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## Cost leadership and bank internationalization

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# Non-technical summary

This paper derives an empirical specification to estimate the entry of banks into foreign markets by setting up affiliates by borrowing from the theoretical trade literature. We develop a stylized model of an international bank that is driven by comparative cost advantages among home and destination market banks as well as predicted loan rate levels in foreign markets. We test this model by combining the Foreign Status Data with publicly available micro data on banks in 30 destination countries.

The empirical results show in line with theoretical predictions that German banks with a marginal cost advantage are more likely to enter foreign markets. We derive marginal costs for a sample of domestic banks and international banks with stochastic frontier analysis and define cost advantage as an indicator equal to one if the domestic bank exhibits lower marginal cost compared to the $5^{th}$ percentile of the marginal cost distribution across banks in each destination market.

We also find that German banks are less likely to enter if the level of their own marginal cost is higher and if foreign banks' marginal costs are lower. Both effects are sensitive to the inclusion of bank-specific cost-to-income ratio, a simple variable which appears to capture much of the theoretical cost advantage effect.

Bank-specific characteristics of domestic banks seem to be more important in determining the foreign entry choice compared to traits of foreign markets. Generally, less profitable banks and those with higher insolvency risk are more likely to operate abroad. These effects are mostly driven by foreign branches, whereas subsidiary operations are not explained well by a theory hinging on comparative advantage in conventional lending business.

# Nicht-technische Zusammenfassung

Die vorliegende Studie bedient sich eines Modells der Handelstheorie, um den Eintritt deutscher Banken in ausländische Märkte durch die Gründung von Niederlassungen zu erklären. Banken unterscheiden sich in diesem Modell hinsichtlich ihrer Effizienz, die sich in unterschiedlichen Grenzkosten ausdrückt. Bei einem entsprechend hohen Zinsniveau im Zielland, kann eine kostengünstig operierende deutsche Bank einen Teil des ausländischen Marktes abschöpfen und dabei Gewinne realisieren, die anfallende fixe Investitionskosten decken. Wir testen dieses Modell mithilfe detaillierter Daten, die dem Auslandsstatus deutscher Banken, das heißt deren Kreditvergabe in 30 Ländern, sowie öffentlich zugänglichen Mikrodaten entstammen.

Die empirische Untersuchung bestätigt, dass Banken mit Kostenvorteilen gegenüber ihren inländischen Konkurrenten eher dazu tendieren, in ausländische Märkte zu expandieren. Hierzu ermitteln wir mittels einer *stochastic frontier analysis* die Grenz-kosten für eine Stichprobe deutscher und internationaler Banken. Mittels eines von uns definierten Kostenvorteilsindikators identifizieren wir deutsche Banken, deren marginale Kosten unter denen des 5. Perzentils der Grenzkostenverteilung im jeweiligen Zielland liegen.

Wir zeigen, dass die Wahrscheinlichkeit einer Expansion ins Ausland sinkt, je höher die Grenzkosten der expandierenden Bank und je geringer die Kosten der Banken im Zielland sind. Beide Effekte reagieren sensitiv auf eine Berücksichtigung bankspezifischer Kosten-Ertrags-Quoten im verwendeten Modell. Kosten-Ertrags-Quoten scheinen demnach einen Großteil des prognostizierten Grenzkosteneffekts zu erfassen.

Die Expansion einer Bank ins Ausland wird wesentlich durch bankspezifische Charakteristika und nicht durch Ziellandfaktoren erklärt. Wenig profitable Banken und Banken mit hohem Insolvenzrisiko tendieren eher dazu, in ausländischen Märkten aktiv zu werden. In diesen Fällen erfolgt die Expansion vorrangig mittels Auslandsfilialen. Internationale Aktivitäten über Auslandstöchter scheinen hingegen nur eingeschränkt durch ein theoretisches Modell erklärt werden zu können, welches komparative Vorteile im klassischen Kreditgeschäft in den Mittelpunkt stellt.

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**Abstract**

We adapt a theoretical model from the goods trade literature to test whether banks with a comparative cost advantage are more likely to enter foreign markets by means of foreign direct investment. We combine detailed proprietary bank-level data on the international activities of all German banks with publicly available bank micro data from possible destination markets to show that the decision to go abroad is driven by relative cost differences. Banks enter markets where they are cost leaders in terms of their marginal cost relative to those of banks in destination markets. They are attracted by markets that are larger and more competitive, as witnessed by lower interest rates charged by the most efficient competitors.

**Keywords:** Trade in financial services, International banking, Productivity, Markups, Marginal costs

**JEL classification:** F3, G21

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# 1 Introduction

Since the beginning of the 1990s, trade in services has been the fastest growing component of international trade. Financial services trade recorded a growth of 32% in 2007, rendering it the fastest growing segment of the services sector (WTO, 2009). The increase of trade in financial services is part of a general increase in services trade, which after 2008-2009 resumed its upward trend with a growth of 9% in 2010 (WTO, 2011).

Despite its growing importance, research that explains which firms engage in services trade is relatively scarce. This is in contrast to research on firms that engage in goods trade, which shows that there are relatively few firms that export and those that do are typically larger and more productive (Bernard and Jensen, 1995; 1999). These findings have inspired a large theoretical literature that attempts to incorporate stylized facts about goods traders into different theoretical frameworks (e.g. Eaton *et al.* 2004; Helpman *et al.* 2004; Melitz and Ottaviano, 2008).

The first generation of heterogeneous-firm models for goods trade emphasize heterogeneity in productivity. According to Melitz (2003) only the most productive firms are able to overcome the fixed costs of exporting and according to Bernard *et al.* (2003) only firms with a comparative cost advantage supply products to any given market.

Breinlich and Criscuolo (2011) present a set of stylized facts, which show that trade in services and goods are in some respects remarkably similar. Firm-level heterogeneity also matters in services trade: only a few firms export services and those that do tend to be larger and more productive. They conclude (p. 196) that: "These models [Melitz, 2003; Bernard *et al.*, 2003] would seem, therefore, to provide a good starting point for explaining the basic characteristics of services exporters." We follow up on their suggestion and focus on banks as international financial service providers.[1]

Descriptive evidence by Buch *et al.* (2011) suggests that heterogeneous service models can be applied to international banking as well. They show that only the largest, most productive banks engage in international affiliate lending, which is consistent with findings on affiliate sales from the goods trade literature (e.g Helpman *et al.*, 2004). Still, they also find differences: whereas only a fraction of all firms trade, almost all banks hold at least some foreign assets. This stylised fact renders heterogeneous firm models less suited to explain banks' cross-border holdings. Therefore, we focus on bank lending through foreign affiliates, i.e. foreign direct investment by German banks.

This paper makes two main contributions. First, we offer empirical evidence on trade in financial services that is informed by firm-level trade theory. We use a

[1]Note that focusing on one service sector is justified, as we cannot speak collectively of "the services sector" (Francois and Hoekman, 2010)

stylized theoretical model inspired by Melitz (2003) and Bernard *et al.* (2003) to estimate a reduced form based on a domestic bank considering to enter a foreign market. Like Bernard *et al.* (2003), we have a Ricardian framework in which only the most productive, lowest-cost bank enters the foreign market.[2] Like in Melitz (2003), upon entry banks face a fixed cost, which in our case is proportional to the demand for lending abroad.

Second, this paper is the first to link individual banks' internationalization strategies to the competitive conditions in foreign markets. This allows us to empirically test Bernard's *et al.* (2003) prediction that entry is a function of banks' marginal costs relative to those of its foreign competitors. Our approach complements De Blas and Russ (2012) and Bernard *et al.* (2003), who simulate the marginal cost distribution, whereas we use the actual empirical distribution of banks' marginal costs and average revenues at home *and* abroad. In addition, we test Melitz' (2003) prediction that only the most productive, lowest-cost banks are able to overcome the fixed costs of exporting.

Our empirical approach consists of two steps. First, we estimate the marginal costs and average revenues of banks as in Koetter *et al.* (2012) for a sample of around 78,000 bank-year observations between 2003 and 2010. To this end, we combine a comprehensive, proprietary dataset that provides detailed information about the foreign lending of German banks with publicly available Bankscope data. The *External Position Report* provided by the *Deutsche Bundesbank* contains information about the international assets of 1,550 German banks held via foreign branches and subsidiaries, year-by-year and country-by-country. The Bankscope data provides financial accounts for a large sample of the world's banks. Second, we use the calculated markup components of German banks, that is home banks' marginal cost, the marginal cost of cost leaders in destination markets, and prices charged abroad, to predict the likelihood of home banks' foreign presence.

In line with Breinlich and Criscuolo (2011) and Buch *et al.* (2011), our results exhibit many commonalities with the evidence on goods trade firms: Banks with foreign affiliates have lower marginal costs, lower prices, but higher markups. Consistent with Bernard *et al.* (2003), relative cost advantages between home and destination market are good predictors of the extensive margin. Consistent with Melitz (2003), the foreign entry decision is also driven by the home country distribution of marginal cost and proxies for fixed entry costs like distance and activity restrictions. These relations remain largely intact after controlling for different risk profiles of German banks that go abroad and for broader definitions of cost leadership. Finally, we find that destination market rates are the most important determinant of the the volume of foreign lending, the estimation of

[2]This cost advantage translates into a higher markup. The ability of a bank to charge a high markup is thus a sign of superior productivity relative to incumbent domestic banks. By contrast, the banking literature views higher markups, e.g. in terms of Lerner indexes, as an indication of higher market power (Degryse *et al.*, 2009).

which involves a significant selection bias for which we adjust.

The remainder of this paper is organized as follows. In section 2, we present the theoretical model and the empirical specifications to estimate foreign entry and bank-specific marginal cost. Section 3 describes bank, foreign activity, and macro data to specify the model. We discuss results in Section 4 and we conclude in Section 5.

# 2 Methodology

We first present a stylized theoretical framework similar to Bernard *et al.* (2003) and De Blas and Russ (2012) with the main purpose to inform the specification of a reduced form to test the importance of relative cost advantages empirically. Specifically, we estimate the likelihood of foreign entry, the marginal costs and the average revenues per bank.

## 2.1 Theory

Consider a world economy with multiple banks and firms. Each country hosts multiple banks with varying productivity levels. Only the most productive bank supplies loans to firms. Except for heterogeneity in productivity, bank production technology is identical. The $k$th-most productive bank delivers output at marginal cost $C_k$. Each country $j$ is served by the bank with the lowest marginal cost, $C_1 = \min\{C_k\}$, in that market. As in Bernard *et al.* (2003), competition is imperfect such that markups, defined as price over marginal cost, differ across banks.

Let bank $i$ consider to open a branch or a subsidiary in country $j$. It will decide to enter country $j$ when it realizes positive profits. To enter this market, the bank incurs a country-specific fixed cost $F_j$, which measures next to physical capital and staffing investment in a new foreign affiliate in particular the pecuniary effort to comply with the associated administrative burden of the chartering procedures in country $j$. The profit of entering country $j$ is:

$$\pi_{ij} = R^L_{ij} L_{ij} - R^D_{ij} D_{ij} - F_j, \tag{1}$$

where $R^L_{ij}$ is the return on lending, $L_{ij}$ is the amount of loans supplied, and $D_{ij}$ is the deposits of bank $i$ in country $j$ with the corresponding interest rate $R^D_{ij}$. Bank $i$ charges the profit-maximizing markup on lending in country $j$ equal to $\tilde{M}_{ij} \equiv \varepsilon/(\varepsilon - 1)$, where $\varepsilon$ is the elasticity of demand for loans in country $j$. The optimal loan interest rate is

$$R^L_{ij} = \tilde{M}_{ij} C_{ij}, \tag{2}$$

where $C_{ij}$ is the marginal cost. In Bertrand equilibrium, the firm has to be the lowest-cost producer, $C_{ij} = C_{1j}$, such that $C_{ij} < C_{2j}$. A bank can only charge

the profit-maximizing markup if the next-best bank with marginal cost equal to $C_{2j}$ is less productive, which is when $\tilde{M}_{ij}C_{ij} < C_{2j}$. Therefore, the banks earns the markup

$$\bar{M}_{ij} = \min\left\{\frac{C_{2j}}{C_{ij}}, \tilde{M}_{ij}\right\}. \tag{3}$$

Like De Blas and Russ (2012), we assume that more productive banks can generate more loans given deposits by assuming that required deposit rates equal the bank's marginal cost $C_{ij}$. In addition, we assume that the bank transforms all its deposits into loans $D_{ij} \equiv L_{ij}$. The profit function of bank $i$ that reflects optimal markups in the lending market is then:

$$\pi_{ij} = (R^L_{ij} - C_{ij})L_{ij} - F_j. \tag{4}$$

Substituting the return of bank $i$ in country $j$ with (2) and (3), we can derive a zero-profit condition in terms of marginal cost, the markup, fixed costs of entry, and loan supply. That is, banks go abroad if $\pi_{ij} > 0$, which requires

$$C_{ij}(\bar{M}_{ij} - 1) > F_j/L_{ij}. \tag{5}$$

When the markup is bound by the next-best bank, $\bar{M} = C_{2j}/C_{ij}$, Equation (5) can be expressed as $(C_{2j} - C_{ij}) > F_j/L^D_{ij}$. Hence, a necessary condition for foreign entry is that the bank is the lowest-cost lender. The difference in marginal costs between the contesting domestic bank and the second-lowest cost bank abroad has to be sufficiently large to compensate for the fixed cost of entry, expressed as a fraction of the demand for loans. If the markup is unbound, banks charge the maximum markup $\bar{M}_{ij} = \tilde{M}_{ij}$. In this case a necessary condition for foreign entry is a markup larger than one.

Next, we specify a simple loan supply equation for country $j$. We assume that bank $i$ can obtain a fraction $0 < \gamma < 1$ of the foreign market and that supply equals demand. Consider a standard neoclassical one-sector production function with constant returns to scale and a perfectly competitive (destination country) capital market to finance physical capital. In equilibrium, the rental rate of capital $R^*_j$ equals the marginal product of capital ($MPK_j$). Aggregate capital income is $MPK_j \times K_j$, where $K_j$ is the capital stock.[3] We assume that $MPK_j \times K_j$ equals the total lending income to the country's lenders $R^*_j \times L_j$[4], of which bank $i$ supplies a fraction $\gamma$. A straight-forward expression for the loan supply of bank $i$ in country $j$ follows:

$$L_{ij} = \gamma L_j = \gamma\left(\frac{MPK_j \times K_j}{R^*_j}\right). \tag{6}$$

Thus, the rental rate of capital $R^*_j$ equals the loan rate in country $j$ in equilibrium. In the short run, this loan rate can deviate from the marginal product of capital.

[3] We set depreciation to zero without loss of generality.

[4] Hence, in equilibrium the capital stock ($K_j$) is fully financed by loans, such that $K_j \equiv L_j$.

Intuitively, a marginal product of capital that is higher than the loan rate, implies an excess demand for capital, which motivates a bank to enter.[5] This expression also shows that even though the markup is positively related to foreign entry, loan rates are negatively related to entry. The reason is that higher prices imply less demand for loans, which depresses profits. This result is in line with Melitz and Ottaviano (2008), who show that banks in larger markets have higher profits despite exhibiting lower prices and markups. In our framework, higher profits increase the likelihood that the bank can compensate the fixed cost of entry.

## 2.2 Estimating Foreign Entry

The selection of home banks into foreign markets is determined by their superior productivity, as reflected by lower marginal costs. Similar to Helpman *et al.* (2008), we define a latent variable $Z_{ij}$ that relates to the condition that banks go abroad given in Equation (5), using the expression for foreign loan demand as in Equation (6)

$$Z_{ij} = \frac{C_{ij}(\bar{M}_{ij} - 1)(\gamma MPK_j K_j)}{F_j R_j^*}. \tag{7}$$

Equation (7) is the ratio of the variable profits to the fixed costs of going abroad. Bank $i$ will enter country $j$ if and only if $Z_{ij} > 1$. The fixed cost of entry $F_j$ are stochastic due to unmeasured international frictions $v_{jt}$. We assume that they are a function of the country fixed effect $a_j$ and other observed measures of the fixed cost associated with setting up a foreign presence $\phi_{jt}$. Let $f_{jt} \equiv \ln F_{jt} = \phi_{jt} - a_j - v_{jt}$, where $v_{jt} \sim N(0, \sigma_v^2)$. We denote lower case letters as the natural logarithm of uppercase letters, such that the latent variable $z_{ijt} \equiv \ln Z_{ijt}$ can be expressed as

$$z_{ijt} = \gamma_0 + \gamma_1 c_{2jt} - \gamma_2 c_{ijt} - \gamma_3 r_{jt}^* + \gamma_4 MPK_{jt} + \gamma_5 K_{jt} + \gamma_6 a_j - \gamma_7 \phi_{jt} + \varepsilon_{ijt}, \tag{8}$$

where $\varepsilon_{ijt} \equiv v_{jt} + u_{ijt} \sim N(0, \sigma_v^2 + \sigma_u^2)$ is i.i.d. and all parameters exhibit expected signs. The only exception is $\gamma_5$, for which the sign is ambiguous due to diminishing returns to physical capital.[6] Whereas we do not observe $z_{ijt}$, we observe whether a bank operates a commercial presence abroad. That is, $z_{ijt} > 0$ when bank $i$ is present in country $j$ and $z_{ijt} = 0$ when it is not present. We use a Probit to model this latent variable and define the indicator variable $T_{ijt}$ to equal 1 when bank

[5] Note that we depart from the international trade literature as we do not model destination-specific loan demand. In analogy to conventional trade theory assuming love-for-variety of households for final goods, an extension of the model could endogenize $\gamma$ by introducing Dixit-Stiglitz type of preferences of firms in country $j$ for different varieties of finance, for example collaterized long-term lending versus short-term debt from commercial paper markets. The limited purpose of the present stylized model is, however, to merely guide the empirical specification and we therefore reserve theoretical expansions for future research.

[6] All the terms enter linearly in logs and $\gamma$ in Equation (7) is parameterized by $\gamma_4$ and $\gamma_5$.

$i$ has assets in a branch or a subsidiary in country $j$ at time $t$ and 0 otherwise. Next, let $\rho_{ijt}$ be the probability that bank $i$ has assets in a branch or subsidiary in country $j$ at time $t$. We divide (8) by the standard deviation $\sigma_\varepsilon$ and specify the Probit equation

$$\begin{aligned}\rho_{ijt} &= \Pr(T_{ijt} = 1|\text{observed variables}) \\ &= \Phi(\gamma_0^* + \gamma_1^* c_{2jt} - \gamma_2^* c_{ijt} - \gamma_3^* r_{jt}^* + \gamma_4^* mpk_{jt} + \gamma_5^* k_{jt} - \gamma_6^* a_j - \gamma_7^* \phi_{ijt})\end{aligned} \tag{9}$$

where $\Phi(.)$ is the cdf of the unit-normal distribution, and starred coefficients equal the original coefficients divided by $\sigma_\varepsilon$. In sum, home banks are more likely to enter foreign markets if the marginal cost of cost leaders in destination countries are high ($\gamma_1$), the domestic bank is productive as reflected by low own marginal cost ($\gamma_2$), loan rates are low in destination markets due to the volume effect on profits ($\gamma_3$), the demand for financial funds is large ($\gamma_4$ and $\gamma_5$), and if the fixed cost of entry are low ($\gamma_6$ or $\gamma_7$).

We proxy the cost of the second best competitor abroad, $c_{2jt}$, as the $5^{th}$ percentile of the marginal cost distribution in country $j$ at time $t$ instead of the second lowest marginal costs in a market to reduce the effect of outliers.[7] Analogously, we measure loan rates abroad, $r_{jt}$, as the $5^{th}$ percentile of the average revenue distribution in country $j$. The generation of these variables from bank micro data is explained below. The marginal productivity of capital ($mpk_{jt}$) and the capital stock ($k_{jt}$) in destination countries are obtained from the Penn World Tables and described in subsection 3.3. We measure the fixed costs of entry either by including country-fixed effects $a_j$ (the baseline) or by including proxies for the fixed cost of entry, $\phi_{jt}$.

All estimations include year fixed effects to control for changes in the profitability of entering foreign markets over time. To avoid simultaneity by construction, all covariates in Equation 9 are lagged by one period. In addition, we add a cost-leadership dummy that equals one when a bank's marginal costs are lower than those of the second best foreign competitor and zero otherwise. We adapt trade models developed for manufacturing firms, but acknowledge in the empirical specification that banks have also risk-return considerations that drive their decision to go abroad. Therefore, we include a *credit risk* control, the *z-score*, the *cost-to-income ratio*, and *return on equity* in our regressions. These variables are described in subsection 3.1.

## 2.3 Estimating Marginal Costs and Prices

To specify Equation (9), we need to estimate the marginal costs of both home and foreign banks as well as destination market loan rates. The former equal the

[7] This choice is inadvertendly heuristic to some extent. We test the robustness of the results changing this threshold up to the $10^{th}$ percentile of the marginal cost distribution in destination countries $j$. Results remain unaffected and are available upon request.

total derivative of total operating cost of bank $i$ with respect to outputs $y$, which requires the specification of a total operating cost function $TOC_{it}$.

In line with the intermediation approach (Sealy and Lindley, 1977), a bank demands three factors (deposits, labor, and physical capital) in complete factor markets at prices $w_{pit}$, where $p = 1, 2, 3$, to generate three outputs $y_{qit}$, where $q = 1, 2, 3$ (securities, loans and off-balance sheet activities). In addition, we include a vector of covariates $z_{it}$ to adjust for differences in relative risk and performance, described in the data section. We choose a translog functional form to specify the total cost function for bank $i$ at time $t$ and include a time trend $T$ to capture technical change.

$$\begin{aligned}\log TOC_{it} = \alpha + \sum_{p=1}^{3} \beta_p \log w_{pit} + \sum_{q=1}^{3} \beta_q \log y_{qit} + \delta \log(z_{it}) + \sum_{p=1}^{3} (\zeta/2)(\log w_{pit})^2 \\ + \sum_{p<k} \sum \eta_{pk} \log w_{pit} \log w_{kit} + \sum_{q=1}^{3} (\theta/2)(\log y_{qit})^2 + \sum_{q<l} \sum \eta_{ql} \log y_{qit} \log y_{lit} \\ + \sum_{p=1}^{3} \sum_{q=1}^{3} \lambda_{pq} \log w_{pit} \log y_{qit} + \sum_{k=1}^{2} \nu_k T^k + \sum_{p=1}^{3} \xi_p \log w_{pit} T + \sum_{p=1}^{3} \omega_q \log y_{qit} T + \varepsilon_{it},\end{aligned} \tag{10}$$

Koetter *et al.* (2012) show that estimated markups are underestimated if firms prefer to incur inefficiencies rather than to reap maximal monopoly rents (see also Hicks, 1935). Therefore, we use stochastic frontier analysis (SFA) to estimate Equation (10) and associated marginal costs net of such possible managerial slack.[8] Cost inefficiency is the difference between minimum and observed costs, given the output level of the bank. Following the SFA literature (Kumbhakar and Lovell, 2000), we assume that $\epsilon_{it} \equiv \varphi_{it} + \psi_{it}$, where the random error term, $\varphi_{it}$, is i.i.d. normally distributed with mean zero and variance $\sigma^2_{\varphi}$. The systematic error term component, inefficiency $\psi_{it}$, is assumed to be i.i.d. with a truncated-normal distribution and variance $\sigma^2_{\psi}$ that is independent of the $\varphi'_{it}s$. We impose homogeneity of degree one on input prices by dividing all factor prices and $TOC_{it}$ by $w_{3it}$ and assume that production technologies are identical across banks. Therefore, we estimate one frontier for all the banks in the sample, which is necessary to permit a comparison of marginal costs. [9]

Given parameter estimates of Equation (10), we calculate the marginal costs

[8]Hence, relative cost level differences are not influenced by differences in market power, permitting a more accurate estimation of the predictions implied by a Dixit-Stiglitz market structure (Dixit and Stiglitz, 1977).

[9]Note that this implies the production technology is identical across banks, which is in accordance with Bernard *et al.* 2003, who assume the production technology is identical across producers.

for each bank in each year as:

$$MC_{it} = \sum_{q=1}^{3} \frac{TOC_{qit}}{y_{qit}} \frac{\partial \log TOC}{\partial \log y_{qit}}. \tag{11}$$

We calculate the derivates as the marginal effects of (10) with respect to our three outputs and adjust for the scaling with $w_{3it}$ in the cross-products of $y_{qit}$ with $w_{pit}$.

To obtain estimates of destination country loan rate distributions, $r^*_{jt}$ in Equation (8), we estimate average revenues per bank as the sum of average cost and average profits. The former are predicted from Equation (10), i.e. we obtain predicted average cost net of inefficiency. To predict the average profits, we follow Koetter *et al.* (2012), and specify the alternative profit model of Berger and Humphrey (1997). Very much in line with the Dixit-Stiglitz market structure (Dixit and Stiglitz, 1977), this model permits banks to possess some pricing power in output markets. Consequently, a profit frontier mimics Equation (10) with the exception that we specify profits before taxes ($PBT$) as the dependent variable.[10] Loan rates are then approximated by predicted average revenues as the sum of average profits and average operating costs.

$$r_{it} = AR_{it} = \frac{\hat{TOC}_{qit}}{\sum_{q=1}^{3} y_{qit}} + \frac{\hat{PBT}_{it}}{\sum_{q=1}^{3} y_{qit}} \tag{12}$$

# 3 Data

We describe here the three types of data we need to combine: bank-level data from Bankscope, the foreign status data of the *Bundesbank*, and macroeconomic data.

## 3.1 Bank data

To estimate marginal costs and prices, we use Bankscope data from unconsolidated financial statements in each country for which at least one German bank reports at least once during the sample period assets in foreign branches and subsidiaries. For these countries, we select all commercial, savings, and cooperative banks that report total loans at least once between 2002 and 2011. Table 1 summarizes cost and profit frontier variables, separating German (home) banks from destination market bank data. We drop entries with missing or negative

[10] A notorious problem in log profit models is the existence of loss-incurring firms, for which the log is not defined. We adjust for negative profits as in Koetter (2006) and replace negative log profits with zero and add a negative-profit indicator to the explanatory variables, which equals the log of the absolute value of profits if profits are negative and zero otherwise.

data for the three factors prices, three outputs, costs, equity and total assets and deflate all monetary volumes to 2005 prices using the consumer price index. We winsorize all factor prices and risk proxies at the 1% level to control for outliers and estimate the frontiers for a sample of 78,222 bank-year observations.

The variables in the cost and profit frontiers are defined as follows. Total operating cost $TOC$ cover all operating expenses of the bank including interest expenses. Profits before tax $PBT$ denotes operating revenues less operating cost. The price of fixed assets $w_1$ is calculated as the ratio of expenses for fixed assets to fixed assets. The cost of labor $w_2$ is proxied as the ratio of personnel expenses to the total number of employees. Funding costs are approximated by the ratio of interest expenses to total deposits. We specify three outputs: securities ($y_1$), gross loans ($y_2$) and off-balance sheet activities ($y_3$). Regarding the vector of risk and return controls $z_{it}$, the former is important in at least two ways. First, banks that have superior productivity could have lower marginal costs because they are better able to manage risk. Second, risk motives, like diversification, could be important in banks' decision to enter foreign markets. Therefore, we first follow Mester (1996, 1997) and include *equity*. To adjust for differences in risk-adjusted performance, we include two risk proxies: *credit risk* is loan impairment charges over gross loans and the *z-score*, which measures insolvency risk. It equals is the sum of return on assets (RoA) and the capital ratio (Equity/total assets, TA) divided by the standard deviation of return on assets over the sample period. Assuming that insolvency occurs when losses cannot be covered by equity, the probability of insolvency is P(RoA $<$ Equity/TA). If RoA follows a normal distribution, z-scores are inversely related to the probability of insolvency (Laeven and Levine 2009). Thus, z-scores reflect the number of standard deviations that a bank's RoA must fall below its expected value before equity is exhausted and the bank becomes insolvent. Lower z-scores therefore indicate riskier banks. We use two relative performance measures: the *cost-to-income ratio* is the sum of personnel expenses and other operating expenses over total revenues, and *return on equity* is pre-impairment operating profit divided by equity.

## 3.2 Foreign status data

We obtain data on the international assets of German banks' branches and subsidiaries, henceforth affiliates for short, from the so-called *External Position Report* that is provided by the *Deutsche Bundesbank*. We obtain end-of-year data on the loans and advances for each bank, which are held in destination markets $j$ by affiliates.[11] We consider loans and advances to foreign enterprises, households

[11]Note that most affiliate lending is directed to borrowers in the country of residence, but not all. For example, a Dutch affiliate of a German bank may also lend to a Belgian customer. We choose here the destination country perspective rather than the alternative host country perspective because we want to test whether a German bank contesting, in terms of this example, the Belgian market has a comparative cost advantage over competing destination market

and general government, but exclude interbank lending which is likely driven by other factors than the demand for financing physical capital. Reporting thresholds for international assets were abolished at the end of 2002, so we use data from 2003-2010.

We manually link the foreign status data to the Bankscope dataset and are able to match 1,550 out of the 2,143 German banks reporting to the foreign status database according to Buch *et al.* (2011). Importantly, they show that the vast majority of foreign activity recorded by the *External Position Report* pertains to cross-border lending, often to just a few countries. Here, we focus on home banks that venture abroad by means of affiliates, which only 41 banks do with foreign presences in 30 countries as shown in Table 2. These banks coincide with those mentioned by Buch *et al.* (2011) that venture abroad by means of branches or subsidiaries. Hence, we capture all large international players and suffer only from attrition among presumably very small banks. Figure 1 presents a world map that indicates the number of affiliates German banks have in each country of the world for our estimation sample. It shows clearly that German bank presence is concentrated in the developed world. Table 2 further shows that most of the 41 banks with affiliates are commercial banks. Those from the savings and cooperative banking sector are mostly, but not exclusively, the large head institutions, so-called Landesbanken and Central Cooperative Banks. Across all sectors, the average international bank operates affiliates in about 13 to 14 countries. The volume of international activities, in turn, is by far the largest among international commercial banks, scoring at around 61 million euro as opposed to 4 million euro on average for cooperative banks.

Table 3 shows summary statistics of marginal costs at home and in destination markets, a cost-leadership dummy, predicted loan rates, risk and return controls, and the volume of foreign lending by German banks. Where applicable, we separate the descriptives with and without affiliates and by banking group.[12] Note that these data are at the bank-destination country-year level ($ijt$). The bottom panel covering all banks vividly illustrates that only very few intermediaries venture into relatively few of the possible 30 countries, namely 1,667 out of 210,462 $ijt$-observations, resembling a mere 0.8%. The three panels above illustrate that across banking sectors substantial differences exist regarding internationalization patterns. Whereas the unconditional likelihood for a commercial bank to enter a given market in a given year is around 12%, it virtually zero for the numerous, but smallest cooperative banks.

Theoretically, the markup a bank can charge is bound by the marginal costs of the second best rival, so we focus on the marginal cost of home banks and those abroad, i.e. $\frac{C_{2j}}{C_{ij}}$ in Equation (3). Comparing marginal costs across columns

banks.

[12]Commercial banks include large and regional commercials, savings banks include central and local savings banks, and cooperative banks include central and regional cooperatives.

confirms that banks with affiliates abroad exhibit significantly lower marginal cost compared to peers at home without foreign affiliates, e.g. 2.5% versus 3.5% for the full sample (bottom panel). This difference is the largest for savings and cooperative banks, whereas it is not significantly different for commercial banks (3.2% versus 3.4%). Also note, that banks that go abroad exhibit next to lower marginal costs also lower prices. This observation is consistent with the international trade literature (e.g. Bernard *et al.*, 2003; Melitz and Ottaviano, 2008) and supports the notion that competitive banks are attracted to competitive markets where they are still able to realize positive margins.

But the comparison of marginal costs of home and foreign banks also illustrates that contesting banks are not necessarily always cost leaders. For the full sample, mean marginal cost abroad faced by German banks that are abroad themselves are 1.6% and thus substantially lower compared to the 2.5% mentioned earlier. Differences across banking groups are corroborated. Cooperative banks abroad are on average cost leaders (1.1% versus 1.5%), savings banks have no significant cost advantage (1.7% versus 1.5%), and commercial banks exhibit significantly larger marginal cost than destination market competitors (3.2% versus 1.6%). The cost-leadership dummy confirms these patterns and jointly they underpin the importance of relative marginal cost *and* loan rate levels abroad that matter for entry (see Equation (3)). Banks can compete in foreign markets because they have lower marginal costs than their rivals at home. Yet, because the bank can compete in that market, its rivals in destination markets are also likely to have low marginal costs, which forces the bank to set a lower price.

To assess the overall impact on entry likelihood we therefore have to use the regression approach reflected by Equation (9).

## 3.3 Macroeconomic data

The specification of Equation (9) also requires macroeconomic variables to proxy for the demand for loans and the fixed costs of entry, which we summarize in Table 4. Following Caselli and Feyrer (2007), we calculate the marginal product of capital as $MPK = \alpha Y/K$ and adjust for the price of capital relative to the price of consumption goods: $MPK = \alpha P_Y Y/P_K K$, where $P_Y/P_K$ is a measure of the average price of final goods relative to the price of reproducible capital. Data on $Y$, $K$ and relative prices are obtained from Version 7.2 of the Penn World Tables (PWT, Heston, Summers and Aten (2011)). We use Caselli and Feyrer's data to calculate the capital share $\alpha$ as one minus the labor share and adjust for differences in reproducible capital shares of total capital income. The capital stock is computed from the investment series in the Penn World Tables with the perpetual inventory method and a six-percent depreciation rate.

We use various proxies for the fixed costs of entry. First, we include geographical *Distance* between Germany and the host country in thousands of kilometers (CEPII, Paris) in the vein of melting iceberg transportation cost. Second, inter-

national banks may follow their customers. Then, foreign loan demand relates to the FDI of German non-financial firms. We include the aggregate volume of *German FDI* in millions of euros from the Microdatabase on FDI (MiDI) of the Deutsche Bundesbank, which resembles a negative fixed cost of entry. Third, *capital regulation* is a combined measure of overall and initial capital stringency. *Activity restrictions* indicate whether banks are restricted from engaging in securities underwriting, insurance underwriting and selling, real estate investments, management, and development. Both variables are obtained from Barth and Levine (2001), and higher scores indicate more stringency and restrictions, respectively. We thus expect negative signs.

# 4 Results

## 4.1 Foreign affiliate probability

Table 5 presents the marginal effects of the estimates of Equation (9), using country fixed effects to proxy the fixed entry costs. Standard errors are clustered at the bank and country level and we also include year dummies throughout. The fit of this selection equation is good as reflected by pseudo-$R^2$ ranging between 17% and 46%. Likewise, discriminatory power is very good with areas under the receiver operating characteristics curve (AROC) ranging between 0.8 and 0.9.

The marginal cost of German banks significantly reduces the probability that bank $i$ has a foreign affiliate in country $j$ at time $t$ in column (1), which is in line with the theoretical prediction. An increase in marginal cost by 1% reduces this likelihood by 1.7%, which is substantial in light of the unconditional entry likelihood of 0.8% for the full sample (see Table 3). The economic significance is corroborated when considering the $5^{th}$ and $95^{th}$ percentiles of the fitted probabilities. They show that a reduction in the probability by 0.017 is comparable to a shift a shift of the fitted probability from the 5th to the 95th percentile.

The second main variable of interest, the marginal cost of cost leaders abroad, is not statistically different from zero. This result shows that for this sample of German banks, the level of productivity, as reflected by the marginal costs in contested markets is not a relevant driver of entry choices. The cost leadership dummy, in turn, captures more directly whether a particular bank has a comparative cost advantage. As shown in Table 3, only around a third of all German banks qualify as cost leaders in the various possible destination markets, i.e. exhibit marginal costs below those of the $5^{th}$ percentile in country $j$ at time $t$. Such cost-leadership increases the likelihood of a foreign affiliate by 0.7%, which is still substantial.

As illustrated in the theory section, it is however not only the comparative cost advantage that matters for entry but also destination market loan rate levels. The baseline specification in column (1) provides no empirical support for

this prediction though. Apparently, destination market traits in terms of competitiveness, i.e. marginal cost and prices charged, have little influence on banks' internationalization choices. This result suggests that at least for this sample of German banks, performance considerations relative to domestic competitors dominate assessments of foreign market competition. This interpretation is further corroborated by the results for the marginal product of capital and the capital stock, which proxy for the size of foreign lending markets. Neither effect is significant.

The results in column (2) address the issue of substantial heterogeneity across banking groups alluded to in Table 3 by specifying according banking group dummies. Accounting for systemic differences is crucial as witnessed by a large increase in goodness-of-fit ($R^2$ from 17% to 33%) and classification accuracy (AROC from 0.8 to 0.95). The negative effect of an increase in marginal cost of the German bank itself by 1% on the probability of operating a foreign affiliate is still significant, but reduced to 1%. Likewise, cost leadership still renders entry more likely, but with a lower magnitude, too. The inclusion of banking group dummies further results in a weakly significant, positive effect of a larger marginal product of capital on foreign entry. In line with theory, $MPK$ growth by 1% increases the foreign affiliate probability by 6 basis points. Overall, the effect of larger foreign loan demand is thus both statistically and economically only weakly significant.

Columns (3) through (6) augment the model with bank-specific controls for differences in risk-return preferences. We include one-by-one the return on equity (column 3), the z-score of Laeven and Levine (2009) (column 4), loan impairment charges over gross loans as a proxy for credit risk (column 5), and cost-to-income (CI) ratios (column 6). Each of these covariates are individually significant, which supports the notion that predominantly bank-specific rather than destination country factors determine (German) banks' internationalization choices. The additional specification of any of the first three covariates does not affect the previous results regarding marginal costs and foreign loan rate levels.

The individual coefficients on bank-specific controls show specifically that more profitable banks with lower credit risk are more likely to operate an affiliate in a given country. The result for the z-score, however, also shows that in particular banks with higher insolvency risk are more likely to venture abroad.[13] Given the negative effect of credit risk though, it seems that it is in particular banks with fairly limited credit exposures and potentially stronger focus on security trading, fee-based services, and other more volatile income sources that are likely to operate such international affiliates.[14]

Whereas the inclusion of these bank-specific proxies did not affect the impact

[13]Recall that higher z-scores indicate more stable banks.

[14]Future research investigating the relation between different types of risk and alternative modes of bank FDI, subsidiaries and affiliates, therefore seems warranted, but outside the scope of this paper.

of marginal costs on foreign entry, the specification of CI ratios does. An increase of CI ratios by 1% reduces the probability to operate a foreign affiliate by almost 2%. At the same time, the effect of increasing marginal cost of the home bank turns positive, albeit with a low magnitude of the marginal effect on the order of 18 basis points. Higher CI ratios are often interpreted in the banking literature as an indication of managerial slack because banks spent more administrative expenses per euro of generated revenues. Alternatively, high CI rations could be interpreted as an indication of increasingly stiffer competition as average costs approach average revenues (Koetter, 2006).

Both interpretations are consistent with our theoretical model. Banks that are less well able to operate their business productively, lack the necessary competitive advantage to enter foreign markets. Likewise, stiffer competition at home permits only the low-cost leaders to recoup the fixed costs associated with foreign entry, which is in line with a cost-leadership dummy that remains significantly positive in column (6).

The joint specification of all bank-specific controls in column (7) confirms most of these results. One noteworthy change is the increase in the magnitude of the positive effect of domestic marginal cost on foreign entry probability to 50 basis points whereas the marginal effect of the CI ratio increases to 2.1%. Apparently, the latter variable captures the theoretical effect the unproductive banks are less likely to go abroad whereas the higher likelihood of entry due to relative cost advantages is fully captured by the cost leadership dummy. The second noteworthy change in results from the joint specification pertains to the profitability of banks. When accounting for both return and risk proxies simultaneously, we find that more profitable banks are less likely to operate affiliates. In conjunction with a positive entry effect of higher insolvency risk, this result further corroborates the notion that especially risk-inclined banks venture abroad, possibly amplifying the propagation of shocks in the vein of Cetorelli and Goldberg (2011).

## 4.2 Alternative fixed cost of entry

A potential reason for the absence of theoretically predicted foreign loan rate effects may relate to the brute-force approximation of foreign entry cost by means of country-specific fixed effects. Therefore, we specify in Table 6 *German FDI*, *Distance* as well as *Capital* and *Activity restrictions* as alternative proxies of the fixed cost of entry.

The estimates of these variables are in accordance with the literature. First, like in the goods trade literature, the probability of going abroad is negatively related to *Distance*. Second, our results confirm that German banks follow their customers (Buch, 2000) as the probability of a foreign presence is positively related to German FDI. Third, higher activity restrictions lower the probability of a foreign presence when controlling for banking-group dummies and bank-specific risk-return traits. This result confirms that regulation matters for foreign bank

entry (Buch, 2003).

The marginal effect of marginal costs at home remain unaffected. They are negative as long as we do not include the CI ratio, which apparently captures the theoretical effect entirely and is in line with expectations negative (see columns 6 and 7). Likewise, cost leadership remains significantly positive as predicted. Whereas the results for the foreign loan demand proxies, the capital stock and the marginal product of capital, remain insignificant, two important changes pertain to the marginal cost and the loan rate level abroad.

Both variables are now significantly positive and exhibit the expected positive signs. An increase of the cost leaders' marginal costs in destination markets by 1% increases the likelihood of a German bank contesting that market by 15 basis points. While statistically significant, this marginal effect is therefore of subordinate economic relevance. Likewise, a reduction of foreign loan rate levels by 1% reduces the probability of entry by 25 basis points. While in line with theory, this price effect gradually turns insignificant as we add bank-specific controls across columns in Table 6, thus confirming the dominance of bank-specific considerations relative to peers in the home market over destination bank market traits to influence internationalization choices.

At the same time, however, country-specific fixed cost of entry in terms of distance, German FDI, and activity restrictions are influential factors. Apparently, these proxies are better able to explain the attractiveness of foreign lending markets than the size of the market (capital stock and the marginal product of capital) and local banking market conditions (marginal cost abroad and foreign loan rates).

## 4.3 Modes of entry: branches versus subsidiaries

Buch *et al.* (2011) emphasize that banks can enter foreign banking markets in different modes: branches or subsidiaries. The main difference is that subsidiaries are legally separate entities and thus obliged to obtain a charter in the destination country, subject to host country prudential and tax regulation, and covered by deposit and other insurance schemes abroad. Hence, especially the fixed cost of entry may differ between these options, which may in turn also influence the marginal effects of the remaining theoretical variables on entry probability.

Table 7 therefore reproduces the results from Table 5 including country, year-, and group-specific fixed effects separately for branches and subsidiaries. The first six columns pertain to branches, the latter six columns present results for subsidiaries.

The results for branches confirm those obtained for the full sample. Based on fixed-entry costs approximated by country-specific effects, banks' own marginal costs reduce the likelihood of foreign entry for as long as the CI ratio is not considered, too. Once we include the latter, the familiar effect that CI ratio and cost leadership dummy capture the theoretically predicted lower likelihood

emerges. Foreign loan rate levels and market size remain insignificant whereas the other bank-specific covariates exhibit the same signs and similar magnitudes as in Table 5.

Regarding subsidiaries, we find that after including the CI ratio in columns (11) and (12) the effects of the marginal cost at home as well as the cost-leadership indicator turn insignificant. The reduction of entry likelihood is now solely captured by CI ratios whereas all theoretical variables are not statistically different. Consequently, entry considerations via the subsidiary mode are apparently subject to very different consideration but trade-inspired proxies of comparative advantage. Potentially, this result reflects that due to their larger legal autonomy, subsidiaries are frequently founded in financial centers with regulatory treatment that is more favorable to the bank and its customers. And subsidiaries seem to offer financial services that are very different from traditional commercial and private lending business, which we capture with our data, such as private wealth management and security trading (see also Fiorentino, Koch, Rudek, 2010).

## 4.4 Intensive margin

The natural follow-up question how likely it is that a bank enters foreign markets with affiliates, concerns how much it will be lending conditional on entry. Equation (9) thus represents the selection equation of more productive banks into foreign markets, which we use to adjust for the well-known selection bias when explaining lending volumes, the so-called intensive margin as in Helpman *et al.* (2008).[15] Another bias they mention is that in a world with bank-level heterogeneity, a larger fraction of the banks is establishing foreign presences in the more "attractive" destinations. To correct for this underlying unobserved firm-level heterogeneity, they include an additional control calculated from the fitted values of the Probit. We are able to go one step further and directly control for unobserved bank-level heterogeneity, by including bank-country fixed effects. This controls for the fact that, conditional on entry, each bank decides to lend a different amount to each country.

To avoid identification of the second stage estimates based solely on the normality assumption for the unobserved fixed cost of entry, we need to specify valid exclusion restrictions in the second stage. These are variables that do affect the fixed cost of entry, but do not affect the amount of foreign lending. The first candidate is *Distance*. A larger distance between Germany and another country makes it more expensive to establish a presence there, for instance due to more costly information generation to screen applicants and initial cost to deal with regulatory and administrative requirements. Yet, the cost of capital transfers does not depend on distance, such that the amount of foreign lending is not

[15] Specifically, we use a two-stage Heckman procedure that adjusts standard errors for the fact that the Mill's ratio is an estimate.

affected by distance.

Second, we considered our other proxies of entry, *Capital*, *Activity restrictions* and *German FDI* in addition to the regulation cost of entry variables used by Helpman *et al.* (2008). However, none turned out to be independent from the intensive margin. Therefore, we estimate the same Probit as in Table 5 and use the country-fixed effects as exclusion restrictions as an alternative to geographic distance. Both exclusion restrictions assume the fixed costs of entry are time-invariant. In addition, using the country-fixed effects as exclusionary restrictions we assume that there is sufficient bank-level heterogeneity, such that the bank-country fixed effects in the second stage are not the same as the country fixed effects in the first stage.

Table 8 presents the results where we distinguish in each pair of columns the intensive margin, i.e. the volume of foreign lending through affiliates $Y_{ijt}$, from the likelihood of entry $T_{ijt}$, which also specifies bank-specific risk-return covariates per bank. The first two pairs of columns corroborate the earlier negative effect of the CI ratio that crowds out the one for domestic marginal cost, irrespective of whether we choose distance of country fixed effects for identification. At the same time, the positive effect of the cost leadership dummy is confirmed, too.

Regarding the intensive margin, columns (1) and (3) confirm the presence of a significant selection bias, as reflected by the estimate of the inverse Mill's ratio that is different from zero. Independent of the exclusion restriction choice, we find a negative marginal effect of foreign loan rates on lending volumes on the order of 30 to 36 basis points. This result could indicate that German banks are more wary of an increased risk of adverse selection in foreign markets, where their ability to tap private information might be inferior to that of local lenders. All other variables are not at all or only weakly significant. Paired with the observation that explanatory power of these regressions is very high, we conclude that the variation in foreign lending is almost entirely explained by bank-country fixed effects.[16]

# 5 Conclusions

We have presented an application of a trade model to international banking that emphasizes heterogeneous firm productivity. Specifically, we develop a reduced form specification of affiliate banks' foreign entry. We test the predictions of this model using a novel sample of 1,550 German banks in the period between 2003 and 2010, which we match with public micro data of affiliates in 30 potential destination markets. To our knowledge this paper is thereby the first to empirically test the importance of banks' *relative* cost advantages in explaining international trade in financial services.

[16]For instance because of persistent client relationships between German banks and their German corporate customers that conducted overseas FDI that the bank followed.

Applying a heterogeneous-firm model to banks seems to offer a useful starting point for explaining the basic characteristics of banks' international affiliate lending. In line with our theoretical predictions, we find that banks enter markets where they are cost leaders in terms of their marginal cost relative to destination markets. Higher levels of marginal costs in destination markets reduce entry likelihoods if we approximate the fixed costs of foreign entry with German non-financial firm FDI, distance, and regulatory activity restrictions of banks instead of with country fixed effects. We also find that markets with larger predicted loan rate levels reduce entry probabilities. This is in line with Melitz and Ottaviano (2008): low-cost banks are attracted to larger markets in which prices are lower, but were they earn higher profits.

Moving forward, our results suggest that heterogeneous firm models could be adapted to better apply to foreign affiliate banking. First, in addition to marginal cost considerations, bank-specific risk controls are also important determinants of banks' internationalization choices. Generally, banks that are less profitable and exhibit larger insolvency risk are more likely to go abroad. Second, when we include our risk proxies, the key variables from our theoretical model no longer have an effect on the likelihood of subsidiaries' foreign entry. Potentially, the decision to start a subsidiary is driven by tax and other considerations unrelated to traditional lending business, on which we focus in this paper. Third, we find only limited evidence that relative cost advantages also explain the volume of lending via foreign affiliates. Instead, lower loan rates increase the loan exposures of German banks' affiliates, which suggests that markets that are larger and more competitive attract more lending.

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Table 1: Summary statistics marginal cost and price estimation

| Full sample | mean | sd | p5 | p95 | N |
|---|---|---|---|---|---|
| w1 (in %) | 151.99 | 323.91 | 31.07 | 438.11 | 78,222 |
| w2 (in thousands) | 43.86 | 16.83 | 24.26 | 71.88 | 78,222 |
| w3 (in %) | 2.46 | 1.19 | 0.98 | 4.40 | 78,222 |
| y1 (in millions) | 706.96 | 11,368.91 | 1.67 | 833.59 | 78,222 |
| y2 (in millions) | 1,385.46 | 12,545.12 | 13.89 | 2,680.56 | 78,222 |
| y3 (in millions) | 914.61 | 17,404.46 | 0.73 | 535.35 | 78,222 |
| Z (in millions) | 177.97 | 1,798.09 | 2.55 | 343.37 | 78,222 |
| TOC (in millions) | 120.58 | 1,163.76 | 1.24 | 227.27 | 78,222 |
| PBT (in millions) | 36.09 | 390.66 | 0.22 | 65.80 | 78,222 |
| cr (in %) | 0.65 | 0.88 | 0.04 | 2.18 | 78,222 |
| cit (in %) | 43.44 | 11.99 | 24.24 | 63.93 | 78,222 |
| zs | 36.62 | 26.82 | 7.68 | 87.86 | 78,222 |
| roe (in %) | 16.42 | 8.69 | 4.48 | 31.54 | 78,222 |
| | | | | | |
| Germany | | | | | |
| w1 (in %) | 112.59 | 256.87 | 33.97 | 271.91 | 10,255 |
| w2 (in thousands) | 50.45 | 13.23 | 37.21 | 72.57 | 10,255 |
| w3 (in %) | 2.73 | 0.83 | 1.72 | 3.75 | 10,255 |
| y1 (in millions) | 1,170.27 | 13,941.11 | 10.43 | 1,543.06 | 10,255 |
| y2 (in millions) | 1,911.82 | 13,264.30 | 36.88 | 3,615.40 | 10,255 |
| y3 (in millions) | 503.42 | 5,407.80 | 2.21 | 395.17 | 10,255 |
| Z (in millions) | 149.92 | 928.64 | 4.81 | 313.36 | 10,255 |
| TOC (in millions) | 190.74 | 1,333.91 | 3.68 | 306.10 | 10,255 |
| PBT (in millions) | 25.77 | 145.17 | 0.60 | 59.90 | 10,255 |
| cr (in %) | 0.98 | 0.80 | 0.20 | 2.28 | 10,255 |
| cit (in %) | 39.40 | 8.65 | 24.27 | 51.91 | 10,255 |
| zs | 33.88 | 19.62 | 13.65 | 65.89 | 10,255 |
| roe (in %) | 18.07 | 6.96 | 8.56 | 30.18 | 10,255 |
| | | | | | |
| All other countries | | | | | |
| w1 (in %) | 157.94 | 332.45 | 30.60 | 455.50 | 67,967 |
| w2 (in thousands) | 42.86 | 17.09 | 23.35 | 71.82 | 67,967 |
| w3 (in %) | 2.42 | 1.23 | 0.94 | 4.47 | 67,967 |
| y1 (in millions) | 637.06 | 10,926.80 | 1.44 | 649.67 | 67,967 |
| y2 (in millions) | 1,306.05 | 12,431.17 | 13.13 | 2,496.34 | 67,967 |
| y3 (in millions) | 976.65 | 18,552.06 | 0.65 | 568.91 | 67,967 |
| Z (in millions) | 182.20 | 1,894.92 | 2.42 | 351.23 | 67,967 |
| TOC (in millions) | 110.00 | 1,135.51 | 1.16 | 207.02 | 67,967 |
| PBT (in millions) | 37.65 | 415.27 | 0.20 | 67.48 | 67,967 |
| cr (in %) | 0.60 | 0.88 | 0.04 | 2.16 | 67,967 |
| cir (in %) | 44.05 | 12.30 | 24.24 | 64.81 | 67,967 |
| zs | 37.04 | 27.72 | 7.31 | 90.23 | 67,967 |
| roe (in %) | 16.17 | 8.89 | 4.15 | 31.81 | 67,967 |

Notes: This table represent summary statistics for the SFA estimation of marginal costs and prices. Sd indicates standard deviation, N indicates the number of observations and p5 and p95 are the 5th and 95th percentile, respectively. One frontier was estimated for the full sample. All data are from Datastream. w1 is operating expenses over assets, w2 is personnel expenses over number of employees and w3 is interest expenses over total deposits. y1 is total securities, y2 is gross loans and y3 is the sum of managed securitized assets, other off balance sheet exposures, guarantees, acceptances and documentary committed credit lines. We also report total equity (Z), pre-impairment operating profit (PBT) and total operating costs (TOC): the sum of interest expenses, loan impairment charges, personnel expenses and other operating expenses, credit risk (cr): loan impairment charges over gross loans, cost-to-income ratio (cit): the sum of personnel expenses and other operating expenses over total revenues, the z-score (zs): the sum of return on assets and the capital ratio over the standard deviation of return on assets, and return on equity (roe): pre-impairment operating profit over equity.

Table 2: Summary statistics: distribution of banks' affiliate lending abroad

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2003-2010 |
|---|---|---|---|---|---|---|---|---|---|
| Commercials | | | | | | | | | |
| Number of banks | 16 | 41 | 48 | 45 | 44 | 48 | 46 | 45 | 86 |
| Number of banks abroad | 4 | 9 | 10 | 8 | 11 | 11 | 12 | 11 | 22 |
| Number of countries with affiliate | 14 | 22 | 24 | 28 | 26 | 26 | 23 | 28 | 30 |
| Average number of countries with affiliate | 11 | 12.8 | 15.6 | 15.4 | 15.8 | 14.2 | 8.8 | 14.4 | 13.8 |
| Average loans and advances per bank | 53026.61 | 56972.62 | 65849.97 | 72208.86 | 81724.01 | 58357.88 | 58088.58 | 59525.56 | 61031.23 |
| Average loans and advances per country | 14662.37 | 16356.57 | 17618.39 | 19041.16 | 21881.75 | 16075.96 | 14828.25 | 15214.68 | 16311.55 |
| Savings | | | | | | | | | |
| Number of banks | 192 | 402 | 413 | 414 | 411 | 401 | 375 | 381 | 465 |
| Number of banks abroad | 2 | 9 | 10 | 8 | 8 | 7 | 6 | 10 | 13 |
| Number of countries with affiliate | 14 | 19 | 21 | 26 | 23 | 23 | 21 | 26 | 29 |
| Average number of countries with affiliate | 12 | 10.7 | 11.5 | 15.25 | 11.8 | 14.5 | 13.25 | 16.25 | 13.3 |
| Average loans and advances per bank | 15262.04 | 13282.44 | 17468.91 | 18980.75 | 25004.8 | 27010.34 | 18765.93 | 14548.13 | 18004.38 |
| Average loans and advances per country | 13742.36 | 15372.04 | 18282.54 | 19823.75 | 20847.75 | 14964.18 | 12804.44 | 13487.56 | 15546.71 |
| Cooperatives | | | | | | | | | |
| Number of banks | 168 | 512 | 519 | 540 | 853 | 814 | 774 | 739 | 999 |
| Number of banks abroad | 0 | 4 | 6 | 6 | 6 | 5 | 4 | 4 | 6 |
| Number of countries with affiliate | 0 | 13 | 16 | 22 | 23 | 8 | 9 | 11 | 26 |
| Average number of countries with affiliate | 0 | 10.5 | 16 | 22 | 23 | 8 | 8 | 11 | 13.6 |
| Average loans and advances per bank | 2628.239 | 2016.253 | 4730.382 | 5248.676 | 4334.121 | 5166.254 | 4081.65 | 3452.966 | 3938.512 |
| Average loans and advances per country | 15236.96 | 19769.78 | 21041.95 | 20674.57 | 20092.2 | 15349.78 | 13943.54 | 12398.43 | 16579.32 |
| Total | | | | | | | | | |
| Number of banks | 376 | 955 | 980 | 999 | 1308 | 1263 | 1195 | 1165 | 1550 |
| Number of banks abroad | 6 | 22 | 26 | 22 | 25 | 23 | 22 | 25 | 41 |
| Number of countries with affiliate | 15 | 22 | 24 | 28 | 26 | 26 | 24 | 28 | 30 |
| Average number of countries with affiliate | 11.3 | 11.8 | 14.1 | 15.9 | 14.9 | 13.9 | 10.1 | 15.1 | 13.6 |
| Average loans and advances per bank | 36186.94 | 38262.9 | 44879.12 | 48707.76 | 55369.8 | 43633.85 | 38784.66 | 38582.9 | 41450.18 |
| Average loans and advances per country | 14356.04 | 16182.98 | 18072.68 | 19431.21 | 21373.17 | 15636.2 | 13979.33 | 14353.88 | 16051.95 |

Notes: This table reports in the yearly columns bank sample characteristics pertaining to those intermediaries that report cross-border lending to non-financial firms to the external position report (*Auslandstatus*) of Deutsche Bundesbank. The last column shows the unique *Number of banks*, which we could match manually with Bankscope information and that enters our regression sample. Of these banks it reports the unique *Number of banks abroad* via foreign affiliates. The *Number of countries with affiliate* is the number of unique countries that has at least one affiliate. The *Average number of countries with affiliate* is the average number of countries within a group (commercials, savings etc.) in which banks have affiliates. Finally, we report *Average loans and advances per bank* and *per country* in thousands of euro.

Table 3: Summary statistics ijt-dimension according to presence abroad

| | mean | std | N | mean | std | N |
|---|---|---|---|---|---|---|
| | Commercials not abroad | | | Commercials abroad | | |
| Bank marginal costs ($c_{ijt}$) | 0.034 | 0.022 | 7634 | 0.032 | 0.017 | 910 |
| Marginal costs abroad ($c_{2jt}$) | 0.020 | 0.014 | 7634 | 0.016 | 0.011 | 910 |
| Cost leadership $I(c_{2jt} > c_{ijt})$ | 0.288 | 0.453 | 7634 | 0.195 | 0.396 | 910 |
| Price of capital abroad ($r_{jt}$) | 3.822 | 2.463 | 7634 | 3.096 | 1.986 | 910 |
| Return on equity ($roe$) | 21.574 | 13.693 | 7634 | 17.562 | 9.877 | 910 |
| Z-score ($zs$) | 25.089 | 23.647 | 7634 | 18.860 | 14.103 | 910 |
| Credit risk ($cr$) | 1.324 | 1.421 | 7634 | 0.888 | 0.930 | 910 |
| Cost-to-income ratio ($cit$) | 36.049 | 16.383 | 7634 | 30.227 | 11.338 | 910 |
| Loans and advances abroad | 0.000 | 0.000 | 7634 | 2463.559 | 14446.662 | 910 |
| | Savings not abroad | | | Savings banks abroad | | |
| Bank marginal costs ($c_{ijt}$) | 0.033 | 0.006 | 75685 | 0.017 | 0.008 | 600 |
| Marginal costs abroad ($c_{2jt}$) | 0.020 | 0.014 | 75685 | 0.015 | 0.009 | 600 |
| Cost leadership ($I(c_{2jt} > c_{ijt})$) | 0.167 | 0.373 | 75685 | 0.430 | 0.495 | 600 |
| Price of capital abroad($r_{jt}$) | 3.754 | 2.439 | 75685 | 2.819 | 1.497 | 600 |
| Return on equity ($roe$) | 19.744 | 6.717 | 75685 | 24.953 | 12.762 | 600 |
| Z-score ($zs$) | 36.831 | 18.805 | 75685 | 19.032 | 9.524 | 600 |
| Credit risk ($cr$) | 0.995 | 0.646 | 75685 | 0.655 | 0.524 | 600 |
| Cost-to-income ratio ($cit$) | 36.389 | 5.614 | 75685 | 14.411 | 8.168 | 600 |
| Loans and advances abroad | 0.000 | 0.000 | 75685 | 346.183 | 981.080 | 600 |
| | Cooperatives not abroad | | | Cooperatives abroad | | |
| Bank marginal costs ($c_{ijt}$) | 0.036 | 0.007 | 127143 | 0.011 | 0.011 | 157 |
| Marginal costs abroad ($c_{2jt}$) | 0.020 | 0.014 | 127143 | 0.015 | 0.010 | 157 |
| Cost leadership ($I(c_{2jt} > c_{ijt})$) | 0.138 | 0.345 | 127143 | 0.694 | 0.462 | 157 |
| Price of capital abroad ($r_{jt}$) | 3.749 | 2.404 | 127143 | 2.797 | 1.737 | 157 |
| Return on equity ($roe$) | 16.696 | 5.961 | 127143 | 9.820 | 5.049 | 157 |
| Z-score ($zs$) | 32.422 | 18.202 | 127143 | 29.338 | 12.438 | 157 |
| Credit risk ($cr$) | 0.936 | 0.643 | 127143 | 0.952 | 0.562 | 157 |
| Cost-to-income ratio ($cit$) | 42.194 | 7.357 | 127143 | 18.207 | 11.386 | 157 |
| Loans and advances abroad | 0.000 | 0.000 | 127143 | 102.943 | 566.395 | 157 |
| | Total not abroad | | | Total abroad | | |
| Bank marginal costs ($c_{ijt}$) | 0.035 | 0.008 | 210462 | 0.025 | 0.016 | 1667 |
| Marginal costs abroad ($c_{2jt}$) | 0.020 | 0.014 | 210462 | 0.016 | 0.010 | 1667 |
| Cost leadership ($I(c_{2jt} > c_{ijt})$) | 0.154 | 0.361 | 210462 | 0.326 | 0.469 | 1667 |
| Price of capital ($r_{jt}$) | 3.754 | 2.419 | 210462 | 2.968 | 1.806 | 1667 |
| Return on equity ($roe$) | 17.969 | 6.861 | 210462 | 19.493 | 11.652 | 1667 |
| Z-score ($zs$) | 33.741 | 18.836 | 210462 | 19.909 | 12.840 | 1667 |
| Credit risk ($cr$) | 0.971 | 0.692 | 210462 | 0.810 | 0.784 | 1667 |
| Cost-to-income ratio ($cit$) | 39.883 | 7.868 | 210462 | 23.402 | 12.782 | 1667 |
| Loans and advances abroad | 0.000 | 0.000 | 210462 | 1479.130 | 10743.371 | 1667 |

Notes: This table reports summary statistics on the estimated marginal costs, prices and control variables per banking group. Each group includes the large and central as well as the regional banks. Std indicates standard deviation, N indicates the number of observations. All marginal costs follow from the sum of the derivatives of the cost function w.r.t to outputs y1, y2 and y3. All prices follow from the scaled sum of fitted total operating costs and fitted profits. We take the 5th percentile of the distribution of prices and costs in each foreign country i at time t or in Germany at time t. The markup abroad is calculated as Marginal costs abroad (5th percentile) / Bank marginal costs $\times$ 100%. Loans and advances are given in thousands of euros. Cost leadership is a dummy that equals one when $c_{2jt} > c_{ijt}$ and zero otherwise.

Table 4: Summary statistics macro variables j,t dimension

| variable | mean | sd | p5 | p95 | N |
|---|---|---|---|---|---|
| Capital Stock | 4244.124 | 9125.346 | 46.445 | 25458.480 | 109 |
| Marginal product of capital | 0.054 | 0.014 | 0.029 | 0.073 | 109 |
| German FDI | 23707.500 | 49233.770 | 13.836 | 123885.700 | 109 |
| Distance | 3.834 | 3.588 | 0.520 | 9.608 | 109 |
| Capital regulation | 5.670 | 1.689 | 2.000 | 8.000 | 109 |
| Activity restrictions | 9.761 | 2.121 | 6.000 | 13.000 | 109 |

Notes: This table reports summary statistics on the macro-economic variables used to control for the loan supply and foreign entry costs. Sd indicates standard deviation, N indicates the number of observations and p5 and p95 are the 5th and 95th percentile, respectively. Following Caselli and Feyrer (2007) we calculate the marginal product of capital as Capital share $\times$ (Constant price GDP per capita $\times$ Population/Capital Stock) and adjust for the price of capital relative to the price of consumption goods. Data on GDP per capita, Capital Stock and relative prices come from Version 7.2 of the Penn World Tables. (PWT, Heston, Summers and Aten (2011)). We use Caselli and Feyrer's data to calculate the capital share as one minus the labor share and adjust for differences in reproducible capital's share of total capital income. The Capital stock is computed from the Penn World Tables using PPP converted GDP per capita, the perpetual inventory method and a six-percent depreciation rate. German FDI is the aggregate volume in millions of euros and is obtained from the Microdatabase on foreign direct investment (MiDI) of the Deutsche Bundesbank. Distance is the geographic distance between Germany and the host country in thousands of kilometers and is obtained from CEPII, Paris. Capital regulation is a combined measure of overall and initial capital stringency, ranging from zero to nine, with a higher value indicating greater stringence. Activity restrictions indicate whether banks are restricted from enganging in securities underwriting, insurance underwriting and selling, real estate investments, management, and development. Higher values indicate more restrictions. Both Capital regulation and Activity restrictions were obtained from Barth and Levine (2001).

Table 5: Cost leadership and the probability of banks going abroad: Main estimates

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Bank marginal costs | −0.0168*** | −0.0098*** | −0.0102*** | −0.0089*** | −0.0093*** | 0.0018** | 0.0049*** |
| | [0.0013] | [0.0010] | [0.0011] | [0.0010] | [0.0010] | [0.0009] | [0.0010] |
| Marginal costs abroad | 0.0004 | 0.0003 | 0.0003 | 0.0003 | 0.0004 | 0.0002 | 0.0002 |
| | [0.0003] | [0.0003] | [0.0003] | [0.0003] | [0.0003] | [0.0003] | [0.0003] |
| Cost leadership dummy | 0.0067*** | 0.0047*** | 0.0046*** | 0.0045*** | 0.0048*** | 0.0025** | 0.0023** |
| | [0.0014] | [0.0012] | [0.0012] | [0.0012] | [0.0012] | [0.0010] | [0.0010] |
| Price of capital abroad | −0.0010 | −0.0008 | −0.0008 | −0.0007 | −0.0008 | −0.0003 | −0.0003 |
| | [0.0007] | [0.0006] | [0.0006] | [0.0006] | [0.0006] | [0.0006] | [0.0006] |
| Capital stock | −0.0095 | −0.0090 | −0.0089 | −0.0081 | −0.0089 | −0.0084 | −0.0075 |
| | [0.0094] | [0.0089] | [0.0089] | [0.0089] | [0.0089] | [0.0087] | [0.0088] |
| Marginal product of capital | 0.0061 | 0.0062* | 0.0061* | 0.0059* | 0.0062* | 0.0047 | 0.0046 |
| | [0.0038] | [0.0036] | [0.0036] | [0.0036] | [0.0036] | [0.0034] | [0.0034] |
| Return on equity | | | 0.0015*** | | | | −0.0045*** |
| | | | [0.0005] | | | | [0.0005] |
| Z-score | | | | −0.0058*** | | | −0.0052*** |
| | | | | [0.0006] | | | [0.0005] |
| Credit risk | | | | | −0.0013*** | | −0.0006** |
| | | | | | [0.0002] | | [0.0003] |
| Cost-to-income ratio | | | | | | −0.0198*** | −0.0213*** |
| | | | | | | [0.0012] | [0.0012] |
| Country fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank group dummies | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 212129 | 212129 | 212129 | 212129 | 212129 | 212129 | 212129 |
| $\hat{\rho}$ p5 | 0.0006 | 0.0001 | 0.0001 | 0.0000 | 0.0001 | 0.0000 | 0.0000 |
| $\hat{\rho}$ p95 | 0.0171 | 0.0188 | 0.0194 | 0.0210 | 0.0187 | 0.0167 | 0.0162 |
| R-squared | 0.1675 | 0.3254 | 0.3267 | 0.3515 | 0.3281 | 0.4289 | 0.4643 |
| AROC | 0.804 | 0.959 | 0.959 | 0.961 | 0.959 | 0.972 | 0.973 |

Notes: this table reports the Probit marginal effects of estimating equation (9) for the years 2002 to 2010. All explanatory variables are lagged one period and all estimations include country and year fixed effects. $\hat{\rho}$ p5 and $\hat{\rho}$ p95 indicate the 5th and 95th percentiles, respectively, of the fitted values of the Probit. AROC indicates the area under the receiver operating characteristic curve. Standard errors clustered at the bank-country level are in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Cost leadership and the probability of banks going abroad: Alternative fixed entry cost proxies

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Bank marginal costs | −0.0170*** | −0.0098*** | −0.0102*** | −0.0089*** | −0.0093*** | 0.0016* | 0.0046*** |
| | [0.0012] | [0.0010] | [0.0011] | [0.0009] | [0.0010] | [0.0009] | [0.0010] |
| Marginal costs abroad | 0.0015** | 0.0015*** | 0.0015*** | 0.0015*** | 0.0015*** | 0.0012** | 0.0012** |
| | [0.0006] | [0.0006] | [0.0006] | [0.0006] | [0.0006] | [0.0006] | [0.0006] |
| Cost leadership dummy | 0.0055*** | 0.0042*** | 0.0042*** | 0.0040*** | 0.0043*** | 0.0022** | 0.0020** |
| | [0.0013] | [0.0011] | [0.0011] | [0.0011] | [0.0011] | [0.0010] | [0.0009] |
| Price of capital abroad | −0.0027*** | −0.0025*** | −0.0024*** | −0.0024*** | −0.0025*** | −0.0014* | −0.0013 |
| | [0.0010] | [0.0009] | [0.0009] | [0.0009] | [0.0009] | [0.0009] | [0.0008] |
| Capital stock | 0.0007 | 0.0006 | 0.0006 | 0.0007 | 0.0006 | 0.0007 | 0.0007 |
| | [0.0006] | [0.0006] | [0.0006] | [0.0005] | [0.0005] | [0.0005] | [0.0005] |
| Marginal product of capital | −0.0007 | −0.0004 | −0.0004 | −0.0006 | −0.0004 | −0.0011 | −0.0014 |
| | [0.0020] | [0.0018] | [0.0018] | [0.0018] | [0.0018] | [0.0018] | [0.0018] |
| German FDI | 0.0011*** | 0.0011*** | 0.0011*** | 0.0011*** | 0.0011*** | 0.0009** | 0.0010*** |
| | [0.0004] | [0.0004] | [0.0004] | [0.0004] | [0.0004] | [0.0004] | [0.0004] |
| Distance | −0.0013*** | −0.0011** | −0.0011** | −0.0012*** | −0.0011** | −0.0011*** | −0.0011*** |
| | [0.0005] | [0.0005] | [0.0005] | [0.0005] | [0.0005] | [0.0004] | [0.0004] |
| Capital restrictions | −0.0002 | −0.0003 | −0.0003 | −0.0003 | −0.0003 | −0.0002 | −0.0002 |
| | [0.0011] | [0.0010] | [0.0010] | [0.0010] | [0.0010] | [0.0009] | [0.0009] |
| Activity restrictions | −0.0021 | −0.0024 | −0.0024 | −0.0025 | −0.0024 | −0.0028** | −0.0030** |
| | [0.0017] | [0.0016] | [0.0016] | [0.0016] | [0.0016] | [0.0014] | [0.0014] |
| Return on equity | | | 0.0015*** | | | | −0.0045*** |
| | | | [0.0005] | | | | [0.0005] |
| Z-score | | | | −0.0059*** | | | −0.0053*** |
| | | | | [0.0006] | | | [0.0005] |
| Credit risk | | | | | −0.0013*** | | −0.0006** |
| | | | | | [0.0002] | | [0.0003] |
| Cost-to-income ratio | | | | | | −0.0194*** | −0.0209*** |
| | | | | | | [0.0012] | [0.0012] |
| Country fixed effects | No | No | No | No | No | No | No |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank group dummies | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 203888 | 203888 | 203888 | 203888 | 203888 | 203888 | 203888 |
| $\hat{\rho}$ p5 | 0.0006 | 0.0001 | 0.0001 | 0.0000 | 0.0001 | 0.0000 | 0.0000 |
| $\hat{\rho}$ p95 | 0.0170 | 0.0193 | 0.0198 | 0.0211 | 0.0192 | 0.0168 | 0.0160 |
| R-squared | 0.1664 | 0.324 | 0.3253 | 0.3518 | 0.3268 | 0.4275 | 0.4648 |
| AROC | 0.803 | 0.959 | 0.960 | 0.961 | 0.959 | 0.972 | 0.973 |

Notes: this table reports the Probit marginal effects of estimating equation (9) for the years 2002 to 2010. $\hat{\rho}$ p5 and $\hat{\rho}$ p95 indicate the 5th and 95th percentiles, respectively, of the fitted values of the Probit. AROC indicates the area under the receiver operating characteristic curve. Standard errors clustered at the bank-country level are in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Cost leadership and the probability of banks going abroad: Robustness check branches vs. subsidiaries

| | Branches | | | | | | Subsidiaries | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Bank marginal costs | −0.0037*** | −0.0023*** | −0.0016** | −0.0015** | 0.0055*** | 0.0067*** | −0.0126*** | −0.0073*** | −0.0069*** | −0.0071*** | −0.0021*** | −0.0004 |
| | [0.0010] | [0.0008] | [0.0007] | [0.0007] | [0.0009] | [0.0010] | [0.0009] | [0.0007] | [0.0007] | [0.0007] | [0.0006] | [0.0006] |
| Marginal costs abroad | 0.0002 | 0.0002 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0000 | −0.0000 |
| | [0.0002] | [0.0002] | [0.0002] | [0.0002] | [0.0002] | [0.0002] | [0.0003] | [0.0003] | [0.0003] | [0.0003] | [0.0003] | [0.0003] |
| Cost leadership dummy | 0.0039*** | 0.0027*** | 0.0027*** | 0.0028*** | 0.0018*** | 0.0017** | 0.0024*** | 0.0020** | 0.0017** | 0.0020** | 0.0010 | 0.0008 |
| | [0.0012] | [0.0008] | [0.0009] | [0.0009] | [0.0007] | [0.0007] | [0.0009] | [0.0009] | [0.0008] | [0.0009] | [0.0008] | [0.0007] |
| Price of capital abroad | −0.0007* | −0.0006 | −0.0006 | −0.0006* | −0.0003 | −0.0004 | −0.0003 | −0.0002 | −0.0002 | −0.0002 | −0.0001 | 0.0000 |
| | [0.0004] | [0.0004] | [0.0004] | [0.0004] | [0.0004] | [0.0004] | [0.0006] | [0.0005] | [0.0006] | [0.0005] | [0.0005] | [0.0005] |
| Capital stock | −0.0017 | −0.0023 | −0.0024 | −0.0025 | −0.0014 | −0.0013 | −0.0075 | −0.0066 | −0.0060 | −0.0066 | −0.0066 | −0.0059 |
| | [0.0060] | [0.0058] | [0.0058] | [0.0058] | [0.0059] | [0.0059] | [0.0079] | [0.0078] | [0.0078] | [0.0079] | [0.0076] | [0.0077] |
| Marginal product of capital | 0.0015 | 0.0010 | 0.0010 | 0.0012 | 0.0002 | 0.0002 | 0.0026 | 0.0028 | 0.0028 | 0.0029 | 0.0023 | 0.0026 |
| | [0.0024] | [0.0024] | [0.0024] | [0.0024] | [0.0024] | [0.0024] | [0.0030] | [0.0029] | [0.0029] | [0.0029] | [0.0027] | [0.0028] |
| Return on equity | | 0.0018*** | | | | −0.0014*** | | 0.0003 | | | | −0.0029*** |
| | | [0.0004] | | | | [0.0003] | | [0.0003] | | | | [0.0003] |
| Z-score | | | −0.0020*** | | | −0.0012*** | | | −0.0040*** | | | −0.0040*** |
| | | | [0.0004] | | | [0.0004] | | | [0.0003] | | | [0.0003] |
| Credit risk | | | | −0.0011*** | | −0.0011*** | | | | −0.0002 | | 0.0003 |
| | | | | [0.0001] | | [0.0001] | | | | [0.0002] | | [0.0002] |
| Cost-to-income ratio | | | | | −0.0116*** | −0.0119*** | | | | | −0.0095*** | −0.0108*** |
| | | | | | [0.0010] | [0.0011] | | | | | [0.0008] | [0.0008] |
| Country fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank group dummies | No | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes |
| Observations | 212129 | 212129 | 212129 | 212129 | 212129 | 212129 | 211130 | 211130 | 211130 | 211130 | 211130 | 211130 |
| $\hat{\rho}$ p5 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| $\hat{\rho}$ p95 | 0.0060 | 0.0099 | 0.0098 | 0.0097 | 0.0069 | 0.0064 | 0.0110 | 0.0094 | 0.0106 | 0.0093 | 0.0088 | 0.0083 |
| R-squared | 0.0852 | 0.2180 | 0.2255 | 0.2203 | 0.3931 | 0.4153 | 0.2084 | 0.3603 | 0.3887 | 0.3604 | 0.4128 | 0.4528 |
| AROC | 0.745 | 0.931 | 0.939 | 0.930 | 0.952 | 0.960 | 0.860 | 0.974 | 0.975 | 0.974 | 0.979 | 0.980 |

Notes: this table reports the Probit marginal effects of estimating equation (9) for the years 2002 to 2010, where (1)—(6) indicate the estimates for the branches and (7)—(12) those for the subsidiaries. All explanatory variables are lagged one period and all estimations include country and year fixed effects. $\hat{\rho}$ p5 and $\hat{\rho}$ p95 indicate the 5th and 95th percentiles, respectively, of the fitted values of the Probit. AROC indicates the area under the receiver operating characteristic curve. Standard errors clustered at the bank-country level are in brackets.*** p<0.01, ** p<0.05, * p<0.1

Table 8: Heckman selection model: The probability and the amount lent abroad

| | $Y_{ijt}$ | $T_{ijt}$ | $Y_{ijt}$ | $T_{ijt}$ |
|---|---|---|---|---|
| Bank marginal costs | 0.2319 | 0.0047*** | 0.2354 | 0.0049*** |
| | [0.2242] | [0.0005] | [0.2248] | [0.0005] |
| Marginal costs abroad | 0.1404* | 0.0008** | 0.1173 | 0.0002 |
| | [0.0775] | [0.0004] | [0.0778] | [0.0005] |
| Cost leadership dummy | 0.0051 | 0.0018*** | 0.0304 | 0.0023*** |
| | [0.1261] | [0.0006] | [0.1290] | [0.0006] |
| Price of capital abroad | −0.3635** | −0.0019*** | −0.3035** | −0.0003 |
| | [0.1488] | [0.0006] | [0.1454] | [0.0009] |
| Capital stock | 0.8646 | 0.0020*** | 0.8371 | −0.0075 |
| | [0.5887] | [0.0001] | [0.5881] | [0.0090] |
| Marginal product of capital | 0.4814 | −0.0010 | 0.6002 | 0.0046 |
| | [0.7163] | [0.0009] | [0.7138] | [0.0040] |
| Distance | | −0.0022*** | | |
| | | [0.0002] | | |
| Cost-to-income ratio | | −0.0214*** | −1.1084*** | −0.0213*** |
| | | [0.0006] | [0.3571] | [0.0006] |
| Return on equity | | −0.0045*** | −0.2009* | −0.0045*** |
| | | [0.0003] | [0.1091] | [0.0003] |
| Z-score | | −0.0051*** | −0.4182** | −0.0052*** |
| | | [0.0003] | [0.1722] | [0.0003] |
| Credit risk | | −0.0006*** | −0.0859* | −0.0006*** |
| | | [0.0002] | [0.0452] | [0.0002] |
| Inverse Mills ratio | 0.5534* | | 0.6571** | |
| | [0.3266] | | [0.3158] | |
| Country-fixed effecs | | No | | Yes |
| Year fixed effects | | Yes | | Yes |
| Bank-country fixed effects | Yes | | Yes | |
| Observations | 1667 | 212129 | 1667 | 212129 |
| $\hat{\rho}$ p5 | | 0.0000 | | 0.0000 |
| $\hat{\rho}$ p95 | | 0.0159 | | 0.0162 |
| AROC | | 0.971 | | 0.973 |
| R-squared | 0.941 | 0.4577 | 0.941 | 0.4643 |
| Adj. R-sq | 0.913 | | 0.913 | |

Notes: this table reports the estimates of a Heckman selection model, where $T_{ijt}$ indicates a foreign presence and $Y_{ijt}$ indicates the logarithm of loans and advances of bank $i$ in country $j$ on year $t$. Standard errors are adjusted for the fact that the inverse Mills ratio in the second step is an estimate. All explanatory variables are lagged one period. $\hat{\rho}$ p5 and $\hat{\rho}$ p95 indicate the 5th and 95th percentiles, respectively, of the fitted values of the Probit. AROC indicates the area under the receiver operating characteristic curve. Standard errors clustered at the bank-country level are in brackets. *** p<0.01, ** p<0.05, * p<0.1

Figure 1: Total number of subsidiaries and branches per country