Review of Finance (2013) 17: pp. 1401–1435
doi:10.1093/rof/rfs033
Advance Access publication: November 21, 2012

Do Banks Benefit from Internationalization? Revisiting the Market Power–Risk Nexus*

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Abstract. We analyze the impact of bank internationalization on domestic market power (Lerner index) and risk for German banks. Risk is measured by the official declaration of regulatory authorities that a bank is distressed. We distinguish the volume of foreign assets, the number of foreign countries, and different modes of foreign entry. Our analysis has three main results. First, higher market power is associated with lower risk. Second, holding assets in many countries reduce market power at home, but banks with a higher share of foreign assets exhibit higher market power. Third, bank internationalization is only weakly related to bank risk.

JEL Classification: F3, G21

1. Motivation

The ongoing turmoil on international banking markets calls the potential benefits of bank globalization into question. Large, internationally active banks may enjoy too much market power and bank internationalization may increase bank risk. So far, there is little empirical evidence analyzing the validity of these concerns. Many studies analyze the effects of foreign

* This article has been partly written during the visits of the authors to the research center of the *Deutsche Bundesbank*. The hospitality of the *Bundesbank* as well as the access to its bank-level financial accounts and External Position Report databases are gratefully acknowledged. Financial support from the National Science Foundation in the Netherlands (NWO) (M. Koetter), the Foundation "*Stiftung Geld und Währung*" (C. Koch), and the EFIGE project financed by the European Commission (SSH-2007-1.2.1) is gratefully acknowledged. We are grateful to Klaus Düllmann, Marcel Fratzscher, Heinz Herrmann, Thomas Kick, Cordula Munzert, Steven Ongena, Esteban Prieto, Winfried Rudek, participants of the seminars at the *European Central Bank*, at the *Deutsche Bundesbank*, at the Annual Meeting of the American Economic Association, and an anonymous referee for most helpful discussions and suggestions on an earlier draft. All errors and inconsistencies are solely our own responsibility.

banks on credit supply in destination countries[1] or performance differences between domestic and foreign banks abroad.[2] But evidence regarding the influence of bank internationalization on market power and risk in the home country is virtually absent from the literature. We close this gap and analyze the implications of bank internationalization on the domestic market power–risk nexus.

We use detailed bank-level data on financial accounts and international assets of all German banks provided by the *Deutsche Bundesbank*. The data allow identifying the number of countries where banks are active (the extensive margin), the share of foreign relative to total assets (the intensive margin), and the different modes of entry into foreign markets (cross-border asset holdings versus foreign branches). Based on the prudential financial accounts data, we estimate banks' markups as the (scaled) difference between average revenues and marginal cost. The resulting Lerner index is a bank-specific measure of market power (Koetter, Kolari, and Spierdijk, 2012). We also observe whether banks are officially declared as being distressed, which serves as our measure of risk (Dam and Koetter, 2012). We use a system estimator that accounts for the simultaneous determination of market power and risk conditional on bank internationalization.

This article contributes to three strands of literature. First, several papers focus on the determinants of cross-border expansion of banks (Berger *et al.*, 2003; Buch and Lipponer, 2007; De Haas and van Lelyveld, 2010). These studies find that regulatory and cultural barriers limit the international expansion of banks. Larger and more profitable banks overcome these barriers more easily. We account for this bank heterogeneity, but ask the reverse question: given that banks are active abroad, how does this foreign presence influence the domestic market power–risk nexus? Answering this question needs to take account of the fact that especially banks with sufficient margins and/or more appetite for risk might decide to expand internationally. To address these potential endogeneity concerns, we adapt the method of Frankel and Romer (1999) to capture the exogenous component of bank internationalization. They use the geographic component of

[1] For example, Mian (2006) and Detragiache, Gupta, and Tressel (2008) show that credit supply declines after the entry of foreign banks in host countries. Giannetti and Ongena (2012) report on the basis of within-host country differences among credit relationships that access to credit is not different between domestic and foreign banks. Survey-based evidence by Popov and Udell (2012) indicates that international banks hit by the crisis have contracted loan supply. However, none of these studies analyzes the effects of international banking on performance at home.

[2] See, Claessens and van Horen (2012) for recent evidence and an overview of the literature.

international trade as an instrument for actual trade. We adapt their method to a panel context and exploit the fact that foreign GDP is a time-varying variable, which is exogenous to the individual bank.

Second, while a plethora of studies analyzes the determinants of bank risk, these studies usually ignore the role of bank internationalization (De Nicoló, 2001; Beltratti and Stulz, 2011). Amihud, DeLong, and Saunders (2002) examine the risk effects of cross-border bank mergers and report that, on average, cross-border bank mergers do not change the risk of acquiring banks. Méon and Weill (2005) study the impact of cross-border mergers in Europe on banks' exposures to macroeconomic risks. They find potential gains in risk diversification from cross-border mergers. Ongena, Popov, and Udell (2011) show that loose home-country regulation and supervision are associated with more risk taking by internationally active banks. We extend these studies by analyzing the most important modes of entry into foreign markets, not just mergers and acquisitions, by analyzing cross-border assets and assets held by foreign branches. We control for diversification effects by accounting for return correlations and distances between foreign markets and the home market, Germany.

Third, the market power–risk nexus for banks has been studied extensively. Many cross-country studies report a negative relationship between market power and bank risk (see, e.g., Beck, 2008; Schaeck, Cihak, and Wolfe, 2009; Ariss, 2010). This negative relationship is in line with the theories of Allen and Gale (2004) and Martinez-Miera and Repullo (2010), who argue that less intense competition increases banks' margins and buffers against loan losses. However, Boyd and De Nicoló (2005) show that banks with market power may inflict excessively high funding costs on corporate customers, ultimately leading to higher credit risk and bank instability. Hence, the theoretical literature provides no clear-cut predictions on the correlation between risk and market power. In contrast to previous empirical studies, we account for the effects of bank internationalization and for the simultaneous relationship between banks' market power and risk. Similar to Degryse and Ongena (2001), we take the simultaneity of (continuous) Lerner markups as measures of market power and (discrete) distress events explicitly into account by estimating a system of equations. After accounting for simultaneity and conditioning on banks' foreign activities, we find that the relationship between market power and risk is negative.

Our results show that being active in many countries (extensive margin) reduces market power, potentially indicating that most banks are not able to efficiently operate large multinational conglomerates. However, larger foreign asset shares (intensive margin) imply larger Lerner indices and

thus more domestic market power. Foreign asset holdings of foreign branches drive this effect. These results could indicate that the gains from a larger and (internationally) more diversified customer pool enhance the ability of banks to generate private information that can also be beneficial in home markets (Hauswald and Marquez, 2006). The impact of internationalization on risk is generally weak. We find an overall negative impact of bank internationalization only for small cooperative banks operating branches in several countries. For these banks, the costs of monitoring a large portfolio outweigh diversification benefits. These results are by and large robust to using alternative measures of market power and risk, to controlling for potential endogenous international activities, and to considering portfolio effects.

The remainder of this article is organized as follows. In Section 2, we develop theoretical hypotheses regarding the relationship between bank internationalization and the market power–risk nexus. In Section 3, we present the data and descriptive statistics. We describe the empirical model in Section 4 and discuss the regression results in Section 5. Section 6 concludes.

2. Theoretical Hypotheses

The core research question in this article is whether bank internationalization affects the market power and the risk of banks. We develop hypotheses based on the literature regarding the determinants of bank internationalization, portfolio effects in banking, and the market power–risk nexus.

2.1 MARKET POWER–RISK NEXUS

The relationship between market power and bank risk is ambiguous from a theoretical point of view. Higher market power may lead to lower risk because more concentrated banking systems reduce incentives of bankers to lend recklessly, and because more concentrated systems can be supervised more effectively by regulators (Allen and Gale, 2004). In a similar vein, Keeley (1990) argues that lower market power reduces profits and thereby makes taking excessive risks more attractive. Another reason for a negative relationship between market power and risk is that increasing competitive pressure, for instance due to foreign contestants, may reduce the customer pool of the average bank, and thus its ability to generate private information (Hauswald and Marquez, 2006). More severe information asymmetries can then increase average credit risk.

But the relationship between market power and risk might also be positive. Higher market power may lead to increased risk taking if banks can roll over loan risk by charging higher interest rates to customers (Boyd and de Nicoló, 2005). If borrowers endogenously choose the risk of their project, an increase in lending rates increases the risk due to an adverse selection effect. Martinez-Miera and Repullo (2010) show that this risk-shifting effect is due to the assumption that loan default rates are perfectly correlated. With imperfect correlations of loan default rates, there is an additional so-called *margin effect*: more competition lowers (expected) loan rates and thus reduces buffers against loan losses. Banks become riskier. The net effect is ambiguous, and we will thus explore which effect dominates in the German data.

2.2 INTERNATIONALIZATION AND MARKET POWER

In this section, we argue that we expect a positive relationship between bank internationalization and market power. We measure market power with bank-specific Lerner indices, which are calculated as the difference between average revenues and marginal cost, scaled by average revenues. We prefer Lerner indices because accounting-based return measures neglect random noise (Bauer *et al*., 1998), and because too few German banks are listed to permit the use of market-based return measures. Given an ongoing debate on how to measure competition and market power in banking (Delis, 2012), we do also consider simple market shares as well as Boone (2008) indicators as alternatives to the Lerner index.

Internationalization may thus affect bank market power through changes in marginal cost revenues, or a combination of both. In contrast to the literature on multinational corporations, no generally accepted model of the international bank exists (Goldberg, 2007). However, existing literature implicitly indicates how bank internationalization could affect average revenues and marginal cost.

Regarding the revenue channel, bank internationalization should increase market power and thus markups because banks have more opportunities to generate private information that can also be exploited in the domestic market. We know from previous work that banks follow their corporate customers abroad (Ball and Tschoegl, 1982; Brealey and Kaplanis, 1996). Private information about foreign markets that is acquired through these relationships is valuable because it may facilitate the support of foreign expansions of other domestic customers. Such information can provide banks with a competitive advantage. This aspect could be particularly relevant in Germany, where many mid-sized firms are active internationally and where

the banking market is characterized by many small and regionally focused banks. Indeed, anecdotal evidence suggests that the German *Sparkassen* perceive their limited presence on foreign markets as being one disadvantage when compared to larger commercial banks. Likewise, Brickley, Linck, and Smith (2012) show that small community banks in the USA prefer so-called banker's banks[3] over larger, national financial institutions to act as correspondent banks in order to avoid sharing private information on local business with these larger potential competitors. Banker's banks are thus a specific form of direct investment by community banks to conduct out-of-state business in order to preserve an informational, i.e., competitive advantage inherent to their local business relationships.

The second channel through which bank internationalization can affect market power is related to marginal cost. New contestants reduce the average number of customers per bank (Hauswald and Marquez, 2006). This decline erodes the ability to properly assess credit applicants because the pool of private sources of information shrinks. A reduced capability in information generation can be countered by a more intensive use of information and communication technology, which increases the screening costs of the bank. International banks should thus have better information sources through a larger customer base and through the mere addition of country expertise. Such banks should therefore incur *ceteris paribus* lower costs to generate private information. In the international trade literature, marginal cost differences across firms reflect productivity differences, which are often assumed to be exogenous. However, for manufacturing firms, it has been argued that exporters invest to raise their productivity up to the point above which they can compete in foreign markets (Lileeva and Trefler, 2010). International trade, in turn, generates learning effects, which leads to endogenous technology improvements that reduce marginal cost. In this vein, international banks might improve their productivity, reduce their marginal cost, and thus increase their market power and markups.

Overall, we expect the information generation effect and the productivity effect of international banking to reduce marginal cost. The market power of banks should therefore increase in the degree of internationalization due to higher revenues and reduced marginal costs.

[3] "Banker's banks" are cooperatives that are owned by community banks. They provide correspondent banking services, such as loan participation, check clearing, but also international services.

2.3 INTERNATIONALIZATION AND RISK

We expect that a higher degree of internationalization in terms of the number of foreign countries (extensive margin) reduces risk. A higher degree of bank internationalization in terms of the volume of foreign assets (intensive margin) does not have a clear-cut impact on bank risk. The reason for this is as follows. Banks can be modeled as portfolio managers that optimize utility as a positive function of expected profits and a negative function of expected portfolio risk (Rochet, 2008). International diversification of assets may then reduce bank risk if the correlation between domestic and foreign returns is sufficiently low or even negative (Berger, 2000).

Two effects run counter to this potential diversification effect. First, banks have incentives to shift risk to countries where the regulatory safety net and its associated implicit and explicit guarantees are underpriced (John, John, and Senbet, 1991; John, Saunders, and Senbet, 2000). Second, an internationally active bank may face monitoring problems related to a loan customer base or the operating cost structure of managing numerous large international assets, which taken together ultimately increase the risk of the bank (Berger, 2000). If monitoring and information costs are high, bank risk might increase, in particular when banks are active in geographically distant markets (Degryse and Ongena, 2005).

To capture diversification effects, we use information on the number of countries in which banks are active (the extensive margin). The expected impact on risk is negative. The effect of the share of foreign activities in total assets (the intensive margin) on bank risk is ambiguous. We explore below to what extent it depends on the correlation of destination markets with the German market and geographical distance, which should increase risk.[4]

3. Data and Descriptive Statistics

To investigate the relationship between bank internationalization, market power, and risk, we use several proprietary bank-level data sets provided by the *Deutsche Bundesbank*. The detailed database on banks' international assets is an important novelty of this article.[5] From the so-called "External

[4] We consider output growth and equity return correlations for lack of preferable data on the returns on foreign financial exposures.

[5] For previous research using these data, see Buch, Koch, and Koetter (2011) or Düwel, Frey, and Lipponer (2011).

Position Report", we get comprehensive information on foreign assets of German banks and their foreign branches year-by-year and country-by-country. Foreign assets comprise loans to banks and nonbanks, stocks, and bonds but exclude off-balance sheet items except for irrevocable credit commitments. The sample period spans 4 years (2003–06). Reporting thresholds on international positions had been abolished at the end of 2001. We focus on the pre-crisis period to exclude the effects of government interventions. Instead, we focus on banks' behavior for a period unaffected by such interventions.

We complement the "External Position Report" with information from prudential financial accounts. Each bank with a German banking license has to submit these data to the supervisory authority. These data pertain to individual banks, not to bank-holding companies, and are unconsolidated. Financial statements include the data of foreign branches, but not of subsidiaries. To measure internationalization, market power, and risk at the same level, we therefore disregard international assets held through subsidiaries. This approach ensures that we assess the domestic market power–risk nexus conditional on the international activities of each German bank that constitutes a legal entity, which includes foreign branch data. These legal entities are also the subject of domestic prudential supervision, antitrust regulation, deposit insurance, and the like.

Subsidiaries, in contrast, are subject to host country control, for example, regarding capital requirements. Clearly, the recent experience of various German banks illustrates that excessive risk taking abroad through subsidiaries can ultimately lead to distress of the entire bank-holding company. We therefore consider foreign activities through subsidiaries as a robustness test because data limitations prevent us from analyzing subsidiaries in a fully parallel fashion. Results mimic the findings reported below for foreign branches. But clearly, further research dissecting more explicitly the implications of internal capital markets, for example, along the lines of De Haas and van Lelyveld (2010), is warranted.

3.1 MEASURING BANK INTERNATIONALIZATION

We obtain data on cross-border assets held by individual banks and on foreign assets held by their respective foreign branches from the "External Position Report." The vast majority of banks holds international assets in at least one foreign country (Buch, Koch, and Koetter, 2011). On average, only 28 out of a total of 2,235 banks that were active in Germany during the sample period are purely domestic. But branches are a cost-intensive entry

Table I. Descriptive statistics on bank internationalization

This table gives the descriptive statistics for the extensive and the intensive margin of banks' foreign activities for the sample period between 2003 and 2006. The *extensive margin* reported in Panel A is a count variable measuring either the number of destination countries in which banks hold foreign assets or the number of countries in which a bank operates foreign branches. The *intensive margin* reported in Panel B is the share of foreign assets relative to the total assets of a bank. We distinguish between assets held in the cross-border mode and assets held through foreign branches. We report each of these measures for all banks included in the sample and for the banks with foreign branches in isolation.

	Full sample (7,118 bank-year observations)			Banks with branches (138 bank-year observations)		
	Mean (SD)	p1	p99	Mean (SD)	p1	p99
Panel A: number of destination countries (extensive margin)						
Cross-border plus branches	13.58	1	54	41.57	0	71
	(9.425)			(21.03)		
Cross-border	13.61	2	54	42.72	7	71
	(9.455)			(20.06)		
Branches	0.087	0	1	4.475	1	32
	(1.084)			(6.39)		
Panel B: foreign asset share (intensive margin)						
Cross-border plus branches	0.044	0	0.434	0.347	0.009	0.828
	(0.076)			(0.231)		
Cross-border	0.042	0	0.322	0.241	0.005	0.958
	(0.066)			(0.185)		
Branches	0.002	0	0.076	0.120	0.001	0.640
	(0.026)			(0.143)		
Total assets	2,090	28	36,60	55,000	198	133,000
	(11,400)			(56,800)		

mode into foreign markets, which only 27 banks choose to serve foreign markets. Subsidiaries and/or branches are run by 37 banks.

We compute two measures of internationalization at the bank level. The first is the *extensive margin* as the number of countries where a bank either holds cross-border foreign assets or operates a foreign branch. If a bank has several branches in a given host country, these are counted as a single observation per bank and country. The difference in the extensive margin between banks with and without foreign branches is stark. The average bank holds foreign assets in approximately 14 countries but hardly any foreign branches (Column 1, Table I). Banks with foreign branches, in contrast, hold foreign assets in around 42 countries and operate foreign branches in approximately 4 countries on average. In this small group of truly international banks, the largest ones have assets in 71 countries in our

sample, and they operate branches in as many as 32 countries (Column 8, Table I).

The second measure of bank internationalization is the volume of foreign assets relative to total assets, i.e., the intensive margin. We aggregate all foreign assets of bank i in destination country j. We also separate the cross-border assets of the domestic headquarters from those held through foreign branches. Note the difference between the destination and host country perspectives that applies to foreign branches: regarding the extensive margin, we consider the number of host countries where banks operate foreign branches, say Turkey. We aggregate the intensive margin, i.e., financial assets, across destination countries to which a foreign branch ultimately lends. The hypothetical Turkish branch may lend primarily to host country counterparties, but also to third-country borrowers, say Greece. Hence, the risk of these foreign assets would be poorly reflected by the host country alone. Considering the host country for the intensive margin captures banks' abilities to acquire host country expertise, whereas the destination country perspective captures the actual geographical diversification of foreign assets. Also, the latter accounts for the effect that branches in financial centers primarily serve as a lending platform to third-party destination countries. Column 1 of Table I shows that, on average, German banks hold ~4.4% of their total assets abroad through either one of these channels. The foreign asset share of the banks with foreign branches considered in isolation is much higher (34.7%).

Our baseline measures of bank internationalization do neither account for the correlation of returns nor for the distance between foreign markets and Germany. Both aspects might potentially affect market power and risk though (Coeurdacier and Guibaud, 2011). For this reason, we modify the extensive and intensive margin as measures of internationalization. For the extensive margin, we compute the average of foreign market equity correlations between the destination country and Germany. In a similar way, we compute real output growth correlations between the destination country and Germany as well as the geographical distance. If, for instance, a given bank is exposed to 10 foreign countries, we include the average of the correlations and distances between these markets and the German market as an additional covariate. Formally, this measure is given by $(1/N_i)\sum_{j=1}^{N_i}\delta_j$, where N_i is the number of (host) countries in which bank i is active (the extensive margin), and δ_j is the correlation between market j and the German market or the bilateral distance, respectively. Since we do not have the specific market returns on a bank-level, we proxy them by equity market returns and Gross domestic product (GDP) growth. For the intensive margin, we weigh foreign assets (the intensive margin) by correlations as well as geographic distances.

With Ai as total assets, we compute for each bank $\frac{1}{A_i}\sum_{j=1}^{N_i} FA_{ij}\delta_j$ and specify correlation- or distance-weighted intensive margins as a second covariate.

3.2 MEASURING MARKET POWER

Our preferred measure of bank market power is the Lerner index, i.e., the difference between average revenues and marginal cost, scaled by average revenues. A higher Lerner index indicates a lower degree of competition (a higher degree of market power). The Lerner index has the advantage that it nests different models of competition, and that it yields a measure at the level of the individual bank (Degryse, Kim, and Ongena, 2009). It can also be computed for each individual bank and for each year, and provides a measure of market power capturing revenue and cost aspects.

We compute the Lerner index from stochastic cost and profit frontier analysis to obtain competition measures net of operational slack (Koetter, Kolari, and Spierdijk, 2012). Marginal cost equal the total derivative of estimated operating cost frontiers with respect to four outputs (interbank loans, customer loans, securities, and off-balance sheet items). We estimate average revenues from a stochastic profit frontier. To account for the three-tier banking structure in Germany and the fact that banks operate under different technology regimes, we estimate both frontiers as latent classes as in Koetter and Poghosyan (2009). This takes account the three-tier structure of the German banking system with savings, cooperative, and (private) commercial banks. These banks differ with regard to their ownership structures, their ability to expand regionally, and their core business model. A latent class model permits production parameters to vary. Average revenues and marginal cost comprise revenues and costs associated with domestic, cross-border, and foreign branch asset holdings.

Bank competition measures are controversial (Carbó *et al.*, 2009). Boone (2008) suggests to directly measure how (cost) inefficiency, as reflected by differences in marginal cost, affects bank profitability. We therefore estimate how profits (π_i) change in response to bank's marginal cost (c_i) by running the following regression for each bank in our sample $\ln \pi_i = \alpha - \beta \ln(c_i)$ (see Degryse, Kim, and Ongena, 2009, p. 36–37). The coefficient β is the so-called Boone indicator of market power. Inefficient banks exhibit higher marginal cost that reduces profits. Therefore, β is negative, and lower market power is reflected by larger magnitudes of the Boone indicator (Delis, 2012). We estimate Boone indicators for each bank using bank-specific data that are available from 1994 until 2010.

Summary statistics for the bank-level variables are provided in Table II. Mean Lerner indices of 23 basis points are in line with the results reported by

De Guevara and Maudos (2007) for a sample of European banks and Koetter and Poghosyan (2009) for German banks. The mean Lerner index is smaller for banks with foreign branches (15 basis points), which may result from the greater degree of competitive pressure these banks are exposed to on international markets.

3.3 MEASURING BANK RISK

To measure bank risk, the previous literature often uses so-called *z*-scores, nonperforming loans, or the volatility of bank-level reserves, profits, or nonperforming loans (see, e.g., Beck, 2008; Laeven and Levine, 2009). Most of these measures capture important aspects of bank risk, but not necessarily the risk that the entire financial institution is distressed and may ultimately cease to exist. Our preferred measure of risk is a measure of bank distress based on the official prudential definition, namely "a situation in which an institutions existence will be endangered without support measures" (Deutsche Bundesbank, 2007, p. 75). Support measures are either exits through restructuring mergers ordered by the Federal Supervision Authorities (*Bundesanstalt für Finanzdienstleistungsaufsicht—BaFin*) or capital injections by bank pillar-specific insurance schemes (Dam and Koetter, 2012). The *Bundesbank* records distress events, which reveal whether the regulator deems the ultimate risk faced by a bank as being too high and thus running the risk of failure. Table II shows that the distress frequency is on average higher for banks that operate foreign branches (7%) than for the full sample (4%).

4. Empirical Model

When choosing their business model, banks implicitly also choose market power and risk of their activities. This is a simultaneous choice. We thus need to estimate the relationship between market power and risk jointly when analyzing the impact of internationalization on the market power–risk nexus. Contrary to the previous banking studies that specify simultaneous risk and return equation models based on continuous variables (Kwan and Eisenbeis, 1997), the distress indicator used to measure risk in this study is binary. Therefore, we employ an instrumental variables procedure suggested by Rivers and Vuong (1988) and described in Wooldridge (2002) for systems with one endogenous binary variable. Degryse and Ongena (2001) use this approach to analyze the relationship between the return on investment of banks and the number of creditor relationships.

Table II. Descriptive statistics for the regression data

This table gives the descriptive statistics for explanatory variables used in the regressions. The total number of bank-year observations is 7,118 and includes all banks with a German banking license between 2003 and 2006. The Lerner index equals the difference between average revenues and marginal cost, scaled by average revenues, multiplied by 100. The Boone indicator is the sensitivity of log profits with respect to log marginal cost as reflected by the coefficient of lnMC in a linear regression on the log of profits per bank. Average revenue and marginal cost are estimated with a latent class stochastic frontier specification of cost and profit functions using data for all German banks available between 1994 and 2010. The distress indicator equals one, if the existence of the bank was officially considered endangered and regulatory authorities step in by providing support measures, either capital injections or restructuring mergers. The *z*-score is $z = (E/A + RoA)/\sigma_{RoA}$ where E/A is the capital–asset ratio, RoA denotes return on assets, and σ_{RoA} denotes the SD of RoA. Output growth or equity return correlations are calculated between destination countries and Germany. Distances are measured in kilometers between destination countries and Germany. All explanatory variables are detailed in Appendix A.1.

	Full sample (7,118 bank-year observations)			Banks with branches (138 bank-year observations)		
	Mean (SD)	p1	p99	Mean (SD)	p1	p99
Market power						
Lerner index	22.67	−9.17	51.56	14.91	−32.61	57.47
	(11.69)			(20.91)		
Boone indicator	−0.89	−4.6	2.11	−0.64	−3.33	2.10
	(4.41)			(1.10)		
Risk						
Distress frequency	0.04	0	1	0.07	0	1
	(0.19)			(0.26)		
Z-score	−4.40	−17.65	0.92	−3.734	−23	1.268
	(4.04)			(4.59)		
Explanatory variables: market power						
Fee income	12.30	2.30	33.44	12.11	1.49	57.80
	(5.41)			(11.58)		
Size quintile	3.06	1	5	4.75	2	5
	(1.39)			(0.69)		
Herfindahl (output cateogories)	46.32	29.42	71.56	38.16	25.58	86.93
	(8.91)			(14.92)		
Publicly incorporated	0.04	0	1	0.50	0	1
	(0.20)			(0.5)		
Branches	28.87	0.17	101.1	8.10	0	88.97
	(21.24)			(17.42)		
Acquisitions	1.93	0	12	4.86	0	14
	(2.48)			(4.4)		
Explanatory variables: risk						
Core capital ratio	5.64	2.59	11.20	4.75	1.18	17.97
	(2.19)			(3.77)		

(continued)

Table II. Continued

	Full sample (7,118 bank-year observations)			Banks with branches (138 bank-year observations)		
	Mean (SD)	p1	p99	Mean (SD)	p1	p99
Reserves	1.51 (1.04)	0	4.58	0.29 (0.36)	0	1.64
Customer loan share	58.86 (12.90)	21.95	83.60	44.03 (20.44)	10.74	95.94
Nonperforming loans	8.75 (7.01)	0.3	32.86	8.05 (12.82)	0.22	66.56
Cost–income ratio	29.38 (6.36)	7.15	42.67	15.97 (12.15)	2.49	44.94
ROE	11.6 (11.57)	−23.29	34.42	9.63 (17.83)	−46.39	58.03
Cost efficiency	84.2 (9.98)	54	98.34	78.76 (18.72)	34.05	99.36
Profit efficiency	73.17 (13.24)	25.19	92.38	63.33 (22.93)	1.63	94.27
Extensive margin						
Average growth correlation	1 (0.163)	0.273	0.891	0.447 (0.154)	0.261	0.836
Average equity return correlation	1 (0.132)	0.345	0.929	0.492 (0.158)	0.214	0.875
Average distance	2,555 (929)	617	4,955	3,934 (1,043)	1,095	5,037
Intensive margin						
Weights = growth correlations	0.029 (0.047)	0	0.266	0.216 (0.140)	0.003	0.474
Weights = equity return correlations	0.003 (0.004)	0	0.018	0.010 (0.011)	0	0.051
Distance weights	85 (209)	0	942	892 (848)	8	2,786

The dependent variable in the market power equation is the Lerner index $LI_{it} = LI^{*}_{it}$, a fully observed continuous variable. Since the probability of distress is not observable, we proxy it by the binary indicator of an observable distress event, such that $PD_{it} = I(PD^{*}_{it} > 0)$. As a first step, we estimate reduced-form Equations (1a) and (1b) to generate instruments for market power (Lerner index = LI) and risk (probability of distress = PD):

$$LI_{it} = \Pi_1' \mathbf{X}_{it-1} + v_{1,it} \tag{1a}$$

$$PD_{it} = \Pi_2' \mathbf{X}_{it-1} + v_{2,it}, \tag{1b}$$

where i is a bank index and t denotes time. We lag the explanatory variables $\mathbf{X}_{it-1}$ by one period to avoid simultaneity. The market power Equation (1a) is estimated using OLS and yields the $(K \times 1)$-vector of parameter coefficients $\hat{\Pi}_1'$. The risk Equation (1b) is estimated using a probit model to obtain the $(K \times 1)$-vector of parameter coefficients $\hat{\Pi}_2'$. Equation (1a) also yields residuals as the difference between observed and fitted market power, $\hat{v}_{1,it} = \mathrm{LI}_{it} - \underset{it}{\hat{\mathrm{LI}}} = \mathrm{LI}_{it} - \hat{\Pi}_1' \mathbf{X}_{it-1}$. Next, we estimate the structural equations of interest:

$$\mathrm{LI}_{it} = \gamma_1 \hat{\mathrm{PD}}^*_{it} + \beta_1' \mathbf{X}_{1,it-1} + \varepsilon_{1,it} \tag{2a}$$

$$\mathrm{PD}^*_{it} = \gamma_2 \underset{it}{\mathrm{LI}} + \beta_2' \mathbf{X}_{2,it-1} + \theta \hat{v}_{1,it} + \varepsilon_{2,it}, \tag{2b}$$

where $\mathbf{X}_{1,it-1}$ and $\mathbf{X}_{2,it-1}$ are two different vectors of exogenous explanatory variables affecting market power and risk that include measures of bank internationalization. Lerner indices and the likelihood of distress are estimated using covariates that are lagged by one year to avoid simultaneity by construction. We follow the bank failure literature to select the covariates shown in Table II that shall explain the occurrence of bank distress (see, e.g., Wheelock and Wilson, 1995). We also specify time-, region-, and banking group-fixed effects. The main qualitative results remain unchanged when we control for regional macroeconomic developments, such as the regional insolvency rate or GDP growth. Equations (2a) and (2b) is estimated with OLS and a probit model, respectively. We bootstrap the standard errors (SEs) because Equations (2a) and (2b) include generated regressors.

The simultaneity between banks' choices of market power and risk is handled in the following way. In the market power Equation (2a), we insert fitted values from the probit estimation of the risk Equation (1b). In the risk equation, we insert the residuals from the continuous reduced-form equation ($\hat{v}_{1,it}$) and the true continuous variable, i.e., the Lerner index LI_{it}. Rivers and Vuong (1988) recommend this procedure because the probit estimation relies on nonlinear estimation techniques. We also use a z-test of the null hypothesis $H_0 : \theta = 0$ that the true Lerner index LI_{it} is exogenous to the probability of distress.[6]

[6] Inserting fitted values from the market power Equation (1a) into the structural Equation (2a) instead of the combination of residuals and the true Lerner index would imply to estimate a probit model with an unknown scaling factor. This would not provide valid inference.

5. Results and Robustness Tests

Table III, Panel (A) provides results of OLS regressions using the Lerner index as dependent variable and Table III, Panel (B) provides results of probit models with the distress indicator as dependent variable. Subsequent tables account for the potential endogeneity of the internationalization variable (Panels A and B of Table IV) and portfolio effects when accounting for output growth and equity correlations as well as the distance between destination and home markets (Panels A and B of Table V).

5.1 MARKET POWER–RISK NEXUS

Columns 1, 2, and 4 of Table III show system estimates using the Lerner index as a measure of market power and the distress indicator as a risk proxy. Both cross terms, indicated by "predicted," are significant and negative. These results support the theoretical models by Allen and Gale (2004) or Martinez-Miera and Repullo (2010): banks with higher market power are less risky. Column 3 shows results using bank specific, but time-invariant Boone indicators to measure market power. There is no significant relationship between the average sensitivity of profits with respect to marginal cost (the Boone indicator), and bank risk. Note that Boone indicators are time-invariant because we estimate them bank-by-bank on time series of at most 17 years (1994–2010). Given this limitation, we continue henceforth with Lerner indices as measures of market power. We also specified the components of the Lerner index, average revenues, and marginal cost, separately, and we used market shares of banks in terms of total assets. Like the Boone indicator, these measures are insignificant. In addition, market power residuals are insignificant in the risk equation. Hence, the null hypothesis that market power is exogenous with respect to risk cannot be rejected.

The overall fit of the model is quite good with an adjusted R^2 of about 0.37 for the market power equation when using the Lerner index and a pseudo-R^2 of 0.29 for the risk equation. All results reported below are based on the regressions including the full set of control variables. In unreported regressions, we have excluded individual explanatory variables one by one to check whether our results might be driven by multicollinearity. This is not the case.

Table III. Baseline regression results

This table shows regression results for the simultaneous system of the market power (2a) and distress (2b) Equations. Estimations of the market power equation in Panel (A) use OLS, estimations of the probability of distress in Panel (B) use a probit model. All explanatory variables are lagged by one period and are defined in Appendix A.1 and Table II. Dummies for different banking groups, time, and regional fixed effects are included but not reported. Internationalization is measured by the number of countries in which bank is present (extensive margin or EM) and the foreign asset share relative to total assets (intensive margin or IM). Panel (A) depicts coefficients with bootstrapped SEs in brackets. Panel (B) reports marginal effects with bootstrapped SEs in brackets. We use two measures of market power: the Lerner index, which increases in the degree of market power, and the Boone indicator, which decreases in the degree of market power. ***, **, and *indicate significance at the 1%, 5%, and 10% levels.

	(1) Lerner index	(2) Lerner index	(3) Boone indicator	(4) Lerner index
Panel A: market power				
EM: number of destination countries (all)		−0.059**	0.070**	
		(0.025)	(0.036)	
IM: foreign asset share (all)		8.335**	−17.487**	
		(3.420)	(8.048)	
EM: number of destination countries (cross-border)				−0.049
				(0.031)
IM: foreign asset share (cross-border)				4.367
				(3.711)
EM: number of destination countries (branches)				−0.668**
				(0.279)
IM: foreign asset share (branches)				28.871***
				(7.390)
Risk (predicted)	−4.739***	−4.730***	−0.208	−4.729***
	(0.198)	(0.181)	(0.193)	(0.207)
Fee income	0.220***	0.228***	−0.004	0.228***
	(0.043)	(0.043)	(0.037)	(0.046)
Size quintile	−1.132***	−0.904***	−0.536***	−0.930***
	(0.125)	(0.147)	(0.139)	(0.146)
Herfindahl (output cateogories)	0.097***	0.103***	−0.085**	0.099***
	(0.014)	(0.015)	(0.034)	(0.018)
Publicly incorporated	−6.039***	−6.151***	−1.390**	−6.428***
	(1.353)	(1.245)	(0.662)	(1.413)
Branches	0.008	0.007	−0.012***	0.008
	(0.009)	(0.008)	(0.002)	(0.009)
Acquisitions	0.095*	0.078	0.001	0.089*
	(0.055)	(0.051)	(0.023)	(0.047)
Constant	16.183***	15.925***	4.169**	16.244***
	(2.165)	(2.178)	(1.949)	(2.427)
Observations	7,118	7,118	7,081	7,118
R^2	0.373	0.376	0.097	0.378

(continued)

Table III. Continued

	(1) Lerner index	(2) Lerner index	(3) Boone indicator	(4) Lerner index
Panel B: risk (distress indicator)				
Measure of market power:				
EM: number of destination countries (all)		0.0001	0.0002	
		(0.0001)	(0.0001)	
IM: foreign asset share (all)		0.0050	0.0028	
		(0.0202)	(0.0161)	
EM: number of destination countries (cross-border)				0.0002
				(0.0001)
IM: foreign asset share (cross-border)				−0.0001
				(0.0268)
EM: number of destination countries (branches)				−0.0047**
				(0.0022)
IM: foreign asset share (branches)				0.0876*
				(0.0482)
Market power (predicted)	−0.0013**	−0.0010**	−0.0001	−0.0009**
	(0.0005)	(0.0005)	(0.0006)	(0.0004)
Market power residuals	0.0008	0.0005	0.0004	0.0005
	(0.0005)	(0.0005)	(0.0006)	(0.0004)
Core capital ratio	0.0009	0.0007	−0.0005	0.0007
	(0.0009)	(0.0007)	(0.0009)	(0.0006)
Reserves	−0.0123***	−0.0129***	−0.0160***	−0.0127***
	(0.0015)	(0.0019)	(0.0021)	(0.0015)
Customer loan share	0.0002**	0.0002**	0.0001	0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Nonperforming loans	0.0000	0.0000	0.0002	0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Cost–income ratio	0.0004*	0.0003	0.0002	0.0003*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
ROE	−0.0003**	−0.0003**	−0.0005***	−0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Cost efficiency	−0.0002**	−0.0002**	−0.0004***	−0.0002**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Profit efficiency	0.0001	0.0001	−0.0000	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Observations	7,118	7,118	7,118	7,118
Pseudo R^2	0.292	0.292	0.275	0.295

5.2 INTERNATIONALIZATION AND MARKET POWER

We expect that internationally more active banks have more market power in home markets. Regarding the *extensive margin*, activities in a larger number of countries reduce the market power at home. According to the baseline result, reporting assets in one additional country reduces Lerner

Table IV. Endogeneity of foreign assets

This table shows regression results for the simultaneous system of the market power and the distress Equations (2a) and (2b). Estimations of the market power equation in Panel (A) only use the Lerner index as dependent variable and OLS, estimations of the probability of distress in Panel (B) use a probit model. All explanatory variables are lagged by one period and are defined in Appendix A.1 and Table II. Dummies for different banking groups, time, and regional fixed effects are included but not reported. Internationalization is measured by the number of countries in which a bank is present (extensive margin or EM) and the foreign asset share relative to total assets (intensive margin or IM). *Exit count* and *Entry count* are count variables of countries from which a bank has withdrawn or into which a bank has expanded. Foreign asset share (Frankel−Romer) is the exogenous component of foreign assets as described in the Appendix A.2. Panel (A) depicts coefficients with bootstrapped SEs in brackets. Panel (B) reports marginal effects with bootstrapped SEs in brackets. ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1) Baseline	(2) Frankel–Romer	(3) Two year lags	(4) Lagged number of entries and exits
Panel A: market power (Lerner Index)				
EM: number of destination countries$_{t-1}$	−0.059**			
	(0.023)			
IM: foreign asset share$_{t-1}$	8.335**			−1.220
	(3.864)			(4.294)
EM: number of countries$_{t-2}$		−0.079***	−0.081***	
		(0.028)	(0.024)	
IM: foreign asset share$_{t-2}$			8.611**	
			(3.840)	
EM: entry count$_{t-2}$				−0.037
				(0.097)
EM: exit count$_{t-2}$				0.217***
				(0.072)
IM: foreign asset share (Frankel–Romer)		5.980*		
		(3.073)		
Risk (predicted)	−4.730***	−4.951***	−4.944***	−5.139***
	(0.183)	(0.272)	(0.289)	(0.370)
Fee income	0.228***	0.231***	0.233***	0.187***
	(0.038)	(0.041)	(0.048)	(0.050)
Size quintile	−0.904***	−0.882***	−0.865***	−0.852***
	(0.141)	(0.197)	(0.192)	(0.193)
Herfindahl	0.103***	0.104***	0.105***	0.115***
	(0.019)	(0.019)	(0.021)	(0.021)
Publicly incorporated	−6.151***	−5.252***	−5.309***	−4.517**
	(1.323)	(1.359)	(1.547)	(1.789)
Branches	0.007	0.012	0.012	0.046***
	(0.010)	(0.014)	(0.014)	(0.011)
Acquisitions	0.078	0.075	0.068	−0.051
	(0.052)	(0.065)	(0.075)	(0.103)
Constant	15.925***	14.897***	14.789***	10.580***
	(1.994)	(2.944)	(2.296)	(2.549)
Observations	7,118	5,219	5,219	3,018
R^2	0.376	0.378	0.379	0.418

(continued)

Table IV. Continued

	(1) Baseline	(2) Frankel–Romer	(3) Two year lags	(4) Lagged number of entries and exits
Panel B: risk (distress indicator)				
EM: number of destination countries$_{t-1}$	0.0001			
	(0.0001)			
IM: foreign asset share$_{t-1}$	0.0050			−0.0072
	(0.0162)			(0.0150)
EM: number of countries$_{t-2}$		0.0001	0.0001	
		(0.0001)	(0.0001)	
IM: foreign asset share$_{t-2}$			0.0034	
			(0.0198)	
EM: entry count$_{t-2}$				0.0000
				(0.0004)
EM: exit count$_{t-2}$				0.0005
				(0.0004)
IM: foreign asset share (Frankel–Romer)		0.0013		
		(0.0131)		
Market power, Lerner (predicted)	−0.0010**	−0.0006	−0.0006	−0.0008
	(0.0005)	(0.0006)	(0.0005)	(0.0007)
Market power, Lerner residuals	0.0005	0.0003	0.0003	0.0005
	(0.0005)	(0.0006)	(0.0005)	(0.0007)
Core capital ratio	0.0007	0.0006	0.0006	0.0006
	(0.0007)	(0.0008)	(0.0008)	(0.0015)
Reserves	−0.0129***	−0.0093***	−0.0094***	−0.0080***
	(0.0016)	(0.0021)	(0.0020)	(0.0025)
Customer loan share	0.0002*	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Nonperforming loans	0.0000	−0.0000	−0.0000	−0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Cost–income ratio	0.0003	0.0002	0.0002	0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
ROE	−0.0003***	−0.0004***	−0.0004**	−0.0003*
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Cost efficiency	−0.0002***	−0.0003***	−0.0003***	−0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Profit efficiency	0.0001	0.0000	0.0000	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Observations	7,118	5,219	5,219	3,018

indices by six basis points, which is a very small effect [Table III, Panel (A)]. This general result holds irrespective of whether we measure market power by the Lerner indices (Column 2) or the Boone indicator (Column 3). At first sight, this negative relationship is at odds with our theoretical priors. The result in Column 4 corroborates that the negative effect is driven by an increase in the extensive margin in terms of operating

Table V. Portfolio effects

This table shows regression results for the simultaneous system of the market power (2a) and distress (2b) Equations. Estimations of the market power equation in Panel (a) only use the Lerner index as dependent variable and rely on OLS, estimations of the probability of distress in Panel (B) use a probit model. All explanatory variables are lagged by one period and are defined in Appendix A.1 and Table II. Dummies for different banking groups, time, and regional fixed effects are included but not reported. Internationalization is measured by the number of countries in which bank is present (extensive margin or EM) and the foreign asset share relative to total assets (intensive margin or IM). Average growth correlations, average equity return correlations, and average distances are means across destination countries where banks are active in a particular year. These measures are related to the extensive margin. Weighted foreign asset shares use GDP growth correlations, equity return correlations, and distance weights, respectively, while being related to the intensive margin. Panel (A) depicts coefficients with bootstrapped SEs in brackets. Panel (B) reports marginal effects with bootstrapped SEs in brackets. ***, **, and *indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Panel A: market power (Lerner Index)				
EM: number of destination countries	−0.059**	−0.068**	−0.083***	−0.052*
	(0.025)	(0.030)	(0.029)	(0.027)
IM: foreign asset share	8.335***	8.448	10.831**	9.611
	(2.948)	(7.865)	(4.883)	(8.134)
EM: average growth correlation		−1.266		
		(1.137)		
IM: weighted foreign asset share (growth correlation)		−0.232		
		(12.229)		
EM: average equity return correlation			−2.302	
			(1.977)	
IM: weighted foreign asset share (equity return correlation)			−64.448	
			(63.987)	
EM: average distance				−0.000
				(0.000)
IM: weighted foreign asset share (distance)				−0.001
				(0.003)
Risk (predicted)	−4.730***	−4.738***	−4.745***	−4.754***
	(0.180)	(0.168)	(0.181)	(0.172)
Fee income	0.228***	0.230***	0.235***	0.225***
	(0.041)	(0.042)	(0.043)	(0.040)
Size quintile	−0.904***	−0.893***	−0.913***	−0.911***
	(0.131)	(0.156)	(0.151)	(0.147)
Herfindahl	0.103***	0.104***	0.104***	0.103***
	(0.023)	(0.017)	(0.018)	(0.015)
Publicly incorporated	−6.151***	−6.134***	−6.218***	−6.136***
	(1.272)	(1.384)	(1.185)	(1.197)
Branches	0.007	0.007	0.008	0.007
	(0.010)	(0.010)	(0.011)	(0.010)
Acquisitions	0.078	0.076	0.083*	0.076
	(0.055)	(0.066)	(0.049)	(0.049)
Constant	15.925***	16.537***	17.842***	16.261***
	(2.137)	(2.211)	(2.672)	(2.348)
Observations	7,118	7,118	7,116	7,118
R^2	0.376	0.377	0.377	0.377

(continued)

Table V. Continued

	(1)	(2)	(3)	(4)
Panel B: risk (distress indicator)				
EM: number of destination countries	0.0001	0.0001	0.0000	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
IM: foreign assets share	0.0050	0.0094	0.0227	0.0249
	(0.0178)	(0.0302)	(0.0271)	(0.0299)
EM: average growth correlation		−0.0030		
		(0.0078)		
IM: weighted foreign asset share (growth correlation)		−0.0079		
		(0.0432)		
EM: average equity return correlation			−0.0039	
			(0.0102)	
IM: weighted foreign asset share (equity return correlations)			−0.5154	
			(0.4175)	
EM: average distance				−0.0000
				(0.0000)
IM: weighted foreign assets/total assets (distance weights)				−0.0000
				(0.0000)
Market power, Lerner (predicted)	−0.0010	−0.0010*	−0.0008	−0.0010*
	(0.0006)	(0.0006)	(0.0006)	(0.0005)
Market power, Lerner residuals	0.0005	0.0005	0.0003	0.0005
	(0.0006)	(0.0005)	(0.0006)	(0.0006)
Core capital ratio	0.0007	0.0007	0.0004	0.0005
	(0.0009)	(0.0007)	(0.0007)	(0.0008)
Reserves	−0.0129***	−0.0129***	−0.0132***	−0.0128***
	(0.0020)	(0.0024)	(0.0018)	(0.0016)
Customer loan share	0.0002**	0.0002*	0.0001**	0.0002**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Nonperforming loans	0.0000	0.0000	0.0000	0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Cost–income ratio	0.0003*	0.0003*	0.0003	0.0003*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
ROE	−0.0003**	−0.0003**	−0.0003**	−0.0003**
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Cost efficiency	−0.0002**	−0.0002**	−0.0002***	−0.0002**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Profit efficiency	0.0001	0.0001	0.0000	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Observations	7,118	7,118	7,116	7,118

branches. This finding is consistent with literature in international economics stressing that foreign expansions, especially through foreign direct investment such as branches, are costly, squeezes profit margins, and can thus only be afforded by the largest, most productive banks (Buch, Koch, and Koetter, 2011). An increase in the number of countries serviced through branches can thus reduce the *average* bank's margin. In addition, detrimental market power effects may arise when banks attempt to manage far-flung multinational structures that are too complex to control. In unreported regressions, we checked whether

threshold effects matter. It turns out that increasing international activities beyond a certain number of countries (10 for cross-border activities, 5 for countries with foreign branches) does indeed drive this negative result.

Regarding the *intensive margin* captured by the foreign asset share. Column 2 in Table III, Panel (A) in fact shows that a higher total share of foreign assets—either through cross-border activities or through foreign branches—has a positive impact on market power. This result also holds when using the Boone indicator, where a negative sign indicates that a larger intensive margin increases bank market power (Column 3). Increasing the foreign asset share by 1% increases the average Lerner index by >8%, potentially reflecting the ability of internationally active banks to accompany their customers on foreign markets and to lower informational asymmetries through local knowledge. Given an average Lerner index of 23% (Table II), this increase is economically substantial and accounts for <1 standard deviation (SD). At the same time, a 1% increase in the foreign asset share would be substantial for the average bank, which holds only ~4.4% of its assets abroad (Table I). The positive effect of internationalization is driven by operating foreign branches, which usually pertains to foreign retail banking. Separating foreign assets by market entry mode (cross-border activities versus operating branches), Column 4 of Table IV, Panel (A) is informative: the predicted increase in Lerner indices by 28% given a 1% increase in foreign asset share held through branches amounts to an improvement in market power by almost 1.5 times the SD (Table II, banks with branches). This substantial positive impact on market power is in line with the earlier conjecture that engaging in international lending relations provides banks with advantages in information acquisition. The foreign assets share obtained through cross-border activities in isolation does not have a significant impact on market power.

For the control variables, we obtain mostly significant and expected results. Larger *fee income* shares increase market power, perhaps because banks can retain market power by substituting traditional interest income with fee income (De Young and Rowland, 2001). *Larger banks* might be able to charge higher markups due to their dominant role in output markets, but they might also enjoy market power due to economies of scale in funding markets. We include a discrete variable to indicate the size quintile of banks' total assets (from 1 to 5). Results are qualitative identical if we use log size instead. They show a negative connection between size and market power, reflecting the fact that smaller banks enjoy market power in regional and niche markets. We measure the degree of specialization of banks' activities using *Hirschman–Herfindahl indices* computed across four

asset categories. More specialized banks exhibit larger market power. *Regional concentration* in Germany is measured by the number of domestic branches per tens of millions of euros of total assets and the number of new acquisitions per domestic regional agglomeration. It enhances market power as well.

5.3 INTERNATIONALIZATION AND RISK

We argued above that internationally better-diversified banks (extensive margin) should exhibit less risk, whereas the effect of larger foreign asset shares (intensive margin) is ambiguous. Table III, Panel (B) shows the determinants of bank distress. The key result is that international banks, in general, are not more risky than domestically active banks. In regressions abstracting from modes of entry, internationalization is insignificant (Columns 2 and 3). An important difference emerges when distinguishing between the two modes of entry (Column 4). We do not find evidence for a significant impact of cross-border activities. As opposed to that, banks that operate branches in many countries exhibit lower risk. With respect to the *extensive* margin, entering an additional country via branches reduces the mean distress probability of 7% (Table II) by 47 basis points (Column 4 in Table III). With respect to the *intensive* margin, reporting higher foreign assets held by branches, in contrast, increases rather than decreases risk. Taken together, these results suggest that it is indeed the diversification effect that matters, rather than the volume of foreign activities *per se*. Our results are thus broadly in line with our prior that the degree of diversification rather than the scale of foreign activities matters for bank risk.

In addition to the internationalization variables, we include a standard vector with so-called CAMEL covariates that capture various aspects of bank-specific risks (capitalization, asset quality, managerial skill, earnings, and liquidity) (Wheelock and Wilson, 1995). We expect banks that are more profitable, better capitalized, and that hold a less risky asset portfolio to be less likely to experience a distress event. The signs for the control variables are in line with these expectations and with the previous literature (Dam and Koetter, 2012). Banks with a lower level of hidden reserves and with a lower return on equity (ROE) are more likely to experience a distress event (Berger, 1995). In line with the example, Wheelock and Wilson (1995), higher cost efficiency and lower cost–income ratios reduce bank risk. Higher profit efficiency, in turn, has no significant impact on risk. This result corroborates that cost and profit efficiency measure different types of optimal behavior of

bank managers (Bauer *et al.*, 1998). The core capital ratio and the share of nonperforming loans do not have a significant impact on bank risk.

5.4 ENDOGENEITY OF FOREIGN ASSETS

The empirical model accounts for the simultaneous determination of market power and risk. But it may fail to address the potential endogeneity of bank internationalization. Endogeneity can arise if banks engage in risky domestic activities and venture abroad to offset high domestic risk or if they self-select into international activities because these reward them with greater domestic market power.

We address concerns about the endogeneity of bank internationalization in three ways: by adopting a proxy for the exogenous component of banks' foreign assets; by using the lagged foreign assets share; and by focusing on banks that have changed their presence abroad.

Turning to the first measure, we adopt a methodology from the literature studying the link between international trade and growth at the country-level. Frankel and Romer (1999) propose to measure the causal impact of trade on growth by employing geographic variables as (exogenous) instruments for international trade. Their method is based on a two-step estimation model. In a first step, a bilateral openness equation is specified. Predicted bilateral openness measures from this equation are then aggregated to obtain a measure of aggregate openness, which is related to a set of exogenous variables only. In a second step, predicted openness is used as an instrument in a regression explaining the impact of openness on GDP per capita. This method does not fully suit our panel context because geographic variables are time-invariant. We need a time-varying exogenous explanatory variable for the first-stage regression. In our setup, foreign macroeconomic variables are exogenous from the individual bank's perspective (see also Appendix A.2). For the predicted foreign asset share to be a good instrument, it should correlate sufficiently with the actual foreign asset share, which is the case. The correlation between the predicted and the actual foreign asset share at the bank level (i.e., aggregated across all countries) is 0.58.

Results are reported in Column 2 of Table IV. They are qualitatively unchanged from those using the actual volume of foreign assets: expansions along the intensive margin increase market power, but these expansions have no impact on risk; risk has a negative impact on market power; and the remaining control variables retain their signs and significance.

The second way to account for the endogeneity of internationalization is to make use of the fact that *current* market power and risk are unlikely to have affected internationalization decisions taken *in the past*. Hence, we use the foreign assets share lagged by two periods as a regressor. Results in Column 3 of Table IV are very similar to those using the actual or the predicted share of foreign assets.

The third method to address endogeneity accounts for the fact that lagged foreign assets may be persistent. We use information on *changes* in foreign activities. *Exit* (*number*) and *Entry* (*number*) are count variables for the number of countries from which a bank has withdrawn or into which a bank has entered 2 years before. Results in Column 4 of Table IV show that past exits have a positive impact on market power. This is consistent with our previous finding that maintaining a foreign presence reduces market power. Past entries have no significant effect although it must be noted that the lag structure of changes in international presence limits the sample considerably.

5.5 PORTFOLIO EFFECTS

Aside from endogenous foreign activity, the neglect of geographical portfolio effects may be crucial, in particular when considering the relationship between internationalization and risk. Table V shows three robustness checks. We address the fact that a mere count of the number of foreign countries (the extensive margin) or the volume of activities (the intensive margin) does not adequately capture portfolio diversification effects. To this end, we construct explanatory variables that draw on extensive and intensive margins that are weighted by return correlations between the destination country and Germany. With respect to the intensive margin, we weigh foreign assets with the correlation of either equity returns or output growth between the destination country and Germany. Alternatively, we weigh foreign activities with the distance between destination countries and Germany. Weighting of the extensive margin runs in parallel. None of these weighted variables is significant. At the same time, the result that being active in a larger number of countries has a negative impact on market power remains intact, and so does the result that internationalization as such has no significant impact on banks risk. Only the positive impact of internationalization on the market power of banks turns insignificant when including foreign activities weighted by GDP growth (Column 2) or distance (Column 4). This could indicate that the scope for better information generation to increase market power, either due to larger pools of customers or

due to experiences gathered from a more diverse set of markets, is limited in countries similar to Germany.

5.6 FURTHER ROBUSTNESS TESTS

We conduct a number of additional tests, results are not reported but available upon request. First, we distinguish weak from severe distress events. In addition to the 240 severe distress events that we consider here, restructuring mergers ordered by the BaFin or capital injections by insurance schemes, there have been 26 weaker distress events, such as mandatory announcements by individual banks to the supervisory authority or official warnings by the BaFin. As a robustness check, we therefore split the sample into weak and severe distress events when estimating the system of equations. Results are qualitatively identical compared to those reported in Table III, in particular as regards the mutual negative impact of market power on risk. The impact of internationalization on risk remains insignificant.

Second, we used the z-score as an alternative risk measure. Measuring bank risk as the official declaration of distress by the regulator is appealing. Yet, larger banks have not experienced distress event during the sample period. To obtain a measure of risk for all banks, we follow Laeven and Levin (2009) and compute, for each bank, a z-score as $z = (\mathrm{E/A}+\mathrm{RoA})/\sigma_{\mathrm{RoA}}$, where E/A is the capital–asset ratio, RoA denotes return on assets, and σ_{RoA} denotes the SD of RoA, which is calculated using a rolling window of 5 years. Z-scores measure the extent to which bank equity is sufficient to cover losses. Higher z-scores indicate less risky banks. This alternative risk measure confirms the negative correlation between risk and market power, but the impact of predicted Lerner indices on the z-score are sometimes insignificant. The impact of internationalization on market power is mostly replicated. As before, internationalization has no significant impact on risk. Results for all remaining explanatory variables do not change.

Third, we split the sample by size and banking group. For all but the mid-sized banks, a higher volume of cross-border assets has a positive effect. The impact of expansions along the extensive margin on market power at home varies across banks of different size. For the smaller banks (smallest 40%), internationalization has an insignificant (negative) effect. For the mid-sized and large banks, internationalization has a positive effect. The negative and significant impact for the full sample is driven by the "upper-mid-sized" banks in the fourth size quintile. One interpretation of this nonlinear effect is that these banks are too large to gain a competitive

edge from foreign expansions as evidenced by smaller banks and that "upper-mid–sized" banks are too small to reap the true scale economies as evidenced by very large banks.

Finally, we account for the fact that the so-called banking "pillars" in Germany differ with regard to their degree of internationalization. Large commercial banks have a long history in foreign markets, whereas savings and cooperative banks are domestically oriented. The result that market power declines when banks are active in many countries is a feature of the subsamples of savings and cooperative banks, but distinctly not a feature of the (private) commercial banks. The positive effect of a large volume of activities is driven by the subsamples of commercial and savings banks. Hence, in terms of market power, commercial banks gain from internationalization whereas cooperative banks lose. In terms of risk effects of internationalization, we do not find significant effects either for the commercial or the savings banks, corroborating the results obtained for the full sample. But for the cooperative banks, risk increases when these banks are active in many countries. In sum, these results point to the difficulties of cooperative banks in successfully venturing abroad, perhaps because they are the least experienced banks on international markets.

6. Conclusions

We use a simultaneous two-equation model to analyze how bank internationalization affects the relationship between banks' market power and risk on the German domestic market. Based on a detailed bank-level data provided by the *Deutsche Bundesbank* for the years 2003–06, we distinguish between the impact of bank internationalization along the intensive margin (the foreign asset share) and along the extensive margin (the countries in which banks are present). Further, we can separate foreign entry through cross-border assets from foreign entry through foreign branches in terms of the extensive margin. Our results are as follows:

First, the correlation between market power and risk is negative. This result is in line with theoretical models that emphasize the importance of market power to build up buffers against shocks and to generate private information to assess risks properly.

Second, banks with a higher foreign asset share have higher market power. This result is robust to using different measures of market power (Lerner index and Boone indicator), to accounting for endogenous foreign market entry, and to accounting for the cross-country correlation of returns. The positive impact of the foreign asset share on market power is driven by assets

held through foreign branches, suggesting that banks with international branches generate private information allowing them to increase revenues and/or lower costs at home. Yet, these advantages are eventually eroded if banks expand into too many foreign countries, as shown by a negative impact of the number of foreign branches (the extensive margin) on domestic market power. Sample splits show that, in particular smaller savings and cooperative banks cannot reap the benefits from bank internationalization in terms of market power.

Third, the relationship between bank internationalization and risk is generally weak for the full sample, and it often turns insignificant. Cooperative banks exhibit a higher probability of distress when increasing the number of foreign countries in which they are active. Diversification benefits are thus limited for small, unsophisticated banks and are overcompensated by the costs of maintaining international branch networks. This result also underpins the importance of distinguishing cross-border assets and foreign branches as distinct channels of internationalization.

Understanding the market power–risk trade-off for internationally active banks is of key importance for policymakers. Given the global financial crisis, the benefits of international banking in terms of enhanced markups, which stabilize the banking system, seem to outweigh the relatively weak impact of bank internationalization on bank risk that prevails in this sample. The potentially detrimental effects on risk through international branch networks, however, emphasize that international integration not only brings about diversification benefits but can also impose additional risks. Overall, our results suggest a balanced approach to the regulation of banks' international activities that incentivizes banks not to follow expensive internationalization strategies if complex risks outweigh market power gains

Appendix A

A.1. DATA APPENDIX

All data are obtained from annual unconsolidated balance sheets, profit and loss accounts, and audit reports reported by all banks to the German central bank (*Deutsche Bundesbank*). We use financial statements of individual banks that represent legal entities. They contain information on domestic and foreign bank activities through foreign branches, but not subsidiaries. Explanatory variables, expect international assets, are corrected for outliers by truncating at the 1st and the 99th percentiles, respectively. Level variables

are deflated with the consumer price index. Descriptive statistics of all variables are given in Table II. Definitions are as follows:

A.1.1 Bank-level Variables

Acquisitions: the number of acquisitions per regional agglomeration in Germany.

Assets: gross total assets. An indicator variable based on the size distribution of total assets per year ranging from 1 (low) to 5 (high).

Banking groups: an indicator variable ranging from 1 to 4 for large banks, regional commercial, regional savings, and cooperative banks. "Large" banks comprise the head institutions of the savings (*Landesbanken*) and cooperative banking sector as well as the largest commercial banks. "Commercial banks" are privately owned, but not necessarily publicly listed banks. "Savings banks" are (local) government-owned regional banks. "Cooperative banks" are mutually owned regional banks.

Branches: the number of domestic branches per bank relative to total assets in tens of millions of euros.

Capitalization: core capital in percent of gross total assets.

Cost efficiency: cost efficiency obtained from a latent stochastic cost frontier analysis with two technology regimes.

Cost–income ratio: personnel expenditure in percent of total administrative cost.

Customer loans: loans to corporate customers and individuals.

Equity: gross total equity in millions of euro.

Herfindahl index (output categories): diversification indicator across four output categories of banks, interbank loans, customer loans, bonds and stocks, and notional values of granted guarantees and credit commitments, calculated as the sum of squared shares of each product category.

Interbank loans: loans to banks and other depository institutions.

Loan-loss provisions: stock of loan-loss provisions in percent of gross total loans.

Nonperforming loans: loans with latent risks according to central bank auditors in percent of total audited loans.

Off-balance sheet items: granted credit guarantees and commitments.

Physical capital: fixed assets including IT capital stock in millions of euros.

Profit efficiency: profit efficiency obtained from a latent stochastic profit frontier analysis with two technology regimes.

Publicly incorporated banks: indicator variable equal to 1 if the bank is publicly incorporated, either as joint stock or public limited company

[*Aktiengesellschaft (AG); Kommanditgesellschaft auf Aktien (KG a.A.); Gesellschaft mit beschraenkter Haftung (GmbH)*].

Reserves: hidden reserves according to Section 340f of the German commercial code in percent of gross total assets.

ROE: operating result, including net interest, fee, commission, and trading income in percent of equity capital.

Securities: bonds and stocks.

Share of fee income: provision and fee income relative to total operating gross revenues.

A.1.2 External Position Report

Data on the international assets of German banks are taken from the External Position report (*Auslandsstatus*) of the *Deutsche Bundesbank*. They are confidential and can be used on the premises of the *Bundesbank* only.

International assets: loans and advances to banks, companies, governments, bonds and notes, foreign shares and other equity, participation abroad, denominated or converted into euro. Irrevocable credit commitments are included but other off-balance sheet items are not. For a more detailed description of this data base, see Fiorentino, Koch, and Rudek (2010).

Branches and subsidiaries: foreign affiliates of German parent banks. Branches do not have an independent legal status, whereas subsidiaries do. We attribute assets held by affiliates to the country in which they are located.

List of countries:

Argentina
Australia
Austria
Belgium
Bosnia
Brazil
Bulgaria
Canada
Cayman Islands
Chile
China
Colombia
Cote d'Ivoire
Croatia
Cyprus
Czech Republic
Denmark
Egypt
Estonia
Finland
France
Greece
Hong Kong
Hungary
India
Indonesia
Ireland
Israel
Italy
Japan
Jordan
Latvia
Lithuania
Luxemburg
Malaysia
Malta
Mauritius
Mexico
Morocco
Netherlands
Netherlands Antilles
New Zealand
Norway
Pakistan
Panama
Peru
Philippines
Poland
Portugal
Qatar
Romania
Russia
Saudi Arabia
Singapore
Slovakia
Slovenia
South Africa
South Korea
Spain
Sri Lanka
Sweden
Switzerland
Taiwan
Thailand
Turkey
Ukraine
United Arab Emirates
United Kingdom
United States
Uruguay
Vietnam

A.1.3 Data on Bank Risk

To measure the soundness of the German banking sector, we use confidential information from the distress database of the *Deutsche Bundesbank* for individual banks at an annual frequency. These data allow for a distinction between different distress categories that differ in terms of severity of distress observed:

- weak distress events: mandatory announcements by individual banks to the supervisory authority and official warnings by the *BaFin* and
- severe distress events: capital preservation measures by banking group-specific insurance schemes or restructuring mergers ordered by the *BaFin*.

A.2. TECHNICAL APPENDIX: EXOGENEITY OF FOREIGN ASSETS

We estimate the exogenous component of foreign assets based on the methodology proposed by Frankel and Romer (1999). The modified first stage Frankel–Romer regression is:

$$\mathrm{FA}_{\mathrm{ijt}} = a_0 + a_{i,1}\mathrm{Dist}_j + a_{i,2}\mathrm{GDP}^*_{\mathrm{jt}} + \varepsilon_{\mathrm{ijt}} \tag{A.1}$$

where $\mathrm{FA}_{\mathrm{ijt}}$ is the share of foreign assets across modes relative to total assets of bank i held in country j in year t, Dist_j is the geographic distance between Germany and country j, $\mathrm{GDP}^*_{\mathrm{jt}}$ is foreign GDP, which is exogenous to the individual bank i, and $\varepsilon_{\mathrm{ijt}}$ is an error term that captures the bank-specific determinants of foreign assets. We estimate Equation (A.1) bank-by-bank using OLS to obtain bank-specific regression coefficients.

The predicted values from this equation are used to obtain a bank-specific instrument of bilateral openness. Re-writing Equation (A.1) in matrix form $\mathrm{FA}_{\mathrm{ijt}} = \mathbf{a}_i'\Theta_{\mathrm{jt}} + \varepsilon_{\mathrm{ijt}}$, where $\mathbf{a}_i$ is the vector of coefficients and Θ_{jt} is the vector of right-hand side variables, bank i's overall predicted foreign assets are given by: $\hat{\mathrm{FA}}_{\mathrm{ijt}} = \sum_j \hat{\mathbf{a}}_i'\Theta_{\mathrm{jt}}$.

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