country | Total (in m€) | % held in branches |
| 1 | Germany | 46,747 | | Germany | 1,308,000 | |
| 2 | United Kingdom | 37,754 | 100 | United Kingdom | 413,800 | 100 |
| 3 | United States | 5,765 | 86 | United States | 210,600 | 100 |
| 4 | Italy | 4,626 | 37 | Italy | 54,188 | 100 |
| 5 | Singapore | 2,983 | 43 | Singapore | 7,018 | 100 |
| 6 | Cayman Islands | 2,108 | 100 | Luxembourg | 1,657 | 0 |
| 7 | China | 926 | 4 | Poland | 1,022 | 0 |
| 8 | Russia | 763 | 0 | Japan | 541 | 100 |
| 9 | Japan | 697 | 100 | Hong Kong | 447 | 100 |
| 10 | Luxembourg | 582 | 0 | Czech Republic | 86 | 83 |
| | Total | 112,500 | 50 | Total | 2,007,000 | 35 |

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

Bankscope provides comprehensive information on balance sheets, income statements and ownership for banks and bank subsidiaries worldwide. We use information from 2002 to 2014. 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 assets and loans, this sample selection procedure yields a sample of 3,744 firm-year observations. It covers 971 subsidiaries, which belong to 667 bank groups.

The main advantages of this sample 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 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 as-

sets, 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.[17] 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.

As the Bankscope dataset is not complete, 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 described above, which also includes purely domestic banks. 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. 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.

Table 2 gives an overview over the descriptive statistics for the main variables (descriptives for the robustness test with Bankscope data are in Appendix 3). In the Bundesbank dataset, fixed-income trading assets amount on average to €298 million per affiliate, or €41 billion per bank group. There are significantly more derivatives held for trading (on average €5.622 billion per affiliate, €894 billion per bank group). As we observe derivatives only from 12/2013 to 12/2015, there are only 8,577 observations for trading derivatives, compared to 24,750 observations for the other monthly variables. On average, affiliates have total assets of €7.5 billion.

# 5 Estimation Results

In this section we present the regression results using the Bundesbank data. Table 3 reports the test of the first hypothesis, where we regress trading assets on the tax rate. Table 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.

[17]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 2: Descriptive statistics

| Variable | Obs. | Mean | Std. Dev. | p1 | p50 | p99 | Frequ. |
|---|---|---|---|---|---|---|---|
| Fixed income trading assets (million €) | 24,750 | 298 | 2,158 | 0 | 0 | 6,768 | M |
| Trading derivatives (million €) | 8,577 | 5,622 | 48,550 | 0 | 0 | 202,100 | M |
| Total assets (million €) | 24,750 | 7,501 | 31,033 | 0 | 825 | 127,000 | M |
| Corporate tax rate | 24,750 | 0.255 | 0.093 | 0.000 | 0.292 | 0.400 | M |
| Nominal GDP (million €) | 24,750 | 147,231 | 208,365 | 199 | 88,109 | 1,078,132 | Q → M |
| Inflation rate (%) | 24,750 | 1.979 | 2.541 | -1.246 | 1.672 | 10.239 | M |
| GDP growth (%) | 24,750 | 2.088 | 2.857 | -4.030 | 1.756 | 10.594 | Q → M |
| Regulation | 24,750 | 1.267 | 0.614 | 1 | 1 | 3 | - |
| Financial sector share | 24,750 | 0.091 | 0.088 | 0.032 | 0.053 | 0.422 | Q → M |
| Subsidiary dummy | 24,750 | 0.217 | 0.412 | 0 | 0 | 1 | M |
| Branch dummy | 24,750 | 0.547 | 0.498 | 0 | 1 | 1 | M |
| Bank group total assets (million €) | 24,750 | 268,700 | 458,300 | 10 | 38,610 | 1,411,000 | M |
| Employees (yearly) | 1,290 | 785 | 3478 | 0 | 64 | 16,314 | A |
| Other assets (million €) | 1,290 | 29,143 | 136,100 | 1 | 1,632 | 619,600 | M → A |

All data from 06/2010 to 12/2015, except trading derivatives 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, Dippelsman, and Mæhle (2001), and monthly GDP growth from these values. We derive the monthly financial sector share by cubic spline interpolation.

## 5.1 Trading Activities in German Banks

In Table 3, we test the effect of statutory tax rates on trading assets. Columns (1) to (4) show results for fixed-income trading assets, and columns (5) to (8) show results for derivatives held for trading.

Columns (1) and (5) show our main specification for fixed-income assets and derivatives, respectively. For fixed-income assets held for trading (column 1), we find a significantly negative coefficient of -2.170. This coefficient indicates that a one percentage point lower corporate tax rate implies on average 2.170% more fixed-income assets held for proprietary trading. For derivatives held for trading (column 5), we find an even higher semi-elasticity, of -6.268. While these semi-elasticities are large, similar magnitudes have been found in other profit shifting contexts, e.g. a tax semi-elasticity for trademarks of -6.2 (Dudar and Voget, 2016).

As all banks in the sample are headquartered in Germany, and firms are often reluctant to shift profits away from their headquarters (Dischinger, Knoll, and Riedel, 2014), our results might be attenuated. We thus rerun the regressions without German headquarters (column 2 and 6). As expected, we find larger semi-elasticities (-3.739 for fixed-income trading assets, and -8.986 for trading derivatives).

In these regressions, we control for several country-level characteristics: GDP, GDP growth, inflation, the importance of the financial sector, and a regulation measure. The inverse hyperbolic sine of GDP as well as the inflation rates and GDP growth have a significantly positive effect. Results for the financial sector share are mixed. However, it is still a threat to identification that other, unobserved country characteristics correlated with the tax rate influence a country's attractiveness for proprietary trading. To address this concern, we use country fixed effects in columns (3) and (7). We continue to find a negative tax effect on fixed-income trading assets, but the coefficient for derivatives turns positive, although not significantly. Note, however, that the coefficient for derivatives is not well identified: Data for derivatives is only available from December 2013 to December 2015 and there were few tax rate changes during this period, none of them in tax havens.

Columns (4) and (8) report the results of the selection model. For fixed-income trading assets we find a semi-elasticity of -3.647, and for derivatives held for trading a semi-elasticity of -8.654. The picture for the inverse Mills ratios is mixed: For fixed-income trading assets, the inverse Mills ratios are not significant on a 10 percent level for all of the 49 months in this sample. For derivatives, 20 of the 25 inverse Mills ratios

TABLE 3: Effect of tax rates on proprietary trading

| Dependent variable | IHS(Fixed-income trading assets) | | | | IHS(Derivatives held for trading) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Including German HQs | Yes | No | Yes | No | Yes | No | Yes | No |
| Wooldridge (1995) selection model | No | No | No | Yes | No | No | No | Yes |
| Corporate tax rate | -2.170*** | -3.739*** | -6.948*** | -3.647*** | -6.268*** | -8.986*** | 14.434 | -8.654*** |
| | (-5.95) | (-9.17) | (-2.82) | (-9.02) | (-11.68) | (-18.65) | (1.29) | (-15.88) |
| IHS(GDP) | 0.066* | 0.251*** | 0.192 | 0.252*** | 0.447*** | 0.641*** | -1.607** | 0.775*** |
| | (1.924) | (8.41) | (0.47) | (8.55) | (9.17) | (11.85) | (-2.04) | (13.39) |
| Inflation rate | 0.215*** | 0.232*** | -0.037*** | 0.232*** | 0.160*** | 0.162*** | -0.011 | 0.125*** |
| | (9.64) | (7.89) | (-2.72) | (8.34) | (4.60) | (5.04) | (-0.71) | (3.98) |
| GDP growth | 0.047*** | 0.072*** | 0.018 | 0.071*** | 0.076*** | 0.106*** | -0.015 | 0.099*** |
| | (4.12) | (5.84) | (1.57) | (6.17) | (3.42) | (4.52) | (-0.70) | (3.41) |
| Financial sector share | -3.420*** | 1.699*** | 14.899*** | 1.824*** | -10.508*** | -6.626*** | -7.604 | -4.149*** |
| | (-6.00) | (3.44) | (2.62) | (3.69) | (-11.00) | (-7.05) | (-1.01) | (-3.23) |
| Regulation | 0.692*** | 0.900*** | | 0.900*** | 0.756*** | 0.990*** | | 0.957*** |
| | (11.36) | (15.94) | | (15.99) | (8.82) | (12.94) | | (12.01) |
| IHS(Total assets) | 0.577*** | 0.494*** | 0.385*** | 0.502*** | 0.794*** | 0.738*** | 0.496*** | 0.735*** |
| | (41.13) | (35.75) | (35.43) | (35.04) | (22.40) | (24.47) | (24.23) | (20.01) |
| IHS(Bank group total assets) | 0.106** | 0.678*** | 0.366*** | 0.018 | -0.382*** | -0.315 | 0.587*** | -0.542*** |
| | (2.38) | (10.18) | (35.03) | (0.34) | (-3.68) | (-1.34) | (24.36) | (-5.62) |
| Subsidiary dummy | -2.588*** | -0.176** | 0.426*** | -0.155 | -2.570*** | -1.631*** | -1.125*** | -1.615*** |
| | (-22.55) | (-2.14) | (4.96) | (-1.54) | (-12.37) | (-10.90) | (-6.50) | (-9.38) |
| Branch dummy | -1.996*** | | | | -0.467** | | | |
| | (-19.84) | | | | (-2.26) | | | |
| Monthly time FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank group FE | Yes | Yes | No | Yes | Yes | Yes | No | Yes |
| Country FE | No | No | Yes | No | No | No | Yes | No |
| $R^2$ | 0.434 | 0.397 | 0.350 | 0.396 | 0.597 | 0.565 | 0.627 | 0.568 |
| Observations | 24,750 | 18,913 | 24,750 | 18,913 | 8,577 | 6,460 | 8,578 | 6,460 |

The dependent variable is the inverse hyperbolic sine of fixed-income securities held for trading (col. 1-4) or of derivatives held for trading (col. 5-8). Appendix 2 defines all variables. Monthly bank data for 2010/06-2015/12 in col. (1)-(4) and for 2013/12-2015/12 in col. (5)-(8) from External Positions of Banks database of Bundesbank (2015a). t-statistics in parentheses, based on bootstrapped standard errors clustered by bank group and by country-month-year.

are significant. These results imply that selection effects do not matter for fixed-income trading assets, but there is selection for derivatives.

## 5.2 Profit Shifting or Shifting of Real Activity?

In Table 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 3.2.2, 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 4 is lower than in Table 3. To be able to use data from a longer time period, we use only fixed-income assets held for proprietary trading in this part (and call them "trading assets" for simplicity).

We first establish that a higher amount of trading assets in an affiliate indeed increases the number of employees in that affiliate (column 1). To ensure that neither the size of the overall bank group nor the size of the particular affiliate drive this effect, we control for bank group fixed effects and other assets in that affiliate. In this regression in column (1) we find that 10% more trading assets increase the number of employees by 0.47%.

In column (2), we include the interaction between the corporate tax rate and trading assets. The coefficient for trading assets is now insignificant, indicating that in a country with a zero tax rate an increase in trading assets does not lead to an increase in employment. The interaction term is positive and highly significant, showing that in high-tax countries more trading assets indeed require more employees. In column (3), we rerun the regression with country fixed effects, and again find that the interaction term is positive and highly significant.

For some tax havens, the statutory tax rate might not accurately capture the incentives to shift profits there (e.g. because the tax haven does not enforce taxation or offers many exemptions). Therefore, as a first robustness check, we use dummies for tax havens and for non-havens instead of the corporate tax rate and interact them with trading assets in column (4). For the non-tax havens, we continue to observe a significant and positive effect of trading assets on employments (point estimate of 0.054, indicating that 10% more trading assets increase the number of employees by 0.54%). For the tax havens, the point estimate is 0.027 and insignificant, confirming again that banks do not relocate employment to tax havens when they move their proprietary trading there.

TABLE 4: Effects on real activity

| | All countries | | | | Havens | Non-Havens |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| IHS(Trading assets) | 0.047*** | 0.015 | 0.005 | | -0.017 | 0.073*** |
| | (3.73) | (0.68) | (0.27) | | (-0.98) | (8.51) |
| Corporate tax rate (CTR) | -0.513 | -1.118 | -0.773 | | | |
| | (-0.78) | (-1.54) | (-0.24) | | | |
| CTR*IHS(Trading assets) | | 0.135** | 0.203*** | | | |
| | | (2.17) | (3.05) | | | |
| Haven*IHS(Trading assets) | | | | 0.027 | | |
| | | | | (1.29) | | |
| Non-Haven*IHS(Trad. assets) | | | | 0.054*** | | |
| | | | | (4.29) | | |
| IHS(Other assets) | 0.288*** | 0.288*** | 0.287*** | 0.289*** | 0.500*** | 0.268*** |
| | (8.02) | (7.96) | (13.29) | (8.09) | (9.22) | (9.92) |
| IHS(GDP) | 0.185*** | 0.184*** | -0.313 | 0.166*** | -1.261 | 0.039 |
| | (3.13) | (3.12) | (-0.55) | (3.54) | (-0.53) | (0.07) |
| Inflation rate | 0.131*** | 0.131*** | 0.021 | 0.127*** | -0.073 | 0.031 |
| | (5.58) | (5.66) | (0.57) | (5.41) | (-0.73) | (0.94) |
| GDO growth | -0.019 | -0.019 | -0.008 | -0.012 | -0.013 | -0.007 |
| | (-1.1) | (-1.09) | (-0.45) | (-0.77) | (-0.39) | (-0.38) |
| Financial sector share | -5.910*** | -5.844*** | 2.635 | -5.761*** | -4.540 | 5.956 |
| | (-6.25) | (-6.20) | (0.28) | (-6.01) | (-0.32) | (0.50) |
| Subsidiary dummy | -1.172*** | -1.171*** | 1.008*** | -1.140*** | 1.529*** | 0.590*** |
| | (-10.27) | (-10.08) | (5.87) | (-10.21) | (6.57) | (2.72) |
| Branch dummy | -2.232*** | -2.203*** | | -2.188*** | | |
| | (-14.54) | (-14.25) | | (-14.27) | | |
| Regulation | -0.078 | -0.091 | | -0.116* | | |
| | (-1.29) | (-1.51) | | (-1.86) | | |
| IHS(Bank group total assets) | 0.139 | 0.134 | 0.074*** | 0.127 | 0.059* | 0.052** |
| | (0.98) | (0.94) | (3.34) | (0.91) | (1.71) | (2.28) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank group FE | Yes | Yes | No | Yes | No | No |
| Country FE | No | No | Yes | No | Yes | Yes |
| $R^2$ | 0.688 | 0.689 | 0.737 | 0.688 | 0.623 | 0.757 |
| Observations | 1,290 | 1,290 | 1,289 | 1,290 | 374 | 915 |

The dependent variable is the inverse hyperbolic sine of the number of employees. *IHS(Trading assets)* is the inverse hyperbolic sine of fixed-income assets held for proprietary trading. Yearly data from 2010 to 2015 from the External Positions of Banks and MiDi databases by the Bundesbank. t-statistics in parentheses, based on standard errors clustered by bank group and by country-year.

In columns (5) and (6) we split the sample into tax havens and non-haven countries. In each subsample, we test whether employment increases with trading assets. To control for country-level characteristics that may influence this relationship, we include country fixed effects. We find a zero effect for tax havens, but for non-havens we find a positive and highly significant effect of 0.073. These results confirm again our second hypothesis.

## 5.3 Importance of Proprietary Trading as a Profit Shifting Channel

The estimated elasticities in Section 5.1 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 paper.

We proceed as follows: We take the estimated tax semi-elasticities in columns (2) and (6) in Table 3 and estimate the percentage change in trading assets if the affiliate had paid a tax of 30% (like the German headquarter). We then multiply this percentage change with the actual level of trading assets in each affiliate.[18] 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

[18] 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.

the estimation with different assumed rates of return.

Table 5 summarizes the results of this back-of-the bank-of-the-envelope calculation. Assuming a constant profitability of 1% (a relatively conservative estimate), our calculations suggest tax savings for 2015 of €450 million from the relocation of fixed-income trading assets and trading derivatives.[19]

Table 5: 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.

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 5 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 Bundesbank, 2016).

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 3 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

[19]With a 2% return on proprietary trading, the tax saving double.

FIGURE 3: Implied monthly tax savings from...

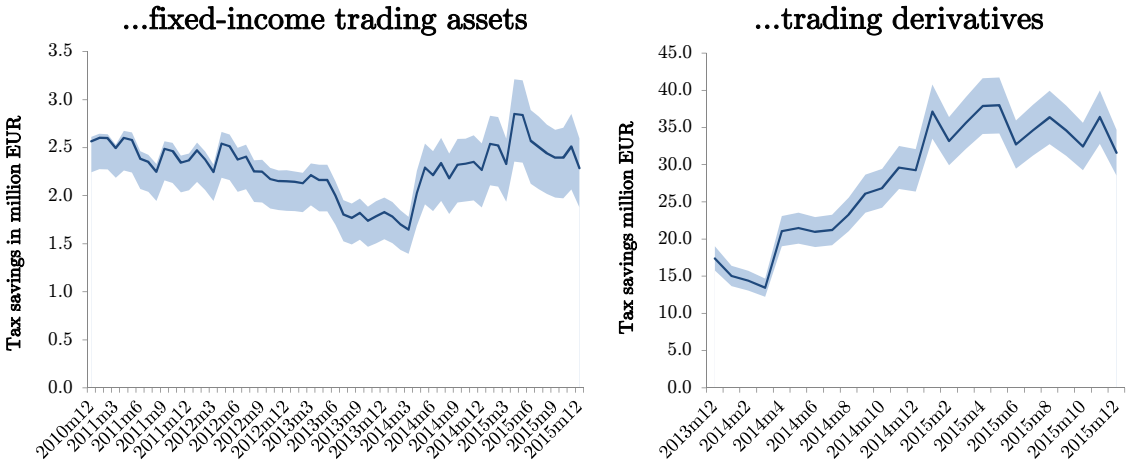



Illustration of implied monthly tax savings: if all lower taxed affiliates were taxed by 30%, our estimated semi-elasticities imply a decline in fixed-income trading assets and in trading derivatives in these affiliate. We calculate the implied tax savings assuming that these trading assets were held 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 3.

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. For example, the United Kingdom (which is an important financial center) has cut its corporate tax rate in April in each year in the sample by 1-2 percentage points, resulting 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.[20]

# 6 Trading Activities in Banks Worldwide

In this section, we test both hypotheses using Bureau van Dijk's Bankscope data. Table 6 presents the 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 the full sample, and columns (3) and (4) for the smaller sample of banks that we can identify as multinationals with certainty. In our main specifications, we find that a 1%-point decrease in the tax rate increases trading assets by 8.2% in the full sample, and by 6.7% in the multinational sample.[21] 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 the tax havens.[22]

In Panel B, we again test whether the tax-induced relocation of trading assets is a profit-shifting activity or the relocation of real activities. 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. Columns (1) to (4) show the results for the full sample, and columns (5) to (8) for the multinational sample. Both sets of results are similar, thus we will only discuss those for the full sample in the following.

In column (1), we use as our explanatory variables the inverse hyperbolic sine of trading assets, the corporate tax rate, the interaction between the two variables and a set of control variables. The result shows that an increase in trading assets increases personnel expenses in high-tax countries, but not in low-tax countries. To ensure that

[20]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.

[21]The fact that we find a smaller coefficient in the multinational sample indicates that some banks that are only in the larger sample react strongly to tax rates. Possibly, these banks have branches in other countries. The Bundesbank data shows that branches are heavily used for proprietary trading, but they are not reported in the Bankscope sample.

[22]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).

TABLE 6: Regressions with Bankscope data

**Panel A: Effects on proprietary trading**

| | Full sample | | Multinationals only | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Corporate tax rate | -8.182*** | -3.900 | -6.731** | -10.641 |
| | (-2.99) | (-0.56) | (-2.23) | (-1.16) |
| Controls and Year FE? | Yes | Yes | Yes | Yes |
| 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**

| | Full sample | | | | Multinationals only | | | |
|---|---|---|---|---|---|---|---|---|
| | All countries | | Havens | Non-Havens | All countries | | Havens | Non-Havens |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| IHS(Trading assets) | -0.120*** | -0.103*** | -0.001 | 0.084*** | -0.135*** | -0.130*** | -0.000 | 0.103*** |
| | (-3.72) | (-3.36) | (-0.17) | (3.78) | (-3.27) | (-3.18) | (-0.00) | (3.48) |
| Corporate tax rate | -6.512*** | -7.681** | | | -8.564** | -10.426** | | |
| | (-2.59) | (-2.18) | | | (-2.54) | (-2.42) | | |
| CTR * IHS(Trading) | 0.571*** | 0.518*** | | | 0.684*** | 0.667*** | | |
| | (5.18) | (4.50) | | | (4.39) | (4.21) | | |
| Controls + Year FE? | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank group FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country FE | No | Yes | Yes | Yes | No | Yes | Yes | Yes |
| $R^2$ | 0.699 | 0.724 | 0.950 | 0.712 | 0.502 | 0.548 | 0.919 | 0.525 |
| Observations | 3,480 | 3,480 | 365 | 3,115 | 1,209 | 1,209 | 160 | 1,049 |

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(Other assets), IHS(Population), inflation, GDP growth, financial sector share and IHS(country average wage) in Panel B. Yearly bank data for 2000-2013 from Bankscope database. t-statistics in parentheses, based on bootstrapped standard errors clustered by bank and by country-year.

no unobserved, time-constant country-level variables drive the results, in column (2) we repeat the same analysis with country fixed effects and find similar results. An increase in trading only increases personnel expenses if it takes place in a country with a tax rate above 20%.

In columns (3) and (4), we split the sample in two groups: bank affiliates in tax havens and those in other countries. We find a significant positive effect of the volume of trading assets on personnel expenses in an affiliate for the non-havens, and a zero effect in the tax havens. Again, the results confirm that the tax-induced relocation of trading assets constitutes a profit-shifting strategy and not the relocation of real activity.

The comparability to the results in the previous section is limited for two reasons: First, the dependent variable here captures the total amount of assets held in the trading book whereas in the regressions for German banks we employ the specific positions of fixed-income assets and derivatives held for trading. Second, as outlined in Section 4, the trading data in Bankscope suffers from a substantial number of missing values and the fact that a major part of proprietary trading is conducted in foreign branches, whereas Bankscope only contains subsidiaries of banks.

Nevertheless, the results on the influence of the corporate tax on trading assets are qualitatively comparable to those we found in the Bundesbank dataset for German multinational banks. Thus we can confirm our hypotheses also with data on bank groups worldwide.

# 7 Conclusion

In this paper, 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 2.2 percent, and trading derivatives by 6.3 percent. 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 book profits 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.

# References


Acharya, Viral, Itamar Drechsler, and Philipp Schnabl, 2014, A pyrrhic victory? Banking bailouts and sovereign credit risk, *The Journal of Finance* 69, 2689–2739.

Bank for International Settlements, 2017, *Consolidated Banking Statistics*.

Barth, James R., Gerard Caprio, and Ross Levine, 2013, Bank regulation and supervision in 180 countries from 1999 to 2011, *Journal of Financial Economic Policy* 5, 111–219.

Bloem, Adriaan M., Robert J. Dippelsman, and Nils Ø. Mæhle, 2001, *Manual for quarterly national accounts: concepts, data sources, and compilation*, Washington, D.C. International Monetary Fund.

Buch, Claudia, 2003, Information or regulation: What drives the international activities of commercial banks?, *Journal of Money, Credit, and Banking* 35, 851–869.

Bundesbank, 2015a, *External Positions of Banks Database 2010-2015*.

Bundesbank, 2015b, *Microdatabase Direct Investment 2010-2015*.

Bundesbank, 2016, *Die Ertragslage der deutschen Kreditinstitute*.

Burbidge, John B., Lonnie Magee, and A. Leslie Robb, 1988, Alternative transformations to handle extreme values of the dependent variable, *Journal of the American Statistical Association* 83, 123–127.

Cerutti, Eugenio, Giovanni Dell'Ariccia, and Maria Soledad Martinez Peria, 2007, How banks go abroad: Branches or subsidiaries?, *Journal of Banking and Finance* 31, 24.

Dell'Ariccia, Giovanni and Robert Marquez, 2010, Risk and the corporate structure of banks, *Journal of Finance* 65, 22.

Deloitte, 2014, Guide to Controlled Foreign Company Regimes, Available online at http://www.deloitte.com/global/en/pages/tax/articles/guide-to-controlled-foreign-company-regimes.html.

Demirgüç-Kunt, Asli and Harry Huizinga, 2001, The taxation of domestic and foreign banking, *Journal of Public Economics* 79, 429–453.

Deutsche Bank AG, 2014, *Annual Report,* available online at https://www.db.com/ir/en/annual-reports.htm.

Devereux, Michael P and Simon Loretz, 2013, What do we know about corporate tax competition?, *National Tax Journal* 66, 745–774.

Dischinger, Matthias, Bodo Knoll, and Nadine Riedel, 2014, There's no place like home: The profitability gap between headquarters and their foreign subsidiaries, *Journal of Economics and Management Strategy* 23, 369–395.

Dombret, Andreas, Thilo Liebig, and Ingrid Stein, 2014, Trennbankensystem - ein Weg zu mehr Finanzstabilität in Deutschland?, *Perspektiven der Wirtschaftspolitik* 15, 41–55.

Dudar, Olena and Johannes Voget, 2016, Corporate taxation and location of intangible assets: Patents vs. trademarks, Discussion Paper 16-015, ZEW.

Ernst & Young, 2011, 2014, Worldwide Corporate Tax Guide, Available online at http://www.ey.com/GL/en/Services/Tax/Global-tax-guide-archive.

Fecht, Falko, Andreas Hackethal, and Yigitcan Karabulut, 2017, Is proprietary trading detrimental to retail investors?, *Journal of Finance*, forthcoming.

Förster, Guido and Dirk Schmidtmann, 2004, CFC Legislation in Germany, *International Tax Review* 32, 476–486.

Gu, Grace Weishi, Ruud de Mooij, and Tigran Poghosyan, 2015, Taxation and leverage in international banking, *International Tax and Public Finance* 22, 177–200.

Hau, Harald, 2001a, Geographic patterns of trading profitability in Xetra, *European Economic Review* 45, 757–769.

Hau, Harald, 2001b, Location matters: An examination of trading profits, *Journal of Finance* 56, 1959–1983.

Heckemeyer, Jost H. and Michael Overesch, 2017, Multinationals' profit response to tax differentials: Effect size and shifting channels, *Canadian Journal of Economics* forthcoming.

Heckemeyer, Jost and Ruud de Mooij, 2017, Taxation and corporate debt: Are banks any different?, *National Tax Journal* 70, 53–76.

Heckman, James J., 1976, The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such

models, in *Annals of Economic and Social Measurement* 5 of NBER Chapters, National Bureau of Economic Research, Inc, 475–492.

Hong, Qing and Michael Smart, 2010, In praise of tax havens: International tax planning and foreign direct investment, *European Economic Review* 54, 82–95.

Houston, Joel F., Chen Lin, and Yue Ma, 2012, Regulatory Arbitrage and International Bank Flows, *Journal of Finance* 67, 1845–1895.

Huizinga, Harry P. and Johannes Voget, 2009, International taxation and the direction and volume of cross-border M&As, *Journal of Finance* 64, 1217–1249.

Huizinga, Harry, Johannes Voget, and Wolf Wagner, 2014, International taxation and cross-border banking, *American Economic Journal: Economic Policy* 6, 94–125.

International Monetary Fund, 2016, *World Economic Outlook Database*.

Johannesen, Niels and Gabriel Zucman, 2014, The end of bank secrecy? An evaluation of the G20 tax haven crackdown, *American Economic Journal: Economic Policy* 6, 65–91.

Karkinsky, Tom and Nadine Riedel, 2012, Corporate taxation and the choice of patent location within multinational firms, *Journal of International Economics* 88, 176–185.

KPMG, 2016, Corporate tax rate table, Available online at https://home.kpmg.com/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html.

Lipponer, A., 2011, Microdatabase direct investment - MiDi, technical documentation, Deutsche Bundesbank, Frankfurt.

Merz, Julia and Michael Overesch, 2016, Profit shifting and tax response of multinational banks, *Journal of Banking & Finance* 68, 57–68.

Ruf, Martin and Alfons J. Weichenrieder, 2012, The taxation of passive foreign investment: lessons from German experience, *Canadian Journal of Economics* 45, 1504–1528.

The Independent, 2015, Five of world's biggest investment banks pay no UK corporation tax, *The Independent,* article by Henry Austin, 23 December 2015.

Wooldridge, Jeffrey M., 1995, Selection corrections for panel data models under conditional mean independence assumptions, *Journal of Econometrics* 68, 115–132.

World Bank, 2011, Survey on bank regulation, Available online at http://go.worldbank.org/WFIEF81AP0.

# Appendix 1: Corporate Tax Rates on Bank Profits

TABLE A1: Corporate tax rates (CTR) affecting banks in percent

| 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 |
| Qatar | 10 | 10 | 10 | 10 |
| Russian Federation | 20 | 20 | 20 | 20 |

TABLE A1: Corporate tax rates (CTR) affecting banks in percent, continued

| Country | 2011 | | 2014 | |
|---|---|---|---|---|
| | CTR general | CTR banks | CTR general | CTR banks |
| 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 |

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. Tax rate data from Ernst & Young (2011, 2014) and KPMG (2016). Countries listed are all countries in which German banks have affiliates.

# Appendix 2: Variable Definitions

TABLE A2: Variable definitions and sources

| Variable | Definition | Source |
|---|---|---|
| **Bundesbank Data** | | |
| Fixed income trading assets | Bonds and debt securities held for trading | Bundesbank (2015a) |
| Trading derivatives | Absolute sum of derivatives with positive and negative fair value that are held for trading | Bundesbank (2015a) |
| Total assets | Total external assets held in the affiliate | Bundesbank (2015a) |
| Other assets | Total non-trading assets, calculated as *Total assets - Fixed income trading assets* | Bundesbank (2015a) |
| Bank group total assets | Total assets in all affiliates and in the headquarter of a bank group | Bundesbank (2015a) |
| Employees | Number of employees in the affiliate | Bundesbank (2015b) |
| Subsidiary dummy | =1 if foreign affiliate is a separate legal entity | Bundesbank (2015a) |
| Branch dummy | =1 for foreign branches of German bank group | Bundesbank (2015a) |
| **Bankscope Data** | | |
| Trading assets | Total trading assets at fair value | Bankscope |
| Total assets | Total assets of the affiliate | Bankscope |
| Other assets | Total non-trading assets, calculated as *Total assets - Trading assets* | 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) |
| Tax haven dummy | =1 if country is classified as a tax haven | Johannesen and Zucman (2014) |
| GDP | Nominal gross domestic product | 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 | 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, Caprio, and Levine (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.

# Appendix 3: Descriptive Statistics for Bankscope Data

TABLE A3: 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 |
| Population (million) | 3,744 | 203 | 231 | 1 | 184 | 1,351 |
| 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 |
| Other assets (million USD) | 3,480 | 20,080 | 96,520 | 46 | 2,262 | 280,100 |
| Country average wage (USD) | 3,480 | 46,774 | 21,139 | 2,509 | 52,438 | 94,881 |

All variables on annual frequency for 2002 to 2014.