Tracing the International Transmission of a Crisis Through Multinational Firms*

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Abstract

This paper shows that idiosyncratic shocks to individual firms can affect growth all over the world, even if shocked firms have no direct foreign connections and no operations abroad. We identify an idiosyncratic shock to a German bank, which caused the bank to cut lending to German borrowers. Multinational parent firms located in Germany became financially constrained. In response, international affiliates of affected parents supported their parent by lending through internal capital markets and became constrained themselves. The real growth of affiliates fell sharply and took three years to fully recover. Though the initial shock only hit the domestic activities of a firm in Germany, the impact in other countries was sizable (for instance, around 0.4 percent of aggregate sales in Austria and the Czech Republic). The findings reveal that idiosyncratic shocks to individual firms influence economic outcomes far beyond firms' direct scope of operation.

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I Introduction

The impact of individual firms on economic outcomes has recently received significant attention. Previous work suggests that idiosyncratic movements of large firms affect growth in their home country (Gabaix 2011). However, there exists little evidence about whether shocks to individual firms have effects beyond firms' home country and direct scope of operation, for example effects on foreign countries and foreign firms that are not directly connected to shocked firms. This paper proposes that an idiosyncratic shock to a firm can impact growth all over the world, even if the shocked firm has no direct foreign connections and operates only in its home country.[1]

The specific transmission mechanism highlighted in this paper operates through the internal capital markets of multinational firms that are connected to a shocked firm. Internal capital markets account for the majority of capital inflows in many countries and are large relative to GDP.[2] Despite their size and ubiquity, it has not been fully established whether internal capital markets can affect the real economy. By tracing out the transmission of an idiosyncratic firm shock, we develop new insights about how internal capital markets operate, including about the magnitude of real effects and the recovery from internal capital shocks.

Evidence about how individual firms affect economic outcomes beyond their direct operations is limited. Key empirical challenges are identifying an exogenous shock to a firm and then assembling detailed data to trace out the effects. We overcome these challenges by combining a quasi-experimental research design with data on firm-to-firm links and capital flows. We first identify an idiosyncratic shock to a large firm, a German bank. The bank faced a severe crisis in 2008/09 and had to reduce lending to its corporate borrowers. The borrowers that we study were all parent firms of multinationals located in Germany.

We document that parents became financially constrained after the lending cut. International affiliates of the constrained multinationals stepped in and increased internal lending to the parent through internal capital markets. However, the affiliates could not raise external credit to compensate for the internal loans and became constrained themselves. This had real effects outside Germany: sales of affiliates with affected parents dropped sharply, remained low for three years, and subsequently recovered. The total impact in foreign countries was large, for instance around 0.4 percent of aggregate sales in Austria and the Czech Republic. Taken together, the findings show that an idiosyncratic shock to a large firm can have effects across the world, beyond the firm's direct reach and country of operation.

[1] The Deutsche Bundesbank does not provide any information on individual firms. All results based on data from Deutsche Bundesbank are anonymized. Information on individual firms comes only from publicly available sources detailed in Section IV.

[2] In recent years, internal capital flows through multinationals accounted for over 50 percent of total capital inflows and amounted to 3.6 percent of GDP in the median country (Broner et al. 2010, using IMF data). Parents and affiliates together produce 36 percent of global output. Foreign-owned affiliates alone produce 8 percent of output in the US, 21 percent in the EU, and 11 percent globally (OECD Analytical AMNE database for 2016).

To identify an exogenous, idiosyncratic shock to a firm, we need to overcome the fact that firms are usually subject to common shocks. For instance, banks that cut lending and their borrowers may suffer from the same underlying aggregate instability, so that the growth of banks and borrowers comoves without any causal impact of bank lending on borrowers. Similarly, parents and affiliates frequently use similar inputs and sell similar products. Common shocks to input prices or product demand could generate spurious comovement between parents and affiliates. Furthermore, productive parents have productive affiliates and larger parents have larger affiliates. Since productive and large firms follow different cyclical dynamics, this again suggests that parents and their affiliates are hit by common shocks (Guadalupe et al. 2012; Fort et al. 2013; Foster et al. 2016).

We overcome the empirical challenge by analyzing a shock to Commerzbank, a large German bank. Through a combination of misjudgments and bad luck, Commerzbank experienced significant losses on its financial investments during the 2008/09 financial crisis. The losses forced Commerzbank to reduce lending to its German borrowers. The lending cut was not caused by Commerzbank's corporate loan portfolio and represented an exogenous shock to the credit supply of German firms with preexisting relationship to Commerzbank. Existing evidence shows that European firms of all sizes, including multinationals, struggle to raise financing when a relationship bank cuts lending (Bentolila et al. 2018; Huber 2018). We find that parents of multinationals headquartered in Germany became financially constrained after Commerzbank's lending cut, relative to borrowers of other banks: parents with higher pre-crisis dependence on Commerzbank reduced bank debt, did not use alternative sources of external financing, and experienced lower sales from 2008 to 2010.[3] In contrast, international affiliates of these multinationals abroad were not directly affected and their credit supply did not fall, since Commerzbank's corporate lending was concentrated in Germany.[4] This implies that Commerzbank's lending cut was an idiosyncratic shock to a firm that initially only affected firms located in Germany.

To investigate whether the initial shock to Commerzbank was transmitted internationally, we study international affiliates whose German parents were directly hit by Commerzbank's lending cut. Our estimation sample exclusively contains affiliates of German parents located outside Germany. We test whether affiliates whose German parents were more dependent on Commerzbank performed differently, relative to other affiliates. We always compare affiliates located in the same country at the same point in time, so that differences in demand or other country-specific shocks do not affect the estimates. The findings are also robust to controlling for the full interaction of country-industry-time fixed effects and other charac-

[3]The vast majority of other German banks were not in crisis during this period. A few other banks also suffered losses but did not cut lending. Hence, we keep these other banks in the control group of our analysis, as we discuss in Sections II, VIII.D, and Appendix B.

[4]To be clear, we interpret Commerzbank's financial losses as an idiosyncratic shock to the bank that then filtered through to its loan supply in Germany. In tracing out the effects of the idiosyncratic shock in other countries, we only use variation in exposure to Commerzbank's domestic activities in Germany, so our estimates are not driven by any activities Commerzbank may have carried out in other countries.

teristics of affiliates and parents (for example, size, leverage, number of banks, and financial ratios) interacted with time. We find that affiliates with greater parent Commerzbank dependence did not have different observable characteristics than other affiliates, were not directly exposed to Commerzbank, and did not face a banking shock themselves. In addition, affiliates with greater parent Commerzbank dependence grew in parallel to other affiliates before the lending cut. These findings suggest that affiliates with greater parent Commerzbank dependence would have continued to evolve in parallel to other affiliates, had Commerzbank's lending cut in Germany not happened.

The first set of affiliate-level results analyzes affiliate sales. Once Commerzbank reduced lending to German parents in 2008, sales of affiliates with greater parent Commerzbank dependence dropped sharply. Their sales began to recover slowly in 2009, but remained lower throughout 2009 and 2010. The association between parent Commerzbank dependence and affiliate sales disappeared after 2011, indicating that affiliates recovered by 2011. Sales growth is an intrinsically interesting outcome because aggregate value added equals sales of final-use products. In line with sales, affiliate employment also fell from 2008 to 2010 and recovered after 2011. These results show that real outcomes of international firms, without any direct connection to Commerzbank, were harmed by the idiosyncratic shock to Commerzbank.

We present a simple model of a multinational firm to explain why affiliate sales may fall when the parent gets hit by a credit supply shock. The key feature is that the multinational operates an internal capital market (Stein 1997; Inderst and Mueller 2003; Matvos and Seru 2014). When the parent cannot get credit, affiliates increase lending to the parent. In the short run, most firms cannot borrow as much capital from external lenders as they would like (Banerjee and Duflo 2014; Catherine et al. 2020; Lian and Ma 2020). Therefore, the increased lending to parents tightens capital constraints for the affiliate. Capital constraints may lower affiliate sales in the short run because firms use working capital to pay variable inputs and labor and because working capital funds the distribution of output to points of sales (Chari et al. 1995). In addition, firms may forego expenditures that generate sales (such as on marketing, product distribution, variable inputs, and machinery) and focus on rebuilding liquidity buffers (Fazzari and Petersen 1993; Calomiris et al. 1995). Overall, the model suggests that internal capital markets can transmit shocks from parent to affiliates.

In the second set of affiliate-level results, we investigate whether internal capital markets contributed to the reduction in affiliate sales. We analyze micro data from the Deutsche Bundesbank. The data report detailed internal capital market positions between each affiliate and their German parent. We begin by considering affiliates that had issued long-term loans to their parent before 2008. Parents had already set up a financial infrastructure to borrow from these affiliates, making it possible to quickly shift capital from these affiliates toward affected parents after 2008. An indicator for previous loans to the parent is therefore a proxy for affiliates that were more likely to financially support their parent during the lending cut. Indeed, we show that affiliates with previous loans to the parent strongly increased lending to

their parent after the lending cut. The reduction in affiliate sales was significantly larger for affiliates with previous loans to the parent.[5] This suggests that increases in internal lending played a role in transmitting the lending cut to affiliates.

Analogously to internal loans, we also identify a proxy for affiliates that sold goods to the parent. Short-term claims by affiliates on parents are a commonly used proxy for internal trade credit and hence for internal trade from affiliates to their parent.[6] We find that short-term claims by affiliates on their parent fell after Commerzbank cut lending. A likely reason is that parents demanded fewer inputs from their affiliates after the lending cut, which caused internal trade to plummet. The sales of affiliates with previous short-term claims fell by more after the lending cut, suggesting that internal trade contributed to the transmission of the shock. However, we show that the effect on affiliates with previous short-term claims was distinct from the effect on affiliates with internal loans. This suggests that internal capital markets continue to explain part of the sales decline, even conditional on a proxy for internal trade. In line with this conclusion, we find similar sales losses for affiliates that were unlikely to trade internally with the parent (affiliates that were horizontal, in the service sector, or did not resell parents' products). Taken together, these results suggest that the effect on affiliate sales was not entirely driven by internal trade.[7]

We investigate further why the shock to internal lending caused sales to fall. We find that affiliates were not able to raise external financing in the short run (e.g., bank debt or external equity). This is consistent with existing evidence suggesting that financial frictions make it difficult for affiliates to quickly raise external funding (Banerjee and Duflo 2014; Catherine et al. 2020). Since affiliates were not able to increase funding, they had to cut assets. We show that holdings of short-term, production-related assets fell from 2008 to 2010 and fully recovered after 2011. These short-term assets include, for example, holdings of raw materials, working capital, and other variable inputs into the production and distribution of output. The temporary reduction and full recovery of short-term assets resembles the evolution of affiliate sales. This indicates that affiliates reduced their production and sales in order to fund the increased lending to their parent.

The theoretical model makes two further testable predictions for shock transmission through internal capital markets. The first prediction is that multinationals cut capital by more for affiliates with low marginal product of capital. The reason is that multinationals can allocate internal capital relatively freely, so parents will require lending from affiliates

[5] Additional results show that the heterogeneous effects were not driven by other affiliate characteristics, such as leverage or total short-term claims (relative to total assets). We do not find heterogeneous effects for affiliates into which the parent had invested more equity (relative to affiliate total assets or affiliate total equity).

[6] See, for instance, Overesch (2006). We confirm the high correlation between internal short-term claims and internal trade credit using German firm data, as described below.

[7] In the main analyses, we analyze multiple outcomes (affiliate sales and internal capital market positions). We show that the results are not driven by a multiple inference problem, using the p-value adjustment developed by Anderson (2008). All adjusted p-values remain below 0.1 if they were below 0.1 without adjustment. The only difference is that five p-values that were below 0.05 without adjustment are between 0.05 and 0.1 when adjusted.

where capital is least productive. We use affiliate growth before the lending cut to proxy for high marginal product. The results show that affiliates with higher pre-growth were significantly less affected by the lending cut to their parent, consistent with the model. The second prediction is that access to external finance softens the blow for affiliates. If external funding is easily available, affiliates can finance internal lending by borrowing instead of reducing production and sales. In line with this prediction, we show that effects were weaker in countries with developed financial markets (high credit-GDP ratio). However, even in developed financial markets, we still find a significant decline in affiliate sales, consistent with evidence that firms are also borrowing-constrained in developed markets (Lian and Ma 2020). Apart from financial development, there was no heterogeneity with respect to other cross-country differences, such as tax rates, business cycle shocks, or geographic location. These tests further support the view that internal capital markets and capital constraints contributed to the sales losses, rather than demand shocks or other confounders.

In the final step of our analysis, we discuss in which countries the transmission of Commerzbank's lending cut through German multinationals had the largest total impact. Specifically, we calculate how much greater total sales of German affiliates in a given country would have been if affiliates with positive parent Commerzbank dependence had grown at the same rate as affiliates with zero parent Commerzbank dependence. This measure of "impact" was largest in countries neighboring Germany. It amounted to 0.49 percent of aggregate sales in the Czech Republic, 0.36 percent in Austria, and 0.31 percent in Poland.[8] In all these countries, the sales share of German affiliates was large relative to the aggregate economy (close to 4 percent). These numbers highlight that a shock to an individual firm in one country (Commerzbank in Germany) can have first-order effects on the distribution of firm growth in many other countries, solely because of transmission through internal networks of multinationals.[9]

The findings of this paper contribute to our understanding of how individual firms affect the international economy. The literature suggests that shocks to "granular" firms can affect aggregate growth in their home country, as studied theoretically (Gabaix 2011; Acemoglu et al. 2012; di Giovanni and Levchenko 2012; Grassi 2017; Magerman et al. 2017; Carvalho and Grassi 2019) and empirically (di Giovanni et al. 2014; Friberg and Sanctu-

[8]The impact numbers reported here are not equivalent to aggregate changes because general equilibrium effects may alter the growth of unaffected affiliates. Therefore, we do not argue that the estimates are identical to aggregate effects and report the impact as relative object (i.e., the aggregated growth of directly affected affiliates relative to unaffected affiliates). However, general equilibrium models typically find that the impact, as reported by us, is of the same order of magnitude as the aggregate effect, or even larger. For instance, using a general equilibrium model, Chodorow-Reich (2014) finds that general equilibrium effects in response to a financial shock exacerbate or, at most, modestly attenuate the total impact of the direct shock (similar to Sraer and Thesmar 2019; Herreño 2020). Similarly, Huber (2018) estimates that general equilibrium effects worsen losses at the regional level.

[9]Commerzbank's lending cut may also have been transmitted internationally through other channels, for example lower demand by German firms for foreign products. We do not measure these channels here, since we focus on transmission through multinationals. In that sense, our estimates may underestimate the importance of an individual firm.

ary 2016; Amiti and Weinstein 2018). We highlight a new channel: an idiosyncratic shock to an individual firm can impact unconnected firms all over the world, even if the initially shocked firm only operates in its home country. This channel is novel because it generates international shock transmission without requiring that a firm is directly connected to other countries. As a result, the channel is distinct from the finding that firms comove with foreign countries where they have direct trade or production links (di Giovanni et al. 2018; 2019a).[10]

In addition, our approach is novel because it quantifies how important an individual firm can be. In contrast, the literature estimates the joint contribution of total firm-level volatility to aggregate fluctuations. This approach is informative about the joint impact of all firms, but it does not reveal the importance of an individual firm to economic outcomes.

A further innovation relative to the literature on granular firms lies in our methodology. We introduce a quasi-experimental approach that isolates the causal impact of a firm on unconnected foreign countries. In contrast, most existing work estimates general comovement between connected firms and countries. This approach has uncovered important facts on international growth patterns. However, it is difficult to know whether the estimates represent the causal transmission of firm-level shocks or whether the estimates also capture common unobserved shocks across connected firms and countries.

We also add to the literature on internal capital markets of multinational firms. Existing work shows that foreign-owned affiliates perform better than domestically owned firms during domestic crises and when domestic capital markets are weak (Desai et al. 2004; 2008; Foley and Manova 2015; Manova et al. 2015; Kalemli-Özcan et al. 2016). These existing findings are consistent with the view that internal capital markets help affiliates. However, foreign-owned affiliates differ in other dimensions, such as greater productivity, distinct production technologies, greater human capital of their workforce, better management, lower reliance on domestic inputs, and lower reliance on domestic product demand (Bloom et al. 2012; Guadalupe et al. 2012; Setzler and Tintelnot 2021). As a result, existing work has not fully established whether internal capital markets transmit shocks across borders.

Our paper overcomes these challenges and delivers new insights. First, we employ a quasi-experimental research design to estimate causal effects. This allows us to show that a shock to the parent causes changes in internal capital flows, which then affect the real growth of affiliates. Second, we directly observe detailed internal capital positions. This allows us to show that shocks to the parent only affect a subset of affiliates, specifically those with preexisting internal capital links to the parent. Third, we examine the dynamic recovery of affiliates. We establish that internal capital shocks are very harmful in the short run, but that affiliates can overcome them in the long run. Fourth, the literature has so far argued that internal capital markets benefit affiliates. In contrast, we show that internal capital markets

[10]The channel also differs from the literature showing that multinational banks with direct operations in several countries transmit crises internationally (Peek and Rosengren 1997; Peek and Rosengren 2000; Acharya and Schnabl 2010; Cetorelli and Goldberg 2012; Popov and Udell 2012; Schnabl 2012; de Haas and van Lelyveld 2014; Ongena et al. 2015; di Giovanni et al. 2019b).

can be harmful and destabilizing. They can cause financial constraints and transmit crises across countries.[11]

A separate literature analyzes resource allocation within domestic business groups (Lamont 1997; Shin and Stulz 1998; Rajan et al. 2000; Gopalan et al. 2007; Boutin et al. 2013; Matvos and Seru 2014; Seru 2014; Almeida et al. 2015; Giroud and Mueller 2015; Giroud and Mueller 2019; Santioni et al. 2020). Our paper differs from this literature in several respects. First, we focus on whether an individual firm operating in one country affects international outcomes, while this literature does not consider the role of individual firms. Second, we trace the flow of capital across countries through multinationals, while this literature considers only within-country resource allocation. One cannot draw conclusions about international capital flows from domestic groups, since international capital flows depend on complex frictions, including differences in legal systems, currency bias, and home bias (Alfaro et al. 2007; Maggiori et al. 2020). Third, we show that internal capital markets are a key channel that drives the transmission of shocks, while the existing evidence is consistent with multiple other channels of transmission.[12]

The results in this paper expand our understanding of the causes of business cycle comovement. Existing evidence shows that countries (Frankel and Rose 1998), regions (Kleinert et al. 2015), region-sector cells (di Giovanni and Levchenko 2010), and firms (di Giovanni et al. 2014; 2018) comove with foreign entities when they are connected through trade and production.[13] Budd et al. (2005), Desai and Foley (2006), Cravino and Levchenko (2017), and di Giovanni et al. (2018) find that multinational parents and affiliates comove. It is not clear, however, whether these findings isolate shock transmission between connected entities or whether they capture common unobserved shocks (Imbs 2004; Abiad et al. 2013). Our contribution to this literature is to overcome the concern about common shocks and to isolate a channel through which shock transmission can generate comovement, thanks to our quasi-experimental approach.[14] Moreover, we show that internal capital markets of multinationals are a key channel that causes shock transmission across countries.[15]

[11]More generally, our results are consistent with the view that multinational activity depends on financial frictions (Antràs et al. 2009; Bilir et al. 2019). Alfaro and Charlton (2009) and Ramondo et al. (2016) report that many multinationals do not trade internally, leaving an important role for internal capital markets.

[12]For instance, adjustments in internal trade between segments, the reallocation of real production inputs, common productivity shocks across segments (e.g., new IT technology), and changes in the group's management approach and risk-taking (e.g., more aggressive investment) may explain the results in the seminal paper by Shin and Stulz (1998). Similarly, Giroud and Mueller (2019) are careful to emphasize that their results capture general "resource allocation" rather than capital flows.

[13]Further cross-country evidence is in Clark and van Wincoop (2001), Baxter and Kouparitsas (2005), Calderón et al. (2007), Burstein et al. (2008), Ng (2010), Liao and Santacreu (2015).

[14]In theory, financial integration can lower comovement (Baxter and Crucini 1995; Kalemli-Özcan et al. 2013; Monnet and Puy 2019) or raise comovement (Morgan et al. 2004; Imbs 2006), depending on whether credit demand or supply shocks are the primary source of fluctuations. In our setting, multinational parents are hit by a credit supply shock, so financial integration through multinationals raises comovement.

[15]Other papers focus on distinct transmission channels: input-output links between firms (Boehm et al. 2019; Huo et al. 2020) and technology transfers (Javorcik 2004; Arnold and Javorcik 2009; Keller and Yeaple 2013; Alfaro-Ureña et al. 2019; Bilir and Morales 2019; Fons-Rosen et al. 2019). Domestic input-output chains are studied in Barrot and Sauvagnat (2016), Alfaro et al. (2020), Carvalho et al. (2020), and Costello

Finally, the evidence in this paper supports two theoretical approaches in international economics. First, the findings are consistent with models where multinationals increase business cycle comovement (Contessi 2010; Zlate 2016; Menno 2017; Tintelnot 2017).[16] Second, the results verify the common modeling assumption that shocks to the parent's production process affect affiliate growth.[17]

II The Idiosyncratic Shock to Commerzbank

This paper investigates how an idiosyncratic shock to a large firm in one country was transmitted internationally. In this section, we describe the specific shock that we analyze: the crisis of Commerzbank, a large German bank.

Commerzbank was the second-largest German bank before the Great Recession. Its business model focused on corporate lending in Germany (with 96 percent of branches located in Germany). Commerzbank's market share in lending to medium-sized (*Mittelstand*) and large firms in Germany was around 13 percent.[18]

The bank also ran trading and investment divisions that had heavily invested in international financial markets prior to the 2008/09 financial crisis. At the onset of the crisis, Commerzbank held large positions in US mortgage-related securities (mortgage-backed securities and collateralized debt obligations) as well as institutional debt that would end up failing (including exposure to Lehman Brothers and the Icelandic banks). After US mortgage markets crashed, these positions caused large losses in Commerzbank's trading and investment divisions.

Overall, Commerzbank's equity capital fell by a total of 68 percent between December 2007 and December 2009. The drop in equity was entirely due to two components: write-downs on financial instruments and income losses (Figure I, panel A). Write-downs on financial instruments were caused by changes in the valuation of derivatives held by the bank, and can therefore be attributed to the trading and investment divisions. The income

(2020). A recent paper by Bena et al. (2020) argues that both internal capital markets and internal trade transmit shocks internationally, consistent with our findings.

[16] Standard models of international trade do not match the degree of comovement observed in the data (Backus et al. 1993; Kose and Yi 2006), even when accounting for vertical production links (Kose and Yi 2001; Burstein et al. 2008; Arkolakis and Ramanarayanan 2009; Johnson 2014) or heterogeneous firms (Ghironi and Melitz 2005; Alessandria and Choi 2007).

[17] See, for instance, Helpman (1984); Markusen (1984); Helpman et al. (2004); Burstein and Monge-Naranjo (2009); McGrattan and Prescott (2009, 2010); Keller and Yeaple (2013); Ramondo and Rodríguez-Clare (2013); Antràs and Yeaple (2014); Ramondo (2014); Menno (2017); Alviarez (2019).

[18] None of the information on individual banks is provided by the Deutsche Bundesbank. Main sources are annual reports of Commerzbank and Dresdner Bank and financial analyst reports listed at the end of Appendix A. Throughout the paper, "Commerzbank" refers to all branches that were part of the Commerzbank network in 2009, including its acquisition Dresdner Bank. Commerzbank had already decided to acquire Dresdner Bank before the crisis hit both banks severely. Both banks suffered significant losses in 2008. Dresdner Bank was more exposed to asset-backed securities, while Commerzbank was more exposed to failing public and institutional debt (including the Icelandic crisis and the Lehman Brothers insolvency). The lending cut affected firms that had banked with the old Dresdner Bank to a similar degree as firms that had banked with the old Commerzbank, so we construct the treatment variable based on relationships to either bank. See Appendix B for more details.

losses were also driven by the trading and investment divisions (Figure I, panel B). Interest income, on the other hand, which includes Commerzbank's earnings from lending to firms, remained on an upward trend up to 2009. These figures suggest that Commerzbank's losses were not caused by the corporate lending portfolio. Instead, Commerzbank's corporate borrowers were growing steadily right until Commerzbank cut lending.

Following its trading and investment losses, Commerzbank became financially constrained. It struggled to get wholesale funding in 2008 and was close to its equity threshold. As a result, it cut lending to German firms. The closest comparison group to Commerzbank is composed of other German commercial banks. They also operated for profit, had a comparable business model, and similar types of borrowers. Commerzbank's lending to German borrowers grew in parallel to other commercial banks and all other German banks until 2007, but fell sharply thereafter (Figure II). In contrast, lending by other German banks actually increased slightly from 2007 to 2009. There was no domestic financial crisis that affected all German banks, for example there was no housing boom and bust. The majority of German banks were hardly exposed to international financial markets and therefore able to continue lending.[19]

Research reports by financial analysts support the view that Commerzbank's lending cut was an exogenous shock to German firms. These reports are useful because analysts communicate directly with bank managers and have access to information beyond banks' official reports. We study 110 analyst research reports extracted from the Thomson Reuters Investext Database, listed in the final table of the Appendix. We extract all reports mentioning Commerzbank in 2008 and 2009, as well as relevant reports from years before and after. We systematically read the reports and use them to answer six questions about Commerzbank's lending cut. Our exact methodology and the results are described in Table A.II.

There are six key lessons from the analyst reports. First, Commerzbank's loan portfolio did not in any way contribute to the losses. In contrast, the performance of corporate borrowers was generally "strong" and generated "healthy returns" until Commerzbank's lending cut (for example, 2008 reports by ESN/equinet and Deutsche Equity Research). Second, Commerzbank's borrowers were not any riskier or more cyclical than other firms (JPMorgan 2007 and Natixis 2006). Third, the investment and trading divisions operated separately from the loan division. There was no cross-hedging of risks and no common strategy, so the divisions were "conceptually separate" (CA Cheuvreux 2008). The evolution of income from the different divisions also suggests that their performance was not correlated (Figure I, panel B).

[19] A few other German banks also suffered losses on international financial markets. Unlike Commerzbank, these other banks cannot be used for a quasi-experimental research design. Other banks either did not cut lending (because they were publicly owned and received immediate financial support) or their borrowers were hit by systematically different shocks relative to other firms. We present detailed narrative evidence on other banks in Appendix B and explicitly analyze firms borrowing from other banks in Section VIII. In any case, focusing on Commerzbank's lending cut is a valid empirical strategy even if some other German banks had cut lending, as long as the majority of other German banks kept lending.

The reports also highlight which investment decisions generated losses. The fourth lesson is that Commerzbank's managers recognized the severity of the US mortgage crisis too late, so exposure to US mortgage-related securities contributed to the losses (Credit Suisse Europe 2008). Fifth, the bank's managers believed that governments would prevent large-scale institutional failures of Commerzbank's interbank partners, such as Lehman and the Icelandic banks, so they suffered severe losses when these banks failed (ESN 2009). In combination, these exposures depleted Commerzbank's equity and forced it to cut lending. Following equity injections by the government, it took Commerzbank until 2010 to stabilize (lesson six). Its lending grew roughly in parallel with other commercial banks from 2010 onward.

III Theoretical Model of an Internal Capital Market

Commerzbank's idiosyncratic shock was transmitted internationally through the internal capital markets of multinationals. This section presents a simple model of a multinational. We assume that the multinational is directly exposed to Commerzbank's crisis and therefore hit by a credit shock. The model then illustrates how an internal capital market can transmit the credit supply shock from parent to affiliates.

The multinational corporation consists of n firms. Without loss of generality, we index the parent firm by $i = 1$ and the affiliates by $i \in \{2, ..., n\}$. The objective of the multinational is to maximize the sum of parent and affiliate profits. The multinational chooses how much capital each firm (parent and affiliates) borrows from external sources and how much capital each firm receives to use in production. External capital borrowed by firm i is given by b_i and capital used in production by k_i. The multinational operates an internal capital market (Stein 1997; Inderst and Mueller 2003; Matvos and Seru 2014). It can move capital across its firms, so that capital borrowed by one firm can be used for production by another firm. Hence, the budget constraint of the multinational is given by $\sum_{i=1}^{n}[b_i - k_i]$.

A firm generates sales using production function $f_i(k_i)$ where capital is the only input. Sales are a function of capital for several reasons. First, firms use working capital to pay for variable inputs and labor (Chari et al. 1995). A shock to the availability of working capital acts like a cost shock. It forces firms to reduce variable inputs and labor, which lowers their sales. Second, working capital can fund the distribution of output to points of sales. A negative shock to capital may force firms to halt the transport of products to customers, which immediately harms their sales. Third, firms maintain working capital stocks as liquidity buffers to guard against unexpected shocks (Calomiris et al. 1995). When working capital falls, firms may elect to rebuild their liquidity buffers by halting expenditures that generate sales (e.g., on variable inputs, marketing, and product distribution). Finally, working capital is used to pay for investment into factors of production (e.g., machinery) (Fazzari and Petersen 1993). Greater investment allows firms to generate more output and sales.

Each production function satisfies the neoclassical conditions $f_{i,1}(k_i) > 0$, $f_{i,11}(k_i) < 0$,

$f_i(0) = 0$, $\lim_{k_i \to 0} f_{i,1}(k_i) = \infty$, and $\lim_{k_i \to \infty} f_{i,1}(k_i) = 0$. (We use subscripts 1 and 2 to indicate the derivative of a function with respect to its first and second argument, respectively. Two subscripts indicate a second derivative.)

The total cost of external borrowing is given by $r(b_i, c_i)$. Borrowing costs depend on the severity of credit supply disruptions hitting the firm, measured by c_i. The greater c_i, the greater the disruption. A negative credit supply shock raises both the total and marginal costs of borrowing, i.e., $r_2(b_i, c_i) > 0$ and $r_{12}(b_i, c_i) > 0$. Borrowing costs are increasing and convex in borrowed capital, i.e., $r_1(b_i, c_i) > 0$ and $r_{11}(b_i, c_i) > 0$. The borrowing cost function satisfies limit conditions $r(0, c_i) = 0$, $\lim_{b_i \to 0} r_1(b_i, c_i) = 0$, and $\lim_{b_i \to \infty} r_1(b_i, c_i) = \infty$. The optimization problem of the multinational is:

$$max_{\{k_i, b_i, \lambda\}_{i=1}^n} \sum_{i=1}^{n} [f_i(k_i) - r(b_i, c_i)] + \lambda [\sum_{i=1}^{n} (b_i - k_i)]. \tag{1}$$

The first-order conditions are:

$$f_{i,1}(k_i) - \lambda = 0 \quad \forall i, \tag{2}$$

$$r_1(b_i, c_i) - \lambda = 0 \quad \forall i, \tag{3}$$

$$\lambda [\sum_{i=1}^{n} (b_i - k_i)] = 0 \quad \lambda \geq 0. \tag{4}$$

Optimality requires that the budget constraint of the multinational firm binds, so that $\lambda > 0$. To investigate the effect of a shock to parent credit supply (keeping constant affiliate credit supply), we fully differentiate the first-order conditions with respect to c_1:

$$f_{i,11}(k_i) \frac{dk_i}{dc_1} - \frac{d\lambda}{dc_1} = 0, \tag{5}$$

$$r_{11}(b_i, c_i) \frac{db_i}{dc_1} + r_{12}(b_i, c_i) \frac{dc_i}{dc_1} - \frac{d\lambda}{dc_1} = 0, \tag{6}$$

$$\sum_{i=1}^{n} [\frac{db_i}{dc_1} - \frac{dk_i}{dc_1}] = 0. \tag{7}$$

We substitute equations (5) and (6) into equation (7). Solving for $\frac{d\lambda}{dc_1}$ gives:

$$\frac{d\lambda}{dc_1} = \frac{r_{12}(b_1, c_1)}{r_{11}(b_1, c_1)} \big[\sum_{i=1}^{n} [\frac{1}{r_{11}(b_i, c_i)} - \frac{1}{f_{i,11}(k_i)}] \big]^{-1}. \tag{8}$$

Since for all firms $r_{12}(b_i, c_i)$ and $r_{11}(b_i, c_i)$ are positive and $f_{i,11}(k_i)$ is negative, $\frac{d\lambda}{dc_1}$ is positive. Intuitively, the existence of an internal capital market implies that the marginal shadow cost of capital increases at all firms following a credit supply shock to the parent. The

changes in affiliate production capital k_i and borrowed capital b_i are:

$$\frac{dk_i}{dc_1} = \underbrace{\frac{d\lambda}{dc_1}}_{>0} \underbrace{\frac{1}{f_{i,11}(k_i)}}_{<0} < 0 \quad \forall i, \tag{9}$$

$$\frac{db_i}{dc_1} = \underbrace{\frac{d\lambda}{dc_1}}_{>0} \underbrace{\frac{1}{r_{11}(b_i, c_i)}}_{>0} > 0 \quad \forall i \neq 1. \tag{10}$$

The multinational smooths out the shock by lowering production capital of each firm, not just the parent (equation 9). As a result, sales of all affiliates fall. The reduction in production capital is greatest for affiliates with low marginal product (i.e., where the second derivative of the production function is greater in absolute terms). Intuitively, the multinational cuts most production capital where it generates the lowest sales loss.

To compensate for the shock, affiliates may increase external borrowing. This effect depends crucially on the marginal cost of external borrowing (equation 10). If the marginal cost of borrowing increases gently (i.e., $r_{11}(b_i, c_i)$ is low), affiliates raise borrowing by almost enough to offset the shock to the parent. However, firms commonly face borrowing constraints, for example due to collateral or cash-flow requirements set by lenders, as discussed by Lian and Ma (2020). In this case, the marginal cost increases sharply and affiliates do not raise borrowing.

Independent of borrowing costs, a robust prediction is that each affiliate increases net lending through the internal capital market. Net lending is the difference between capital borrowed by an affiliate, which is stable or increasing after the parent is shocked, and capital used in production by an affiliate, which falls. The increased internal lending by affiliates goes to the parent, so net lending by the parent falls.[20]

In the main analyses below, we test the predictions of the model. We examine how affiliate sales, borrowing, and internal lending responded when a credit supply shock hit the parents of German multinationals. We also explore heterogeneity using proxies for affiliates' marginal product and access to external borrowing, in line with the predictions of the model.

IV Data

We trace out the international effects of Commerzbank's shock using three datasets: information on the relationship banks of German parents, balance sheets of international affiliates from the Microdatabase Direct Investment (MiDi, Deutsche Bundesbank 2017a), and bal-

[20]To gauge how internal lending depends on borrowing costs, we carry out an initial data analysis. We regress net lending by an affiliate to the parent on the interest rate spread in the affiliate host country (difference between lending and deposit rate). A greater spread indicates that the average cost of external borrowing is greater. We find that affiliate net lending falls with the spread (Table A.I, columns 1 and 2), while funding by the parent rises with the spread (columns 3 and 4). This suggests that borrowing costs affect the degree of internal lending.

ance sheets of German parents from the Ustan database (Deutsche Bundesbank 2017b).

IV.A Relationship Banks of German Firms

We obtain proprietary data on the names of the relationship banks (*Hausbanken*) of 112,344 German firms from the year 2006. The data are from the credit rating agency Creditreform, which collects the information from firm surveys and financial statements. Our main treatment variable measures the fraction of a parent's relationship banks that were Commerzbank branches:

$$\text{Parent CB dep} = \frac{\text{Number of parent's relationship banks that were CB branches}}{\text{Total number of parent's relationship banks}}. \quad (11)$$

The vast majority of firms only used one Commerzbank branch as relationship bank, so results are similar when we use the fraction of bank companies rather than bank branches to define the treatment variable. In additional robustness tests, we also use indicator variables for different parts of the distribution of parent Commerzbank dependence to investigate nonlinear effects. We do not have data on loan quantities from Commerzbank to individual firms. However, in the German system of relationship banking, information on relationship banks accurately predicts which firms were exposed to which banks (see Section V.B).

The variable parent Commerzbank dependence is highly correlated with Commerzbank's branching expansions after World War II and after German reunification, which suggests that it captures Commerzbank dependence accurately (Huber 2018). Mean parent Commerzbank dependence was 0.23 and about 40 percent of parents had zero Commerzbank dependence (Figure III).[21]

IV.B MiDi

The data underlying MiDi are collected by Deutsche Bundesbank as part of its supervisory duties. German parents have to report an international affiliate to Deutsche Bundesbank if they hold at least 10 percent of an affiliate's equity and if the affiliate's total assets exceed 3 million Euro. These reporting criteria have been constant since 2002, so we use data from 2002 until 2015, the most recent year at the time of data provision.

A remarkable feature of MiDi is that it contains detailed balance sheet positions on internal capital market positions between affiliates and parents. We can see annual measures of long-term loans from affiliate to parent, equity invested by the parent, total liabilities owed to the parent by the affiliate, and short-term claims by the affiliate on the parent.[22] MiDi also includes annual data on affiliate balance sheets, sales, employment, and industry.[23]

[21] We cannot match data on the bank relationships of international affiliates to the MiDi data. However, we show using several tests that affiliates were not directly exposed to Commerzbank's lending cut in Section VIII.D.

[22] There is no distinction between long- and short-term liabilities toward the parent in the data.

[23] We winsorize all outcome variables at the 1st and 99th percentiles of their distribution to mitigate the

Our estimation sample includes all affiliates that were directly owned by a German parent in 2006, the final year before the global financial crisis began in the US housing market. We remove affiliates in the financial sector from the sample. Using a unique firm identifier, we match parents' relationship banks to MiDi.[24] We match the relationship banks for 26.4 percent of parents in MiDi. The other parents do not appear in the data on relationship banks. The affiliates of matched parents were responsible for 70.8 percent of total sales by international affiliates in MiDi in 2006.[25] Overall, there are 655 German parents and 2,695 international affiliates in our data. The foreign direct investment of German firms was the third-largest in the world in 2006, so the data contain affiliates located all over the world.

IV.C Ustan

Ustan is a dataset of annual balance sheets of non-financial German firms. The data are collected by the Deutsche Bundesbank as byproduct of its lending activity (Becker et al. 2019). Ustan is also available from 2002 to 2015. Some parents that appear in MiDi do not appear in Ustan, so we supplement Ustan with data from Bureau van Dijk Orbis Historical Financials for these parents. Overall, we have balance sheet data on 407 of the 655 German parents in MiDi. The average parent had 3.8 international affiliates in 2006 (Table A.III).[26]

V Empirical Strategy

We outline how we trace the effects of Commerzbank's idiosyncratic shock. In short, we first identify the effects on multinational parents borrowing from Commerzbank in Germany and then investigate the effects on international affiliates. We verify this empirical strategy, by showing that Commerzbank's lending cut reduced parents' credit supply and by presenting evidence supporting the identification assumption.

impact of outliers. However, this step is not essential, as we find similar coefficients without winsorizing. Since some outcome variables are in logs and contain a handful of zeros, we add 1 unit (1,000 Euro) to all log outcome variables throughout the paper. In robustness checks, we use a different transformation of the outcome variable, the inverse hyperbolic sine. Table A.IV and Table A.VIII show that results remain similar. The inverse hyperbolic sine of y is defined as $\text{IHS}(y) = ln(y + (y^2+1)^{\frac{1}{2}}) \approx ln(2) + ln(y)$, so that first differences can be interpreted as approximate log changes (Burbidge et al. 1988; MacKinnon and Magee 1990; Chen 2013; Arcand et al. 2015).

[24]The match was performed by the Research Data and Service Center of the Deutsche Bundesbank (Schild et al. 2017). MiDi and Ustan are available to researchers for on-site use in Frankfurt under strict guidelines (Schild and Walter 2017).

[25]Larger parents in MiDi are more likely to be matched to their relationship banks. To investigate whether this might affect our estimates, we carried out robustness checks by parent size. We do not find heterogeneity with respect to parent size, suggesting that the match does not systematically affect the estimates.

[26]Our main treatment variable is parent Commerzbank dependence. There was no linear relationship between parent Commerzbank dependence and parent characteristics, including bank debt, trade credit (borrowing from external firms), and leverage. Parents with Commerzbank dependence in the middle bins were on average larger than parents with zero Commerzbank dependence. This relationship arises mechanically, since larger firms have more relationship banks, and are therefore more likely to have a relationship to a Commerzbank branch while also having one or more other banks.

V.A Empirical Challenge

The empirical challenge in identifying transmission of shocks across firms is that, in general, there are unobserved shocks that simultaneously hit connected firms. Consider a global decrease in demand for a particular car model produced by a German multinational. The parent that produces the less popular model in Germany would produce and sell fewer cars in Germany. At the same time, affiliates that produce the same model in other countries would produce and sell fewer cars in their host countries. Even without a causal transmission channel from parent to affiliates, parent and affiliate growth would comove.

A related issue arises from the fact that size and productivity of parents and affiliates are positively correlated, as shown in existing work (Guadalupe et al. 2012). We also know that firm outcomes differ systematically by size and productivity (Fort et al. 2013; Foster et al. 2016). These facts again suggest that parents and affiliates are often exposed to common shocks. Comovement between parents and affiliates does not imply shock transmission.

V.B Commerzbank's Lending Cut and Relationship Banking

To overcome the challenge of common shocks, we need to identify a shock that affected only parents, but did not directly impact international affiliates. Commerzbank's lending cut during the financial crisis 2008/09 provides such a shock. Commerzbank's corporate lending was concentrated on firms in Germany. As a result, the bank credit supply of international affiliates of German multinationals was not directly harmed by Commerzbank's lending cut.[27] In our main analyses, we compare the growth of affiliates, whose German parents were relatively dependent on Commerzbank for financial services, to the growth of other affiliates, whose German parents had lower or zero Commerzbank dependence. Our estimation sample exclusively contains affiliates of German multinationals located outside Germany. We always compare affiliates located in the same country at the same time.[28]

Some German parents worked closely with Commerzbank. German corporate finance traditionally relies on a system of relationship banking. This means that German firms form close relationships with a few relationship banks. In German, relationship banks are literally called "home banks" (*Hausbanken*), which highlights the tight ties between firms and banks. Bank-firm relationships are long-lasting, as only 1.7 percent of firms add a new relationship bank per year (Dwenger et al. 2015). The most common services provided by relationship banks are loans and payment transactions (Elsas 2005).

[27] To support this point, we show in Section VIII that affiliates with greater parent Commerzbank dependence did not reduce borrowing from banks after Commerzbank's lending cut. Moreover, the results are robust to excluding countries where Commerzbank had an international office or business dealings with local banks.

[28] This strategy implies that we estimate the reduced-form impact of the lending cut on affiliates, following, for example, Chodorow-Reich (2014). We do not estimate the structural relationship between bank loans and firm outcomes. The reason is that a lending cut can affect firms through many channels, including loan amounts, interest rates, the length of loan commitments, and uncertainty about future loan supply. Commerzbank dependence is a valid proxy for the overall effect of exposure to a lending cut, but not a valid instrument for any individual channel.

Economic theory suggests that relationship banks gain an informational advantage from their longstanding dealings with relationship borrowers (Sharpe 1990; Boot 2000). This reduces asymmetric information and improves banks' monitoring capabilities. But the informational advantage creates an adverse selection problem when firms want to find new lenders. This problem is particularly severe in a recession like the 2008/09 crisis when lenders suspect that firms not getting credit from their original relationship banks are likely to default. As a result, in a relationship based system like Germany's, firms struggle to get credit when their relationship banks cut lending.

Existing evidence confirms that multinational parents in Europe depend on the credit supply of their relationship banks. For instance, Bentolila et al. (2018) and Huber (2018) for Spain and Germany, respectively, report that firms of all sizes, including multinational parents, underperform when their relationship bank cuts credit.[29]

V.C Commerzbank's Lending Cut Affected German Parents

Our empirical strategy posits that Commerzbank's lending cut reduced the credit supply of German parents for whom Commerzbank was an important relationship bank. We confirm this view using the Ustan dataset, which exclusively contains German parents. The main treatment variable is parent Commerzbank dependence in 2006. We find that the total bank debt of parents with greater Commerzbank dependence fell significantly after Commerzbank cut lending in 2008 (Table A.IV, column 1). The estimate implies that bank debt of the average parent in the sample was 34.7 log points lower due to Commerzbank's lending cut. The specification controls for firm size, industry, leverage, and indicators for whether the parent had an affiliate in Asia, the EU, or the US.[30]

We also report results based on survey data from the Ifo institute. During Commerzbank's lending cut, firms with higher Commerzbank reported more restrictive bank loan supply, compared to firms with other relationship banks (Table A.V). Before the lending cut, there was no association between parent Commerzbank dependence, reported bank loan supply (Table A.V), and bank debt growth (Figure A.I), including during the 2003 recession. This shows that parents with higher Commerzbank dependence were on parallel growth paths to other parents and not more cyclical. Overall, the evidence suggests that parent Commerzbank dependence is a valid proxy for exposure to the bank lending cut.[31]

[29] Media reports regularly describe that German multinationals take out bank debt when they want to finance investments or when they cannot access bond markets, for example Reuters (2008; 2018).

[30] Point estimates are similar without controls. See Section VI for a detailed discussion of control variables.

[31] Commerzbank's lending stock fell by around 17 percent after 2008, relative to other German banks (Figure II). The narrative evidence and the survey suggest that Commerzbank's loan supply recovered after 2011 (Section II and Table A.V). Therefore, the point estimates in Table A.IV and Figure A.I imply that the effects of Commerzbank's lending cut on parents' bank debt were proportionally larger and more persistent than the lending cut itself. One reason for this discrepancy could be that parents voluntarily reduced their bank debt after the lending cut, because they were "scarred" by the experience of the lending cut. This is consistent with evidence that firms use less external financing when their managers personally experienced a credit crisis (Graham and Narasimhan 2004; Malmendier et al. 2011) and with reports that German firms preferred alternative means of financing after 2009 because bank loan supply had proven to be risky (Fuchsbriefe 2018). Note,

Parents were unable to compensate for the lost bank debt using non-bank financing. Between 2008 and 2010, parents did not raise more external trade credit (from outside the multinational), bonds and other forms of debt, or equity (Table A.VI, columns 1-3). After 2011, external trade credit increased (Figure A.II). Parents compensated for around 79 percent of the lost bank debt using external trade credit after 2011, taking the point estimates literally.[32] Consistent with this timing, parent sales were significantly lower from 2008 to 2010, but recovered after 2011 (Table A.VI, column 4). Taken together, the results suggest that parents became financially constrained and it took them until roughly 2011 to overcome the constraints.

The Ustan sample is relatively small, containing 407 parents. Nonetheless, the effects on bank debt, trade credit, and sales are significantly different from zero (at 10 percent, 1 percent, and 10 percent, respectively). The findings using Ustan are quantitatively similar and statistically indistinguishable relative to previous estimates of the effects of Commerzbank's lending cut on German firms (Huber 2018). For the remaining analysis of this paper, we take as the starting point the observation that Commerzbank's idiosyncratic crisis caused an exogenous financial shock to German parents. We then investigate whether the shock to parents was transmitted through internal capital markets and affected international affiliates.

V.D Support for the Identification Assumption

Our empirical analysis tests whether affiliates with high parent Commerzbank dependence grew more slowly and increased internal lending after Commerzbank's lending cut. The main treatment variable is the Commerzbank dependence of the German parent in 2006. Our analysis identifies the causal effect of parents' exposure to the lending cut under a parallel-trends assumption: affiliates whose parents had high Commerzbank dependence would have evolved in parallel to other affiliates had the parents not been exposed to Commerzbank's lending cut. Several factors suggest that this assumption holds. First, Commerzbank's lending cut was exogenous to German parents and their international affiliates, as detailed in Section II. It was caused by Commerzbank's trading and investment losses and not by the performance of multinationals borrowing from Commerzbank. Second, affiliates with greater parent Commerzbank dependence were on parallel growth paths right until Commerzbank's lending cut (Figure IV). This suggests that that they were facing the same types of shocks and would have continued to grow in parallel without the lending cut.

A third factor supporting the identification assumption is that we can control for key confounders. Most important, the main specifications include country fixed effects interacted with time fixed effects, so country-specific shocks have no effect on our estimates.

however, that the 90 percent confidence interval does not exclude that the effect of parent bank debt was the same as the magnitude of Commerzbank's lending cut.

[32] Existing work shows that it takes time to raise external financing. For instance, Paravisini et al. (2015) report that trade credit reacts only marginally in the first year after a shock and Antràs and Foley (2015) find that trade credit terms improve after multiple interactions.

The findings below are also robust to additional control variables, which include, among others, country-industry-year fixed effects, as well as the interactions of year fixed effects with pre-crisis size, leverage, balance sheet ratios, number of banks, and exposure to other banks of parents and affiliates. These control variables ensure that other determinants of affiliate growth, such as shocks to product demand, are kept constant.

V.E Affiliate Characteristics and Parent Commerzbank Dependence

Further support for the identification assumptions comes from the fact that the average characteristics of affiliates were similar across bins of parent Commerzbank in 2006. The average affiliate was a medium-sized firm, with annual sales of 54 million Euro and 196 employees (Table I). On average, parents held 87.6 percent of an affiliate's equity. In general, there was no linear relationship between affiliate characteristics and parent Commerzbank dependence. Affiliate size, leverage, the degree of lending and financing through internal capital markets, and parents' ownership share were balanced.

Affiliates of parents with positive Commerzbank dependence operated in similar industries as affiliates with zero parent Commerzbank dependence (Table A.VII, top panel).[33] The correlation of industry shares between the two groups was high, at 0.89. The geographic distribution of affiliates was also similar in both groups, which was reflected in a correlation of country shares across the two groups of 0.98 (Table A.VII, bottom panel).[34]

Our identification assumption does not require balanced affiliate characteristics. All our specifications include firm fixed effects, which absorb time-invariant differences across affiliates. Nonetheless, the balance of affiliate characteristics is helpful because it implies that affiliates with high parent Commerzbank dependence were not fundamentally different from other affiliates and likely hit by similar shocks over time, apart from the lending cut affecting their parents. This corroborates the parallel-trends identification assumption.

VI The Effect on Affiliate Sales

We investigate whether the disruption to parents' credit supply, due to Commerzbank's crisis, affected the sales of international affiliates.

[33] We do not report data by bins of Commerzbank dependence, as above, because disclosure rules of the Deutsche Bundesbank do not allow us to report statistics for cells that contain only a few firms. Commerzbank's 2008 annual report contains a similar industry breakdown for Commerzbank's corporate borrowers.

[34] The most common host countries of affiliates were the US, France, Italy, the Netherlands, and the United Kingdom. Apart from the US and China, the ten most common countries were in Europe. This suggests that a gravity equation holds for the location of affiliates.

VI.A Graphical Evidence on Affiliate Sales

We begin by exploring dynamic effects over time. We use the following specification for outcome variable y of affiliate a located in country c in year t:

$$\ln(y_{act}) = \sum_{\tau=2002}^{2015} \beta_\tau \times \text{Parent CB dep} \times \mathbb{1}(t=\tau) + \gamma_a + \lambda_t + \\ + \sum_{\tau=2002}^{2015} \phi'_\tau \times \mathrm{X}_{ac} \times \mathbb{1}(t=\tau) + \varepsilon_{act}. \tag{12}$$

The treatment variable of interest is parent Commerzbank dependence, measured in 2006. We estimate the effect of parent Commerzbank dependence in every year from 2002 to 2015. We use 2006 as the baseline year, because it was the final year before the global financial crisis began in the US housing market. The coefficients of interest β_τ measure the effect (in log points) of parent Commerzbank dependence in year τ relative to 2006.

The specification includes affiliate fixed effects γ_a to control for time-invariant differences across affiliates and year fixed effects λ_t to control for global macroeconomic shocks. X_{ac} is a vector of affiliate-level controls, measured in 2006 and interacted with year fixed effects. In the baseline specification, we include fixed effects for size (deciles of sales), industry, country, and deciles of leverage. We include these controls because the existing literature has shown that during our sample period there were systematic differences in firm growth correlated with firm size (Fort et al. 2013), industry (Alviarez et al. 2017), country (Eaton et al. 2016), and leverage (Giroud and Mueller 2017). Results are robust to a range of additional controls.[35] Standard errors are two-way clustered at the level of the country and the parent.

The first outcome variable y_{act} we consider is affiliate sales.[36] We plot the relationship between affiliate sales and parent Commerzbank dependence, relative to the pre-crisis baseline year 2006 and conditional on all controls, for a parent with average Commerzbank dependence (Figure IV). The point estimates for the years before 2008 are all small and statistically insignificant. This supports the identification assumption, suggesting that affiliates whose parents had higher Commerzbank dependence were on parallel trends to other affiliates.

After Commerzbank cut lending to German parents in 2008, sales of affiliates with

[35] As in all empirical papers, choosing the number of baseline controls poses a trade-off. On the one hand, a large number of fixed effects may control for endogenous variation more accurately. On the other hand, many fixed effects may overweight small differences in treatment within fixed effect groups and produce unrepresentative estimates (Angrist and Pischke 2008, page 226). In the baseline specifications, we balance this trade-off by including country-year and industry-year fixed effects separately and by classifying industries according to the NACE 1.1 one-digit system (16 industries in total). In Table III, we find similar results when classifying industries according to the NACE 1.1 two-digit system (88 industries in total) and when including the full interaction of country-industry-year fixed effects. Results are also similar when we additionally control for parent characteristics and when we use a fully balanced panel (Table A.IX).

[36] The results are robust to using the inverse hyperbolic sine of sales instead of log sales as outcome (Table A.VIII).

greater parent Commerzbank dependence fell sharply. Capital constraints can affect sales through several channels. Affiliates may have suffered from a shortage of working capital and liquidity, cut spending on variable inputs and labor, reduced the distribution of existing output to points of sales, and rebuilt liquidity buffers by foregoing short-term expenditures that generate sales (e.g., on marketing, variable inputs, and production distribution; see Section III).

After the initial shock, affiliate sales recovered partially in 2009 and 2010 but still remained at a lower level.[37] From 2011 onward, the coefficients on parent Commerzbank dependence are close to zero again. This implies that affiliates with greater parent Commerzbank dependence recovered to the level of unaffected affiliates from 2011 onward. The full recovery suggests that affiliates did not reduce investments that harmed their long-run growth prospects between 2008 and 2010.

VI.B Baseline Results on Affiliate Sales

The graph suggests that Commerzbank's 2008 lending cut lowered the sales of international affiliates from 2008 to 2010 and that affiliate sales recovered after 2011. We investigate these hypotheses formally by estimating the effect separately for two periods, 2008 to 2010 and 2011 to 2015:

$$\begin{aligned}\ln(y_{act}) = \beta_1 \times \text{Parent CB dep} \times \mathbb{1}(\text{2008-10})_t + \beta_2 \times \text{Parent CB dep} \times \mathbb{1}(\text{2011-15})_t \\ + \gamma_a + \lambda_t + \phi_1' \times \mathrm{X}_{ac} \times \mathbb{1}(\text{2008-10})_t + \phi_2' \times \mathrm{X}_{ac} \times \mathbb{1}(\text{2011-15})_t + \varepsilon_{act}.\end{aligned} \tag{13}$$

The main specification contains parent Commerzbank dependence and the baseline controls, all interacted with time fixed effects for the two periods.

The point estimate implies that sales of affiliates whose parents had average Commerzbank dependence were on average 9.7 log points lower between 2008 and 2010 (significant at the 5 percent level), relative to affiliates whose parents had zero Commerzbank dependence (Table II, column 3). Comparing the affiliate and parent effects (from Table A.VI, column 4) implies that a shock lowering parent sales by 10 percent reduced affiliate sales by 6.6 percent. The estimate for 2011 to 2015 is small, positive, and statistically insignificant. This confirms that affected affiliates recovered to the level of unaffected affiliates after 2011.

The point estimates in the specifications with fewer controls are similar to the baseline effect (columns 1-2). This suggests that affiliates with greater parent Commerzbank dependence were not hit by different shocks, in line with the parallel-trends identification assumption. The estimates with fewer controls have larger standard errors and much lower R-squared. Hence, the controls soak up a significant amount of noise. This is in line with

[37] We carry out a formal test for the significance of the sales drop from 2008 to 2010 in Tables II and III. Since we use a panel specification with firm and year fixed effects, the relevant hypothesis is whether sales were jointly significantly different from 2008 to 2010. We find that the reduction in sales from 2008 to 2010 was statistically significant at the 5 percent level.

the view that there was significant heterogeneity in the shocks hitting firms across different sizes, industries, countries, and leverage groups during the sample period.

There was no extensive margin effect, as affiliates with greater parent Commerzbank dependence were not more likely to exit (Table A.X, column 1) or enter (column 2). Parents were also not more likely to exit themselves (column 3). These findings are not surprising, given that affiliates and parents recovered from the effects of the lending cut after 2011.

VI.C Effects By Bins of Parent Commerzbank Dependence and Further Robustness

Some parents that had Commerzbank as relationship bank also had other relationship banks in 2006. These parents may have found it easier to substitute the missing credit from Commerzbank with lending from other banks, since the vast majority of German banks continued to lend during the crisis (Figure II). To test this argument, we construct six bins of parent Commerzbank dependence: one bin for affiliates with zero parent Commerzbank dependence and five bins for the quintiles of positive parent Commerzbank dependence. We then estimate one specification based on equation 13. The only difference is that the relevant treatment variables are now indicators for the six bins interacted with the 2008-10 indicator instead of the linear parent Commerzbank dependence interacted with the 2008-10 indicator.

We plot the effects on affiliates falling into the six bins of parent Commerzbank dependence (Figure V). The excluded bin is for affiliates with zero parent Commerzbank dependence. The point estimates for affiliates with parent Commerzbank dependence in the bins up to 0.25 are small and insignificant. In contrast, point estimates are negative, significant, and of roughly equal magnitude for the two bins between 0.25 and 0.5. Finally, the coefficient for the top quintile of affiliates above 0.5 is the largest and is significant, although standard errors overlap with the bins between 0.25 and 0.5.

We explore potential differences across bins more formally in Table III. We test for differences between affiliates from 0 to 0.25, 0.25 to 0.5, and above 0.5 (columns 1-3) or between affiliates up to 0.25 and above 0.25 (columns 4-6). We find that the coefficient on affiliates from 0 up to 0.25 is essentially zero and not significantly different from affiliates with zero parent Commerzbank dependence (Table III, column 1). This implies that affiliates with positive but low parent Commerzbank dependence faced no financial shock because their parents could borrow from a relatively large number of other relationship banks after Commerzbank's lending cut. This finding further strengthens the identification assumption because it highlights that there was no general relationship between positive parent Commerzbank dependence and slow growth. There was only a difference if the parent was relatively strongly dependent on Commerzbank. The coefficients on affiliates above 0.25 are consistently negative and significantly different compared to affiliates from 0 up to 0.25 (columns 1) and compared to all affiliates below 0.25 (column 4).

We explore the robustness of the results further using the treatment bins. The point estimates are very similar when we use a larger set of control variables, replacing one-

digit with two-digit industry fixed effects (88 industries) and interacting all controls with year fixed effects (columns 2 and 5). Results also remain stable when we include the full interaction of country-industry-year fixed effects (columns 3 and 6). Given the large number of regressions, it is not surprising that one coefficient becomes marginally insignificant for the group of affiliates with parent Commerzbank dependence above 0.5 in one regression (column 3). All other coefficients remain significant at least at the 5 percent level. For the remainder of the paper, we continue with the baseline specifications and the linear treatment variable, since a large number of fixed effects and treatment variables may overweight small treatment variation and produce unrepresentative estimates (Angrist and Pischke 2008, page 226). However, in unreported results, we find that all estimates throughout the paper are similar if we use the larger number of controls and treatment groups from Table III.[38]

As a final check, we examine affiliate employment. The pattern of results resembles the pattern for affiliate sales (Table A.XI). The effect is small and insignificant for affiliates below 0.25 (column 2), but negative and significant for affiliates between 0.25 and 0.5 (column 2) and for all affiliates above 0.25 (column 3). The point estimates are generally smaller than for sales, implying an employment drop of 4.5 log points from 2008 to 2010 and a recovery after 2011 (column 1).

VII The Importance of Internal Capital Markets for the Effect on Sales

So far, we have established that the shock to parents' credit supply had real effects on affiliate sales. This section presents evidence suggesting that internal capital markets contributed to the drop in affiliate sales.

VII.A Affiliates That Increased Internal Lending Were More Affected

We first test the importance of internal capital markets using a heterogeneity analysis. We use preexisting internal capital market positions to assign affiliates to two heterogeneity categories. Using preexisting positions is preferable to using actual changes in internal capital flows because actual changes are endogenous to other shocks hitting affiliates.

The first heterogeneity characteristic we analyze is whether affiliates had issued long-term loans (maturity above one year) to their parent at some point before 2008. Parents had already set up a financial infrastructure to borrow from these affiliates. This made it easier for parents to quickly borrow capital from these affiliates after Commerzbank's lending cut. We test for heterogeneous treatment effects by specifying:

$$\begin{aligned} \ln(y_{act}) = {} & (\beta_1 + \beta_1' \times \text{het}_{ac}) \times \text{Parent CB dep} \times \mathbb{1}(\text{2008-10})_t \\ & + \beta_2 \times \text{Parent CB dep} \times \mathbb{1}(\text{2011-15})_t + \gamma_a + \lambda_t \\ & + \phi_1' \times \text{X}_{ac} \times \mathbb{1}(\text{2008-10})_t + \phi_2' \times \text{X}_{ac} \times \mathbb{1}(\text{2011-15})_t + \varepsilon_{act}. \end{aligned} \tag{14}$$

[38] See the discussion above on the downsides of including many controls in the baseline specification.

The indicator variable het_{ac} identifies whether a firm falls into the given heterogeneity category. The coefficient β_1 estimates the effect of parent Commerzbank dependence from 2008 to 2010 on affiliates that do not fall into the given heterogeneity category, while β_1' measures the additional effect from 2008 to 2010 on affiliates that fall into the category. We add het_{ac} to the control variables, interacted with the indicator for 2008 to 2010. This avoids bias if there were shocks that affected all affiliates in the given heterogeneity category independently of their parent Commerzbank dependence.

In a specification without the heterogeneity term, we find a positive effect on internal loans by affiliates to the parent. Affiliates with average parent Commerzbank dependence increased long-term loans by 8.7 log points from 2008 to 2010 (significant at the 10 percent level), relative to affiliates with zero parent Commerzbank dependence (Table IV, column 1). Since the average parent owned 88 percent of an affiliate, parents were likely able to direct affiliates to increase internal lending. In column 2, we include the heterogeneity term. We find that the effect on long-term loans was driven by affiliates with previous long-term loans before 2008. The coefficient on the interaction between previous loans and parent Commerzbank dependence is positive, large, and significant at the 5 percent level. Affiliates that had previously lent to their parent had to increase internal lending to their parent by more from 2008 to 2010.

Next, we examine whether the sales decrease was stronger for affiliates that increased lending by more. We find that the additional sales reduction for affiliates with previous long-term loans was large and significant at the 1 percent level (Table V, column 1). The effect on affiliates without previous long-term loans was smaller and statistically insignificant. This finding implies that the effect on affiliate sales was to a large extent driven by affiliates that had to increase internal lending to their parent after the lending cut.

The second heterogeneity characteristic we consider relates to internal trade. We measure whether affiliates held internal short-term claims (maturity less than a year) on the parent before 2008. Internal short-term claims are largely composed of internal trade credit to the parent. Hence, internal short-term claims are a commonly used proxy for internal trade from affiliates to the parent.[39]

Without testing for heterogeneity, we find that affiliates with average parent Commerzbank dependence reduced short-term claims by 18.8 log points from 2008 to 2010 (significant at the 5 percent level), relative to affiliates with zero parent Commerzbank dependence (Table IV, column 3). A likely explanation is that financially constrained parents demanded fewer production inputs from affiliates. This slowed internal trade and therefore short-term claims by affiliates on their parent. The slowdown in short-term claims was larger for affiliates with previous short-term claims. The interaction between previous short-term

[39] See, for example, Overesch (2006). We do not observe internal trade credit directly in the MiDi data on affiliates. But we can observe both internal trade credit and internal short-term claims in the Ustan data on German multinationals. The correlation between the percent change in trade credit and the percent change in short-term claims (both to affiliates in the same multinational) is 0.93 for the year before the lending cut. This confirms that changes in internal short-term claims are a good predictor for changes in internal trade credit.

claims and parent Commerzbank dependence is negative and significant at the 10 percent level (column 4). This confirms that affiliates with previous short-term claims were more exposed to a slowdown in internal trade with the parent. We also find that the effect on sales was larger for affiliates with previous short-term claims (significant at the 10 percent level), relative to affiliates without short-term claims (Table V, column 2). This suggests that the reduction in internal trade lowered affiliate sales.

To compare the effects of internal lending and internal trade, we include both heterogeneity categories in one specification. The additional effect on affiliates with previous long-term loans remains large and significant at the 1 percent level (V, column 3). The additional effect on affiliates with previous short-term claims becomes slightly smaller and insignificant. These estimates suggest that internal lending continues to explain an important part of the decline in sales, even conditional on a proxy for internal trade. Overall, the findings support the view that increased lending through internal capital markets played an important role in the transmission of the lending cut to affiliates.[40]

For completeness, we also examine the other internal capital positions. We find that equity invested by the parent into the affiliate did not change significantly from 2008 to 2010 (Table A.XII, column 1). A likely reason is that equity divestment is a relatively slow and cumbersome process.[41] Similarly, liabilities owed to parents by affiliates did not decrease significantly (Table A.XIII, column 1). Instead of adjusting equity or liabilities, the evidence suggests that affiliates transferred capital to their parent by increasing internal lending.[42]

VII.B Affiliates Did Not Raise External Financing

In principle, affiliates may have funded the increase in internal lending by raising external financing. However, there was no change in affiliates' external liabilities, which includes borrowing from banks, as well as equity raised from non-parents (Table A.XIII, columns 2 and 3). Both coefficients are close to zero and insignificant. Affiliates were also unable to reduce external long-term loans to non-parents (column 4). This would have required early repayment of long-term loans by external borrowers, which is difficult to enforce.

The findings suggest that affiliates were not able to raise external funding to finance the increased lending to parents. This view is supported by a large literature showing that

[40] We test whether this heterogeneous effect was driven by other preexisting affiliate characteristics, such as leverage or total short-term claims (relative to total assets). In unreported results, we find that the heterogeneous effects with respect to long-term loans to the parent remain stable and significant when we control for heterogeneous effects with respect to leverage or short-term claims. Furthermore, we find no evidence that sales of affiliates with high leverage or high short-term claims were more negatively affected by parent Commerzbank dependence.

[41] Consistent with this finding, affiliates that were more dependent on parent equity financing (high parent equity over affiliate total assets) did not experience faster drops in equity and sales (Table A.XII, columns 2 and 3). In unreported results, we also find no heterogeneity in the effects by parent ownership share.

[42] The data from the Deutsche Bundesbank do not differentiate between long- and short-term liabilities owed to parents, unlike in the case of assets.

firms in many countries are borrowing constrained and unable to raise additional external financing in the short term when hit by a shock (for summaries, see Banerjee and Duflo 2014; Catherine et al. 2020; Lian and Ma 2020), likely due to asymmetric information problems (Sharpe 1990; Boot 2000).

VII.C Affiliates Reduced Short-Run Inputs to Finance Internal Loans

Since they were unable to raise external financing or reduce external loans, affiliates had to cut assets to finance the increased lending to parents. In particular, affiliates reduced their stock of short-term assets from 2008 to 2010 (Table A.XIII, column 5). The point estimate implies a decrease of 4.9 log points from 2008 to 2010 (significant at the 5 percent level). Short-term assets fully recovered after 2011 (insignificant point estimate of 0.02).

Short-term assets include inputs that are important for production and sales in the short run. These are, for instance, holdings of raw materials and other variable inputs; working capital to pay for employees, suppliers, and the distribution of products to points of sales; trade credit issued to external customers; and liquidity buffers against shocks. The reduction in short-term assets suggests that affiliates became financially constrained. They reduced inputs required for production and sales and instead lent to the parent. Consistent with this view, the evolution of short-term assets over time mirrored the evolution of sales. Both short-term assets and sales were lower from 2008 to 2010 and fully recovered after 2011.

VII.D Access to External Finance Mattered

We find that the effect was stronger for affiliates in countries with underdeveloped financial markets, measured by the ratio of credit to GDP (Table VI, column 1). When affiliates found it harder to borrow locally, they were less able to fund internal lending with external funds, and instead they had to reduce their sales by more.

But even in developed financial markets, affiliates still suffered significant sales losses, as indicated by the stable and significant baseline coefficient (column 1). This is consistent with existing work showing that firms are borrowing constrained even in economies with large financial markets, at least in the short run (Lian and Ma 2020). Overall, these results suggest that access to capital played an important role in generating the real effects on affiliates.

VII.E Affiliates With High Pre-Crisis Growth Were Less Affected

The theoretical model predicts that credit shocks transmitted through an internal capital market should be less harmful for affiliates with high marginal product of capital (Section III). The reason is that multinationals can freely allocate capital internally. Multinationals therefore find it optimal to withdraw less capital from affiliates where it is more productive in terms of generating sales.

We use affiliates' pre-crisis sales growth from 2006 to 2007 as proxy for high marginal product. We find that affiliates with faster pre-crisis growth were less affected by their parent's Commerzbank dependence (Table VI, column 2). The interaction effect between pre-crisis growth and parent Commerzbank dependence is positive and significant at the 5 percent level. This suggests that parents were less likely to transmit the crisis to affiliates with high growth potential, consistent with the view that Commerzbank's lending cut was transmitted through internal capital markets.

VIII Alternative Explanations for the Effect on Affiliate Sales

We have so far argued that increased net lending by affiliates to their parent contributed to the decrease in affiliate sales. We investigate whether alternative hypotheses can fully account for the reduction in affiliate sales. We show that internal trade, tax shifting, and other banking shocks cannot explain the entire effect on affiliate sales.

VIII.A Effects Are Similar in Industries With Less Internal Trade and Reselling

We consider whether internal trade between affiliates and parents might explain all of the sales losses at affected affiliates. Horizontal affiliates operated in the same industry as their parent and were therefore less likely to internally trade with the parent. We find no significant difference between the effect on horizontal and vertical affiliates (Table A.XVI, column 1). If anything, the point estimate suggests a slightly weaker effect for vertical affiliates. We also find no significant difference for affiliates in the service sector, which are less likely to trade with their parent (column 2). If only internal trade mattered, we would expect significantly stronger results for vertical affiliates and weaker results for service sector affiliates (Cravino and Levchenko 2017). These results suggest that input trade between affiliates and parents does not explain the entire effect.

We also investigate whether the effect is driven by affiliates that do not produce themselves but primarily resell their parent's output. To exclude such affiliates, we drop all affiliates in wholesale and retail (Table A.XVII). The coefficient becomes slightly larger and remains significant. This suggests that affiliates that primarily resell their parent's output do not drive the effect.

VIII.B Local Business Cycles, Demand Shocks, and Tax Differences Do Not Explain the Effects

We find no evidence that the effects differed by GDP per capita growth (Table A.XIV, column 1) or national house price growth (column 2) between 2007 and 2009. The Great Recession hit firms in the service sector less strongly than non-service firms (Eaton et al. 2016), but the effect on affiliates in the service sector was similar to other sectors (Table A.XVI, column 2). There was also no significant difference between affiliates located in

Asia, the EU, and the US (Table A.XV). These results show that local demand conditions, the magnitude of the Great Recession, or broad differences across locations did not drive the effects on affiliates.

We test whether tax shifting between parents and affiliates affects the results. We drop all affiliates located in countries defined as tax havens by Gumpert et al. (2016) (Table A.XVIII, column 1). We interact parent Commerzbank dependence with the difference in the corporate tax rate between Germany and the affiliate host country (column 2). Finally, we interact parent Commerzbank dependence with an indicator for affiliates located in countries where the corporate tax rate was lower than in Germany (column 3). The coefficients on parent Commerzbank dependence remain stable and significant in all specifications. Hence, there is no evidence that the effects differ in countries with low tax rates. This is not surprising, given that we use a dynamic research design where the shock varies within countries over time, while tax rates are absorbed by country-year fixed effects.

VIII.C Affiliates Were Not Directly Exposed to Commerzbank

We examine whether affiliates were directly exposed to Commerzbank's lending cut. If this were true, bank debt of affiliates with higher parent Commerzbank dependence should have fallen by more. However, affiliate liabilities toward banks and other non-parents did not change significantly, suggesting that affiliate bank debt was not affected (Table A.XIII, column 2).

As further test, we exclude from the sample all countries where Commerzbank had a foreign branch. The point estimate becomes slightly larger and remains statistically significant (Table A.XIX, column 1). This implies that the results are not driven by affiliates' exposure to Commerzbank branches outside Germany. Next, we control for the fraction of bank lending in the affiliate's host country that came directly from German branches of the three largest German banks in 2006. We separately test the effect of such lending to non-financial firms (column 2) and to financial firms (column 3) in the affiliate's host country. In both columns 2 and 3, the coefficients on parent Commerzbank dependence become even larger than the baseline results and remain statistically significant. The coefficients on the fraction of bank lending by the three largest German banks are small and insignificant.[43]

We cannot match affiliate relationship banks to MiDi, but we can analyze them separately, using data from Orbis. We find that the correlation between parent and affiliate Commerzbank dependence is low at 0.025. In addition, only 3 percent of foreign affiliates had a direct bank relationship to Commerzbank. Overall, these results suggest that affiliates' direct exposure to Commerzbank's foreign or German branches cannot explain the effects on affiliate growth.

[43]The lending data for columns 2 and 3 come from the dataset Austa provided by the Deutsche Bundesbank (Krueger et al. 2017). We scale the lending stock of German banks with total lending provided by the Bank of International Settlements. We also examined heterogeneity using lending by the five and ten largest German banks and by all German banks. The results were similar.

VIII.D Dependence on Other German Banks

Finally, we study whether parent dependence on other German banks affected affiliates from 2008 to 2010. We study three groups of other banks that made losses during the financial crisis 2008/09: Landesbanken (state-level publicly owned banks) with trading losses, municipal savings banks that partially owned these Landesbanken, and other banks with trading losses. We find no evidence that affiliates whose parents depended on any of these banks grew more slowly from 2008 to 2010 (Table A.XX). The results are consistent with narrative evidence in Appendix B suggesting that other German banks did not cut lending during the crisis. Public banks received immediate support and guarantees from the government and the savings banks actually increased lending. Other commercial banks had financial buffers and hedging strategies, unlike Commerzbank.[44]

IX The Magnitude of Shock Transmission Through Multinationals

In the final step of our analysis, we calculate in which countries the idiosyncratic shock to Commerzbank had the largest effects because of transmission through multinationals.

IX.A The Transmission of Commerzbank's Lending Cut Across Countries

We estimate the reduction in total sales of affiliates whose parents were hit by Commerzbank's lending cut by country. Specifically, we calculate how much greater total annual sales of German affiliates in a given country would have been between 2008 and 2010 if all German affiliates had grown at the same rate as unaffected German affiliates (with zero parent Commerzbank dependence). We call this quantity the "impact on total sales of German affiliates." For country c, it is given by:

$$\begin{aligned}&\text{(Impact on total sales of German affiliates)}_c = \\ &|\hat{\beta}_1| \times \text{(Weighted average of parent CB dep of affiliates of German parents)}_c \\ &\times \text{(Total sales of affiliates of German parents in 2006)}_c.\end{aligned} \tag{15}$$

Estimate $\hat{\beta}_1$ is the effect of parent Commerzbank dependence on the sales of an individual affiliate from 2008 to 2010. We use the baseline estimate $\hat{\beta}_1$ from Table II, column 3 for this calculation. To measure the parent Commerzbank dependence of a representative German affiliate in country c, we use the sales-weighted average parent Commerzbank dependence of German affiliates. The product of the first two terms is an estimate of the sales loss (in percent) at a representative German affiliate in country c. Finally, the third term is the total value of sales of non-financial German affiliates in country c in 2006, calculated using MiDi.

[44]The affected Landesbanken were BayernLB, HSH Nordbank, Landesbank Baden-Württemberg, Sachsen LB, and WestLB. Other affected banks are Deutsche Bank, DZ Bank, IKB, HypoVereinsbank, and KfW, as listed in Hüfner (2010). Huber (2018, Appendices E and F) also shows that trading losses at other German banks did not have real effects on firms.

By multiplying the effect on a representative affiliate with the third term, we get an estimate of the impact on total sales of German affiliates in country c, relative to what total sales would have been had all German affiliates grown at the same rate as unaffected affiliates. We are interested in how large the impact was compared to the aggregate economy, so we report the impact as a percentage of aggregate sales.

We present results for the most common locations of German affiliates in Table VII.[45] The mean impact relative to aggregate sales was 0.18 percent. It was modest in the United States (0.03 percent), but large in the Czech Republic (0.49 percent), Austria (0.36 percent), and Poland (0.31 percent). The differences across countries were mostly driven by heterogeneity in the size of German affiliates relative to the aggregate economy. German affiliates were responsible for only 0.2 percent of aggregate sales in the US, but for a large part of sales in economies at Germany's Eastern border, up to 4 percent in the Czech Republic.

To illustrate the magnitude of the effects, consider the concrete example of the Czech Republic. If affected German affiliates (with positive Commerzbank dependence) had grown at the same rate as unaffected affiliates, total sales of affected German affiliates in the Czech Republic between 2008 and 2010 would have been 1.8 billion Euros higher (or 0.49 percent of aggregate sales). Hence, Commerzbank's lending cut, even though it initially only hit German firms, was an important determinant of the distribution of firm growth in the Czech Republic.[46]

Existing work suggests that large firms or banks affect growth in their home country. In our setting, a financial shock originating from an individual bank in one country (Commerzbank in Germany) had large impacts on the growth of unconnected firms in other countries.

IX.B Aggregate Implications

The discussion so far focused on the impact on total sales of affected affiliates (with positive parent Commerzbank dependence), relative to the growth of unaffected affiliates. An interesting question is whether the numbers in Table VII are also informative about changes in aggregate sales. The impact numbers would be identical to aggregate changes if the growth of unaffected affiliates would have been the same with and without the sales losses at affected affiliates. General equilibrium effects could cause the growth of unaffected affiliates to differ across the two cases. On the one hand, sales of unaffected firms may have increased when affected affiliates became constrained, as product demand shifted from affected to unaffected affiliates. On the other hand, sales of unaffected firms may have fallen because the constraints at affected firms lowered aggregate demand and because unaffected firms de-

[45] We exclude China and Switzerland because data on total sales of German affiliates are not available.

[46] Of course, all these effects relate only to transmission through multinationals. Other transmission channels may have further depressed economies abroad because of Commerzbank's lending cut, for example if German customers demanded fewer goods from abroad. We intentionally keep these other channels constant in our research design, so that we can isolate the effect of multinationals.

pended on affected affiliates through input-output links (Acemoglu et al. 2016; di Giovanni et al. 2018).

Chodorow-Reich (2014) uses a calibrated general equilibrium model to investigate general equilibrium effects after a subset of firms becomes financially constrained. The results in Chodorow-Reich (2014) suggest that general equilibrium effects are likely to harm the growth of unaffected affiliates or have at most a weak positive effect.[47] The models in Sraer and Thesmar (2019) and Herreño (2020) also imply that our "impact" measure may be close to the aggregate effect. Consistent with these results, Huber (2018) estimates that general equilibrium effects of a financial shock exacerbate losses at the regional level. This would make aggregate losses even larger than the impact numbers in Table VII. While exact aggregate effects depend on model calibrations, the impact numbers may be informative at least about the order of magnitude of aggregate effects.

X Conclusion

This paper highlights that shocks to individual firms can have far-reaching effects that extend beyond firms and countries directly connected to shocked firms. We identify an idiosyncratic shock to a firm, the crisis of Commerzbank in 2008/09. This crisis had direct effects on Commerzbank's borrowers in Germany because Commerzbank cut lending to its German borrowers. However, the crisis ultimately also affected firms in other countries that were not directly linked to Commerzbank. Specifically, affiliates of German multinationals had to financially support their parents through internal lending, if their parents were directly hit by Commerzbank. This mechanism sharply reduced the real growth of affiliates.

The idiosyncratic shock to Commerzbank did not directly affect firms in any other country but Germany. Nonetheless, due to transmission through multinationals, the shock lowered the relative growth of affected affiliates by over 0.3 percent of aggregate sales in Austria, the Czech Republic, and Poland. A large firm can therefore impact firm growth in countries that are outside the scope of its direct operations.

The results also underscore the workings of multinationals' internal capital markets. We analyze a detailed regulatory dataset that reports internal capital market positions between German parents and each one of their international affiliates. We find that internal capital markets are a key channel of shock transmission. In particular, shocks were only transmitted to affiliates that had preexisting internal capital links to the parent, in the form of internal lending. These affiliates became financially constrained due to the internal capital shock and it took them roughly three years to recover. The findings highlight that internal capital markets of multinationals can have severe negative impact on economic growth.

[47] At most, the results in Chodorow-Reich (2014) suggest that growth improvements of unaffected affiliates would undo 27 percent of the total losses at affected firms. Applying this correction to the numbers in Table VII, the aggregate impact in the Czech Republic, Austria, and Poland would still be sizable, at 0.36, 0.26, and 0.23 percent, respectively.

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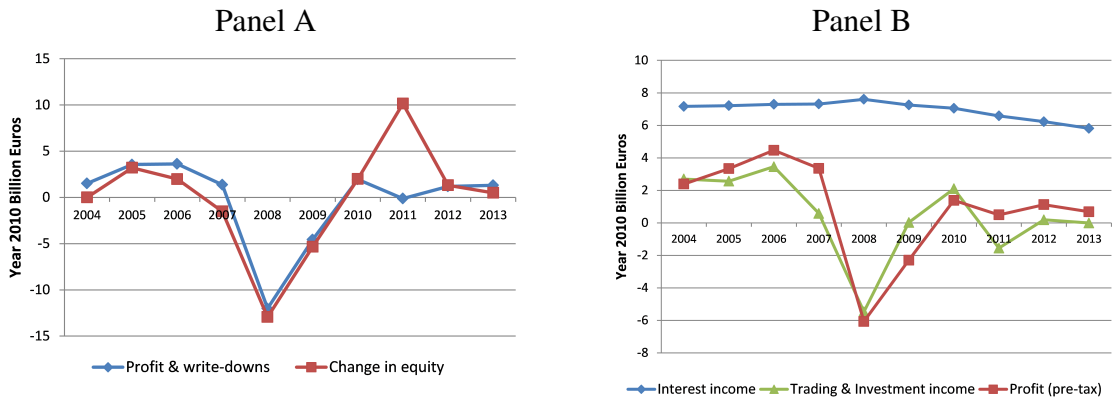
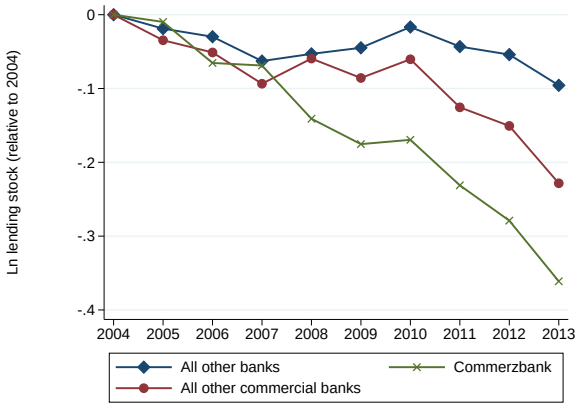
Figure I: Commerzbank's equity capital, write-downs, and profits



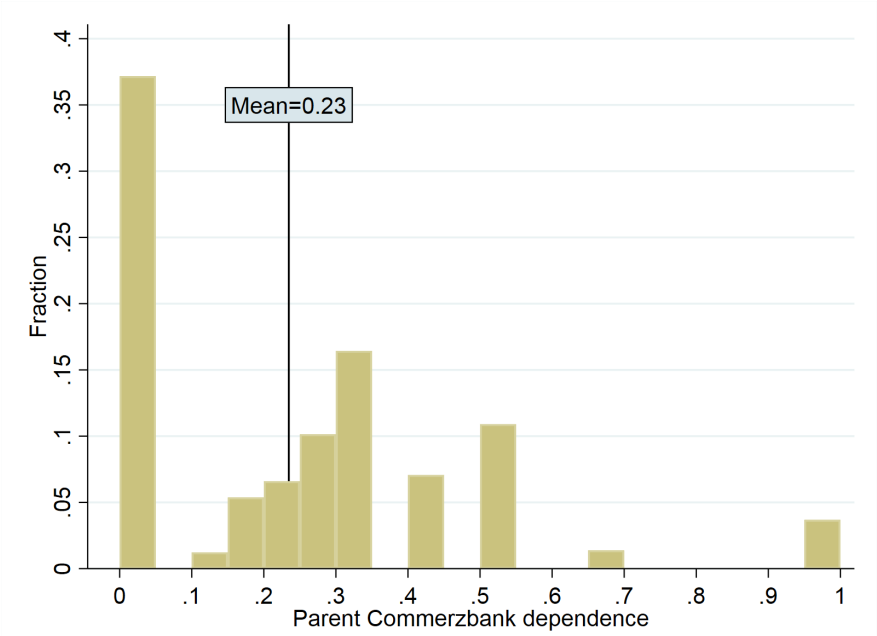
Notes: The left panel shows Commerzbank's profits and write-downs plus equity capital. Write-downs arise from changes in revaluation reserves, cash flow hedges, and currency reserves. Panel B shows the composition of Commerzbank's profits. Interest income is interest received from loans and securities minus interest paid on deposits. Trading and investment income is the sum of net trading income, net income on hedge accounting, and net investment income. Pre-tax profit is interest income plus trading and investment income minus costs. The values are in year 2010 billion Euro. The positions of Commerzbank and Dresdner Bank for the years before the 2009 take-over are aggregated. Data source: bank annual reports, Huber (2018), own calculations.

Figure II: Lending by German banks



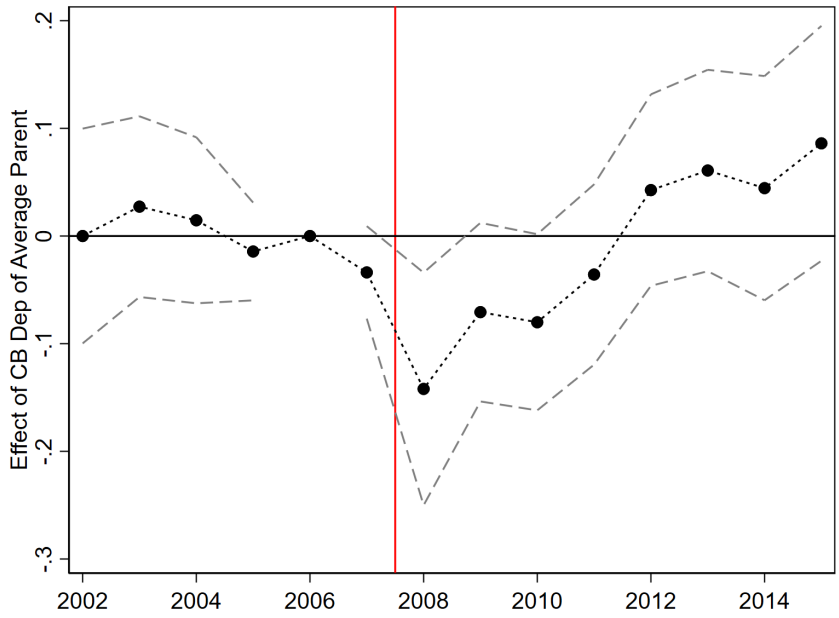
Notes: The figure plots the log lending stock to German non-financial customers for different groups of banks, relative to 2004. The values are in year 2010 billion Euro. We include lending by branches of Commerzbank and Dresdner Bank to calculate lending by Commerzbank (provided in the bank annual reports). We subtract lending by Commerzbank from aggregate lending by all German banks (provided by the Deutsche Bundesbank) to calculate lending by all other banks. We subtract lending by Commerzbank, savings banks, Landesbanken, and cooperative banks from aggregate lending by all German banks to calculate lending by all other commercial banks. Data source: bank annual reports, Deutsche Bundesbank, Huber (2018), own calculations.

Figure III: Distribution of Parent Commerzbank dependence



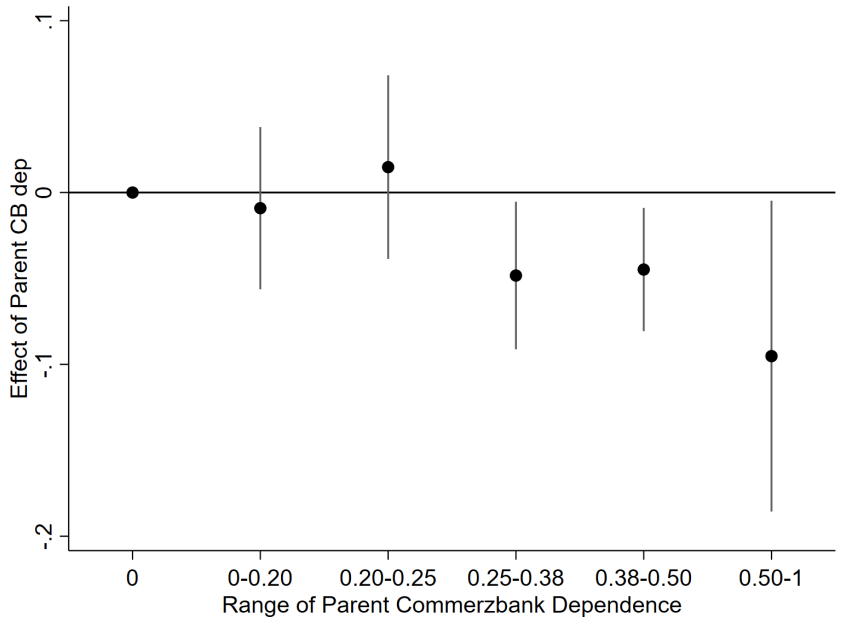
Notes: The figure shows a histogram of Commerzbank dependence for the 655 German parents in our dataset in 2006. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Figure IV: Impact of parent Commerzbank dependence on affiliate sales



Notes: The figure plots coefficients on parent Commerzbank dependence, interacted with year fixed effects. The grey, dashed lines represent 90 percent confidence intervals. The coefficients are estimated in a single regression. The outcome is log affiliate sales. The following time-invariant control variables are calculated for affiliates in the year 2006 and interacted with a full set of year fixed effects: industry fixed effects, fixed effects for deciles of total sales, fixed effects for deciles of leverage, and country fixed effects. The specification also contains affiliate and year fixed effects. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Figure V: Impact on affiliate sales by bins of parent Commerzbank dependence



Notes: The figure plots the relationship between bins of parent Commerzbank dependence and affiliate sales from 2008 to 2010. The bins represent the quintiles of parent Commerzbank dependence for positive values of parent Commerzbank dependence. The grey, dashed lines represent 90 percent confidence intervals. The coefficients are estimated in a single regression. The following time-invariant control variables are calculated for affiliates in the year 2006 and interacted with indicator variables for 2008-10 and 2011-15: industry fixed effects, fixed effects for deciles of total sales, fixed effects for deciles of leverage, and country fixed effects. The specification also contains affiliate and year fixed effects and parent Commerzbank dependence interacted with the 2011-15 indicator. The coefficients are scaled by the average parent Commerzbank dependence, which was 0.23, to make them comparable to the previous results. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table I: Affiliate summary statistics by bins of parent Commerzbank dependence

	Range of parent Commerzbank dependence				
	0	0.01-0.25	0.26-0.50	0.51-1	Total
Sales	42,184	50,056	65,406	52,495	54,400
	(107,225)	(131,195)	(178,667)	(128,354)	(147,351)
Employment	162	222	200	211	196
	(434)	(530)	(518)	(452)	(496)
Total assets	69,818	75,853	118,348	97,095	93,160
	(280,584)	(303,662)	(426,055)	(353,319)	(357,546)
Leverage (%)	52.10	50.70	52.81	49.18	51.83
	(33.75)	(32.20)	(34.60)	(32.74)	(33.65)
Long-term loans to parent (%)	0.38	0.15	0.44	1.92	0.46
	(3.28)	(2.19)	(3.53)	(7.04)	(3.60)
Equity from parent (%)	14.11	14.09	15.36	15.13	14.69
	(22.82)	(19.27)	(22.44)	(21.33)	(21.71)
Liabilities toward parent (%)	11.24	13.76	13.38	8.37	12.54
	(21.01)	(22.27)	(22.25)	(16.56)	(21.60)
Short-term claims on parent (%)	4.40	4.81	3.81	3.45	4.19
	(12.51)	(12.80)	(11.17)	(10.40)	(11.91)
Ownership share of parent in affiliate	0.878	0.870	0.884	0.842	0.876
	(0.240)	(0.234)	(0.237)	(0.276)	(0.240)
Number of affiliates	721	675	1,101	198	2,695

Notes: The table shows means (standard deviations) for affiliates. Sales and total assets are in thousand Euro. Leverage is defined as liabilities divided by total assets. The balance sheet items are in percent of total assets. The number of affiliates in the bottom row refers to the number of affiliates in MiDi in 2006. All values are for 2006. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table II: Impact of parent Commerzbank dependence on affiliate sales

	(1)	(2)	(3)
Outcome	Affiliate sales		
Parent CB dep × 2008-10	−0.1286	−0.1403*	−0.0967**
	(0.0979)	(0.0806)	(0.0489)
Parent CB dep × 2011-15	0.0574	0.0486	0.0298
	(0.0527)	(0.0523)	(0.0422)
R^2	0.011	0.038	0.092
Number of firms	2,695	2,695	2,695
Observations	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Size bin FE × Time FE	No	Yes	Yes
Industry FE × Time FE	No	Yes	Yes
Country FE × Time FE	No	No	Yes
Leverage bin FE × Time FE	No	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. Parent CB dep is the fraction of the parent's relationship banks that were Commerzbank branches in 2006. Time fixed effects are two indicator variables for the periods 2008-10 and 2011-15. The following time-invariant control variables are calculated for affiliates in the year 2006 and interacted with time fixed effects: industry fixed effects, fixed effects for deciles of total sales, fixed effects for deciles of leverage, and fixed effects for the country of the affiliate. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table III: Impact on affiliate sales by bins of parent Commerzbank dependence

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome	Affiliate sales					
Parent CB dep: (0, 0.25] × 2008-10	−0.0147	−0.0025	−0.0044			
	(0.0258)	(0.0241)	(0.0253)			
Parent CB dep: (0.25, 0.5] × 2008-10	−0.0553***	−0.0430**	−0.0416**			
	(0.0206)	(0.0200)	(0.0210)			
Parent CB dep: (0.5, 1] × 2008-10	−0.1060*	−0.0728**	−0.0820			
	(0.0564)	(0.0369)	(0.0599)			
Parent CB dep: (0.25, 1] × 2008-10				−0.0538***	−0.0450***	−0.0435***
				(0.0178)	(0.0161)	(0.0169)
Parent CB dep × 2011-15	0.0172	0.0524	0.0225	0.0290	0.0580	0.0302
	(0.0418)	(0.0378)	(0.0382)	(0.0387)	(0.0385)	(0.0347)
R^2	0.092	0.192	0.294	0.092	0.192	0.294
Number of firms	2,695	2,695	2,695	2,695	2,695	2,695
Observations	24,941	24,941	24,941	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls × Time FE	Yes	No	No	Yes	No	No
Controls × Year FE	No	Yes	Yes	No	Yes	Yes
Country FE × Industry FE × Year FE	No	No	Yes	No	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. The regressors are explained in Table II. Columns 1 and 4 interact the controls with indicator variables for the periods 2008-10 and 2011-15. Columns 2 and 5 control for finer (two-digit) industry fixed effects and interact the controls with year fixed effects. Columns 3 and 6 interact the controls with year fixed effects and contain for country-industry-year fixed effects. The coefficients are scaled by the average parent Commerzbank dependence, which was 0.23, to make them comparable to the previous results. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table IV: Impact of parent Commerzbank dependence on internal capital markets

Outcome	(1) LT loans to parent	(2) LT loans to parent	(3) ST claims on parent	(4) ST claims on parent
Parent CB dep × 2008-10	0.0867*	0.0544	–0.1878**	–0.0843
	(0.0508)	(0.0340)	(0.0929)	(0.0690)
Parent CB dep × 2008-10 × Previous long-term loans to parent		0.5427**		
		(0.2206)		
Parent CB dep × 2008-10 × Previous short-term claims on parent				–0.1938*
				(0.1094)
Parent CB dep × 2011-15	0.1015	0.0985	–0.1437	–0.1418
	(0.0696)	(0.0689)	(0.1062)	(0.1058)
R^2	0.031	0.035	0.059	0.059
Number of firms	2,695	2,695	2,695	2,695
Observations	24,941	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes	Yes
Previous long-term loans to parent × Time FE	No	Yes	No	No
Previous short-term claims on parent × Time FE	No	No	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome in columns 1 and 2 is log long-term loans by the affiliate to the parent. The outcome in columns 3 and 4 is log short-term claims on the parent by the affiliate. Column 2 analyzes heterogeneity by whether the affiliate had issued long-term loans to its parent in any year before 2008. Column 4 analyzes heterogeneity by whether the affiliate held short-term claims on its parent in any year before 2008. The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table V: Effects were stronger for affiliates with large internal capital market positions

	(1)	(2)	(3)
Outcome	Affiliate sales		
Parent CB dep × 2008-10	−0.0647	−0.0305	−0.0265
	(0.0408)	(0.0434)	(0.0415)
Parent CB dep × 2008-10 × Previous long-term loans to parent	−0.5414***		−0.5094***
	(0.1774)		(0.1824)
Parent CB dep × 2008-10 × Previous short-term claims on parent		−0.1244*	−0.0751
		(0.0668)	(0.0604)
Parent CB dep × 2011-15	0.0327	0.0310	0.0333
	(0.0431)	(0.0423)	(0.0430)
R^2	0.093	0.092	0.093
Number of firms	2,695	2,695	2,695
Observations	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes
Previous long-term loans to parent × 2008-10	Yes	No	Yes
Previous short-term claims on parent × 2008-10	No	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. Column 1 analyzes heterogeneity by whether the affiliate had issued long-term loans to its parent in any year before 2008. Column 2 analyzes heterogeneity by whether the affiliate held short-term claims on its parent in any year before 2008. The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table VI: Effects were stronger for affiliates with weak access to external finance and slow pre-growth

	(1)	(2)
Outcome	Affiliate sales	
Parent CB dep × 2008-10	–0.1080*	–0.0953*
	(0.0613)	(0.0490)
Parent CB dep × 2008-10 × Credit/GDP low	–0.1984***	
	(0.0282)	
Parent CB dep × 2008-10 × Credit/GDP high	0.0276	
	(0.0568)	
Parent CB dep × 2008-10 × Affiliate pre-growth in sales		0.0597**
		(0.0280)
Parent CB dep × 2011-15	0.0298	0.0333
	(0.0474)	(0.0427)
R^2	0.073	0.117
Number of firms	2,661	2,244
Observations	24,681	23,143
Affiliate FE	Yes	Yes
Year FE	Yes	Yes
Controls × Time FE	Yes	Yes
Affiliate Sales growth × 2008-10	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. Column 1 tests for heterogeneity by whether the affiliate host country was in the top or bottom 10 percent of the distribution of credit to GDP in 2006 (based on World Bank data). Column 2 tests for heterogeneity by the growth in affiliate sales from 2006 to 2007. The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table VII: The impact in different countries

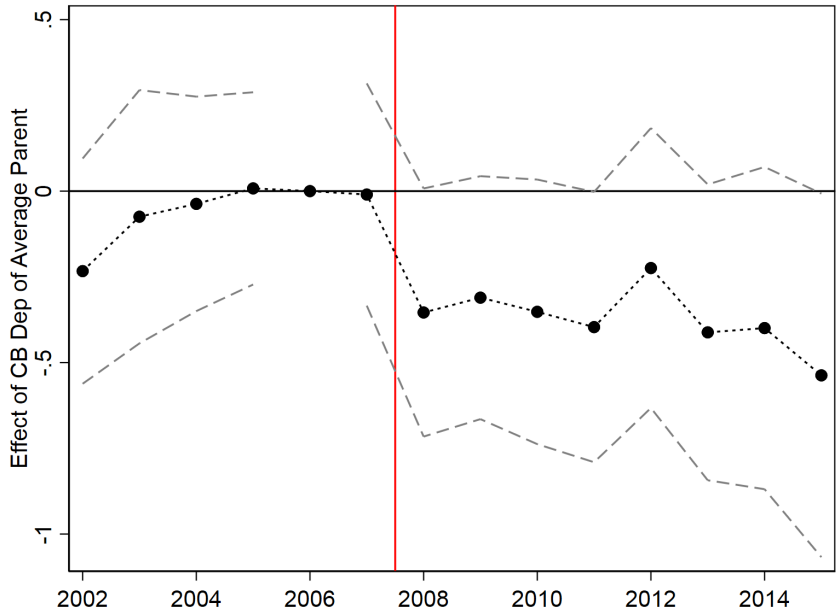
Affiliate country	
Czech Republic	0.49
Austria	0.36
Poland	0.31
Netherlands	0.10
Spain	0.10
France	0.07
United Kingdom	0.07
Italy	0.05
United States	0.03
Mean	0.18
Median	0.10

Notes: We calculate the "impact" on total annual sales of German affiliates between 2008 and 2010 if all German affiliates had grown at the same rate as unaffected German affiliates (with zero parent Commerzbank dependence). The table reports the impact scaled by aggregate sales of non-financial firms in the given country. The mean and median refer to the countries listed in the table. We include the most common locations of German affiliates, apart from China and Switzerland because data on total sales of German affiliates are not readily available. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, Eurostat, US Census Bureau, own calculations.

Online Appendix

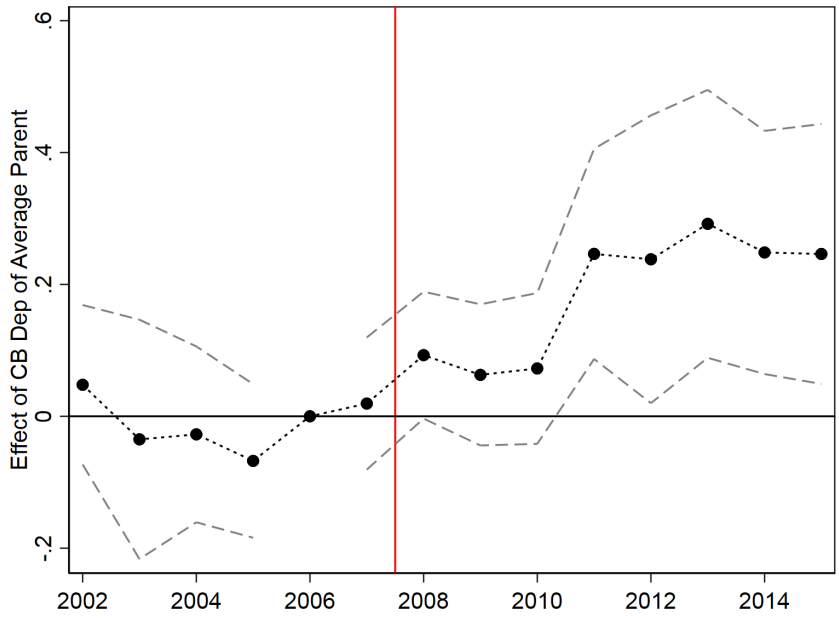
Appendix A: Supplementary Figures and Tables

Figure A.I: Impact of Commerzbank dependence on parent bank debt



Notes: The figure plots coefficients on parent Commerzbank dependence, interacted with year fixed effects. The grey, dashed lines represent 90 percent confidence intervals. The coefficients are estimated in a single regression. The outcome is log parent bank debt. The following time-invariant control variables are calculated for parents in the year 2006 and interacted with year fixed effects: industry fixed effects, fixed effects for deciles of total sales, fixed effects for deciles of leverage, and fixed effects for whether the parent had an affiliate in Asia, the EU, or the US. The coefficients are scaled to reflect the effect on a parent with average Commerzbank dependence, which was 0.23. Standard errors are clustered at the parent level. Data source: Research Data and Service Centre of the Deutsche Bundesbank, Ustan 2002-2015, Orbis Historical Financials, own calculations.

Figure A.II: Impact of Commerzbank dependence on parent trade credit



Notes: The figure plots coefficients on parent Commerzbank dependence, interacted with year fixed effects. The grey, dashed lines represent 90 percent confidence intervals. The coefficients are estimated in a single regression. The outcome is log trade credit borrowed by a parent from external sources. The following time-invariant control variables are calculated for parents in the year 2006 and interacted with year fixed effects: industry fixed effects, fixed effects for deciles of total sales, fixed effects for deciles of leverage, and fixed effects for whether the parent had an affiliate in Asia, the EU, or the US. The coefficients are scaled to reflect the effect on a parent with average Commerzbank dependence, which was 0.23. Standard errors are clustered at the parent level. Data source: Research Data and Service Centre of the Deutsche Bundesbank, Ustan 2002-2015, Orbis Historical Financials, own calculations.

Table A.I: The relationship between internal capital market positions and interest rates

	(1)	(2)	(3)	(4)
Outcome	Total lending by affiliate to parent		Total funding by parent to affiliate	
Interest rate spread	−0.1818*	−0.2023*	0.4263***	0.4120***
	(0.1060)	(0.1076)	(0.1155)	(0.0900)
R^2	0.007	0.012	0.008	0.031
Number of affiliates	1,594	1,363	1,594	1,363
Corporate tax rate	No	Yes	No	Yes
ln(GDP)	No	Yes	No	Yes

Notes: The table reports estimates from OLS cross-sectional regressions. The outcome variable in columns 1 and 2 is total lending by the affiliate to the parent (long-term loans plus short-term claims). The outcome variable in columns 3 and 4 is total funding provided by the parent to the affiliate (equity plus liabilities). Interest rate spread is the difference between lending and deposit rate in the affiliate host country. The regressions in columns 2 and 4 control for the corporate tax rate and log GDP of the affiliate host country. The data are for 2006. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.II: Insights about Commerzbank's lending cut from financial analyst reports

Question	Number of relevant reports	Answer yes	Answer no	Answer unclear
1) Does the report mention that the German loan portfolio contributed to Commerzbank's losses from 2008 to 2009?	83	0	83	0
2) Was the loan portfolio to German firms and households riskier at Commerzbank than at other German banks from 2004 to 2007?	16	0	16	0
3) Does the report mention that the trading and lending divisions at Commerzbank cross-hedged risk from 2004 to 2009?	110	0	110	0
4) Does the report mention that exposure to US mortgage-related securities contributed to Commerzbank's losses from 2008 to 2009?	83	72	11	0
5) Does the report mention that exposure to Lehman brothers and the Icelandic banks contributed to Commerzbank's losses from 2008 to 2009?	83	8	75	0
6) Did Commerzbank stabilize after 2010?	10	8	0	2

Notes: This table summarizes insights from 110 financial analyst reports. Reports are included if they are available on the Thomson Reuters Investext Database and contain information about at least one of the six questions listed in the table. We use all reports on Commerzbank/Dresdner Bank from the years 2008 and 2009 as well as all reports that are relevant to one of the six questions from years before and after. The full list of reports appears as the final table of this Appendix.

We formulate six key questions that relate to the origin and nature of Commerzbank's lending cut (Table A.II). For each question, we count the number of reports that contain any information relating to a question (column "Number of relevant reports"). We then categorize the reports into three categories. Either a report offers a clear conclusion (columns "Answer yes" and "Answer no") or it discusses the question, but offers no clear judgment ("Answer unclear").

For example, consider question 1 about whether the German loan portfolio contributed to Commerzbank's losses. 83 out of 110 reports discuss the origins of Commerzbank's lending cut. Not a single report mentions that developments in the loan portfolio of Commerzbank in Germany caused its losses and lending cut in 2008/09. Hence, all reports get counted as answering no. For questions 1, 3, and 5 there are no unclear answers because the questions simply count whether a report mentions a topic.

For questions 2 and 6, there can in principle be unclear answers due to the open nature of the questions. In practice, there are no unclear answers to question 2 because all reports take a clear stance on the risk of Commerzbank's loans. There are two unclear answers to question 6 because two reports mention that Commerzbank repaid government equity without stating whether this implies a full recovery.

The acquisition of Dresdner Bank by Commerzbank was announced in mid-2008 and completed in January 2009 (see Appendix B). There are few relevant reports that analyze Dresdner Bank separately, so we provide information for the enlarged Commerzbank. Generally, when we refer to Commerzbank, this includes the old branches and divisions of Dresdner Bank.

Table A.III: Parent summary statistics by bins of Commerzbank dependence

	Range of parent Commerzbank dependence				
	0	0.01-0.25	0.26-0.50	0.51-1	Total
Commerzbank dep	0	0.211	0.400	0.896	0.235
	(0)	(0.038)	(0.073)	(0.157)	(0.238)
Sales	349,843	391,211	484,549	152,829	395,394
	(1,527,767)	(1,613,460)	(1,877,845)	(515,649)	(1,641,595)
Total assets	535,864	640,151	1,317,124	578,200	831,892
	(2,929,303)	(3,285,272)	(5,242,464)	(2,184,213)	(3,934,859)
Number of affiliates	2.95	3.89	4.55	4.89	3.82
	(4.56)	(6.58)	(6.87)	(9.18)	(6.23)
Bank debt	73,915	46,898	60,267	54,447	59,895
	(197,131)	(151,873)	(145,003)	(96,847)	(161,721)
Trade credit	44,047	39,164	46,206	23,139	42,693
	(159,189)	(175,074)	(142,306)	(64,090)	(155,222)
Leverage (%)	46.38	50.48	48.62	43.67	47.97
	(29.01)	(21.33)	(22.81)	(25.67)	(25.12)
Number of parents	242	152	226	35	655

Notes: The table shows means (standard deviations) for parents. Bank debt, sales, total assets, and trade credit are in thousand Euro. Leverage is defined as liabilities divided by total assets. The number of parents in the bottom row refers to the number of parents in MiDi in 2006. All values are for 2006. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, Ustan 2002-2015, Orbis Historical Financials, own calculations.

Table A.IV: Impact of parent Commerzbank dependence on parent bank debt

Outcome	(1) ln(bank debt)	(2) IHS(bank debt)
Parent CB dep × 2008-15	−0.3470*	−0.3702*
	(0.1962)	(0.2081)
R^2	0.041	0.041
Number of firms	407	407
Observations	4,495	4,495
Parent FE	Yes	Yes
Year FE	Yes	Yes
Size bin FE × Time FE	Yes	Yes
Industry FE × Time FE	Yes	Yes
Affiliate location FE × Time FE	Yes	Yes
Leverage bin FE × Time FE	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome in column 1 is log parent bank debt. The outcome in column 2 is the inverse hyperbolic sine of parent bank debt, defined as $\text{IHS}(y) = \ln(y + (y^2+1)^{\frac{1}{2}})$. Parent CB dep is the fraction of the parent's relationship banks that were Commerzbank branches in 2006. Time fixed effects is an indicator for the period 2008-15. The following time-invariant control variables are calculated for parents in the year 2006 and interacted with time fixed effects: industry fixed effects, fixed effects for deciles of total sales, fixed effects for deciles of leverage, and fixed effects for whether the parent had an affiliate in Asia, the EU, or the US. The coefficients are scaled to reflect the effect on a parent with average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are clustered at the parent level. Data source: Research Data and Service Centre of the Deutsche Bundesbank, Ustan 2002-2015, Orbis Historical financials, own calculations.

Table A.V: Survey among German firms on bank credit supply

	(1)	(2)	(3)	(4)	(5)	(6)
YEAR	2007	2008	2009	2010	2011	2012
CB dep	-0.111	-0.095	-0.473**	-0.316*	0.059	0.379**
	(0.157)	(0.140)	(0.190)	(0.182)	(0.197)	(0.184)
Observations	856	988	1,032	946	898	503
R^2	0.460	0.371	0.204	0.213	0.207	0.199
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Size bin FE	Yes	Yes	Yes	Yes	Yes	Yes
ln age	Yes	Yes	Yes	Yes	Yes	Yes
Dep var from 2006	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports estimates from cross-sectional firm-level regressions for different years. The outcome is the answer to the question: "How do you evaluate the current willingness of banks to grant loans to businesses: cooperative (coded as 1), normal (0), or restrictive (-1)?" It is standardized to have zero mean and unit variance. The coefficients are interpreted as the standard deviation increase in banks' willingness to grant loans from increasing Commerzbank dependence by one. Surveying for most firms happens early every year, which is why the result for 2008 does not yet reflect the effect of Commerzbank's lending cut. The control variables include industry fixed effects, state fixed effects, bins for employment size (1-49, 50-249, 250-999, and over 1,000 employees in 2006), log firm age in 2006, and the outcome measured in 2006. Standard errors are clustered at the level of the county. Data source: Huber (2018), Ifo Institute, and own calculations.

Table A.VI: Impact on parent external financing and sales

Outcome	(1) Trade credit	(2) Bonds and other debt	(3) Equity	(4) Sales
Parent CB dep × 2008-10	0.0840	−0.0012	−0.0494	−0.1465*
	(0.0585)	(0.1431)	(0.0461)	(0.0827)
Parent CB dep × 2011-15	0.2639***	0.1198	−0.0855	−0.0359
	(0.1017)	(0.2468)	(0.0639)	(0.1169)
R^2	0.132	0.057	0.213	0.222
Number of firms	407	407	407	136
Observations	4,495	4,495	4,495	2,457
Parent FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Size bin FE × Time FE	Yes	Yes	Yes	Yes
Industry FE × Time FE	Yes	Yes	Yes	Yes
Affiliate location FE × Time FE	Yes	Yes	Yes	Yes
Leverage bin FE × Time FE	Yes	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome in column 1 is log parent trade credit from external sources, in column 2 log parent bonds and other debt, in column 3 log parent equity, and in column 4 log parent sales. The regressors are explained in Table A.IV. The coefficients are scaled to reflect the effect on a parent with average Commerzbank dependence, which was 0.23. Time fixed effects are indicators for the years from 2008-10 and 2011-15. R^2 is the within-firm R^2. Standard errors are clustered at the parent level. The data in columns 1 to 3 are from the Research Data and Service Centre of the Deutsche Bundesbank, Ustan 2002-2015. The data in column 4 are from Orbis Historical Financials, 1990-2015.

Table A.VII: Distribution of affiliates by industry and country

	Parent CB dep= 0	Parent CB dep> 0	Total
Industry			
Wholesale, retail, and repair	36.62	36.52	36.55
Manufacturing	26.35	33.28	31.43
Real estate, renting, and business activities	28.57	16.97	20.07
Transport, storage, and communication	3.19	5.72	5.05
Country			
United States	8.18	7.85	7.94
France	9.57	7.24	7.87
Italy	6.38	4.46	4.97
Netherlands	5.27	4.86	4.97
United Kingdom	6.24	4.51	4.97
Switzerland	6.80	3.85	4.64
Spain	5.83	4.05	4.53
Austria	6.24	3.80	4.45
Poland	3.47	4.41	4.16
China	2.08	4.41	3.78
Czech Republic	4.58	3.14	3.53
Number of affiliates	721	1,974	2,695

Notes: The table displays the most common industries (measured using the NACE 1.1. classification) and the most common host countries of foreign affiliates, separately for affiliates whose parents had zero Commerzbank dependence and for affiliates whose parents had positive Commerzbank dependence. The data are from 2006. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.VIII: Impact on the inverse hyperbolic sine of affiliate sales

Outcome	(1) IHS(affiliate sales)
Parent CB dep × 2008-10	–0.1034* (0.0594)
Parent CB dep × 2011-15	0.0282 (0.0616)
R^2	0.084
Number of firms	2,695
Observations	24,941
Affiliate FE	Yes
Year FE	Yes
Affiliate controls × Time FE	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is the inverse hyperbolic sine of affiliate sales, defined as $\text{IHS(y)} = \ln(y + (y^2+1)^{\frac{1}{2}})$. The regressors are explained in Table II. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, Ustan 2002-2015, Orbis Historical Financials, own calculations.

Table A.IX: Controlling for parent characteristics and using a balanced panel

	(1)	(2)	(3)
Outcome	Affiliate sales		
Parent CB dep × 2008-10	–0.0842**	–0.1032**	–0.1208**
	(0.0405)	(0.0451)	(0.0561)
Parent CB dep × 2011-15	0.0417	0.0163	0.0418
	(0.0384)	(0.0452)	(0.0611)
R^2	0.093	0.094	0.108
Number of firms	2,695	2,695	704
Observations	24,941	24,941	9,856
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes
Parent number of banks FE × Time FE	Yes	No	No
Parent industry FE × Time FE	No	Yes	No

Notes: The table reports estimates from OLS panel regressions. The outcome in all columns is log affiliate sales. Columns 1 and 2 add fixed effects for the number of the parent's relationship banks and parent industry, respectively. Column 3 uses a fully balanced panel of affiliates with data in every year from 2002 to 2015. The remaining regressors are explained in Table II. The reported coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.X: Entry and exit of affiliates and parents

Outcome	(1) Number of exiting affiliates	(2) Number of new affiliates	(3) Parent exit
Parent CB dep	0.0249	−0.0260	0.0155
	(0.0205)	(0.0266)	(0.0201)
R^2	0.446	0.416	0.075
Number of firms	624	624	624
Observations	624	624	624
Controls	Yes	Yes	Yes
Number of affiliates in 2006	Yes	Yes	Yes

Notes: The table reports estimates from OLS cross-sectional regressions. The outcome in column 1 is the number of the parent's affiliates that exited between 2008 and 2015. The outcome in column 2 is the number of affiliates newly added by the parent between 2008 and 2015. The outcome in column 3 is an indicator for whether the parent did not report any affiliates in MiDi in 2015 (i.e., whether the parent exited between 2008 and 2015). The regressors are explained in Table A.IV. We additionally control for the log number of affiliates in 2006. The coefficients are scaled to reflect the effect of average parent Commerzbank dependence, which was 0.23. Standard errors clustered at the level of the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XI: Impact on affiliate employment

	(1)	(2)	(3)
Outcome	Affiliate employment		
Parent CB dep × 2008-10	–0.0447		
	(0.0307)		
Parent CB dep: (0, 0.25] × 2008-10		0.0040	
		(0.0076)	
Parent CB dep: (0.25, 0.5] × 2008-10		–0.0180*	
		(0.0093)	
Parent CB dep: (0.5, 1] × 2008-10		–0.0555	
		(0.0345)	
Parent CB dep: (0.25, 1] × 2008-10			–0.0242***
			(0.0093)
Parent CB dep × 2011-15	0.0109	0.0057	0.0110
	(0.0271)	(0.0268)	(0.0224)
R^2	0.078	0.079	0.079
Number of firms	2,695	2,695	2,695
Observations	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log affiliate employment. The regressors are explained in Tables II and III. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XII: Effects did not differ by parent equity holdings

	(1)	(2)	(3)
Outcome	Equity from parent		Sales
Parent CB dep × 2008-10	−0.0465	−0.0473	−0.0927**
	(0.0354)	(0.0388)	(0.0454)
Parent CB dep × 2008-10 × Equity from parent/assets		0.0095	0.0095
		(0.0375)	(0.1735)
Parent CB dep × 2011-15	−0.0743*	−0.0697	0.0371
	(0.0436)	(0.0452)	(0.0437)
R^2	0.100	0.103	0.097
Number of firms	2,695	2,244	2,244
Observations	24,941	23,143	23,143
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes
Equity from parent/assets × Time FE	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome in columns 1 and 2 is log equity invested into the affiliate by the parent. The outcome in column 3 is log affiliate sales. Columns 2 and 3 analyze heterogeneity by the ratio of equity invested into affiliate by the parent over affiliate total assets in 2007. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XIII: Impact on further financial positions of affiliates

	(1)	(2)	(3)	(4)	(5)
Outcome	Liabilities toward parent	External liabilities	External equity	External LT loans	Short-term assets
Parent CB dep × 2008-10	0.0788	0.0008	0.0153	0.0898	–0.0487**
	(0.0948)	(0.0349)	(0.0441)	(0.0774)	(0.0197)
Parent CB dep × 2011-15	0.0050	0.0289	0.0024	0.0504	0.0024
	(0.1410)	(0.0499)	(0.0526)	(0.0829)	(0.0337)
R^2	0.067	0.067	0.074	0.047	0.089
Number of firms	2,695	2,695	2,695	2,695	2,695
Observations	24,941	24,941	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log liabilities toward the parent in column 1, log liabilities of the affiliate excluding liabilities owed to the parent in column 2, log equity invested by non-parents in column 3, log long-term loans of the affiliate excluding long-term loans to the parent in column 4, and log short-term assets of the affiliate excluding short-term claims on the parent by the affiliate in column 5. The regressors are explained in Table II. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XIV: Effects did not differ by domestic growth

Outcome	(1) Affiliate sales	(2) Affiliate sales
Parent CB dep × 2008-10	−0.0994**	−0.1021**
	(0.0461)	(0.0487)
Parent CB dep × 2008-10 × GDP per capita growth in bottom 10%	−0.0094	
	(0.1137)	
Parent CB dep × 2008-10 × GDP per capita growth in top 10%	−0.0382	
	(0.0298)	
Parent CB dep × 2008-10 × House price growth in bottom 10%		−0.0055
		(0.0632)
Parent CB dep × 2008-10 × House price growth in top 10%		−0.0174
		(0.0710)
Parent CB dep × 2011-15	0.0299	0.0603
	(0.0435)	(0.0561)
R^2	0.074	0.064
Number of firms	2,664	1,879
Observations	24,718	17,367
Affiliate FE	Yes	Yes
Year FE	Yes	Yes
Controls × Time FE	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log affiliate sales. Column 1 tests for heterogeneity by whether the affiliate host country was in the top or bottom 10 percent of the distribution of GDP per capita growth from 2007 to 2009 (based on World Bank data). Column 2 tests for heterogeneity by whether the affiliate host country was in the top or bottom 10 percent of the distribution of house price growth from 2007 to 2009 (based on the OECD house price index). The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XV: Effects did not differ by location

	(1)	(2)	(3)
Outcome	Affiliate sales		
Parent CB dep × 2008-10	−0.1054**	−0.0748	−0.0913*
	(0.0420)	(0.0582)	(0.0539)
Parent CB dep × 2008-10 × Affiliate in Asia	0.0525		
	(0.1122)		
Parent CB dep × 2008-10 × Affiliate in EU		−0.0393	
		(0.0618)	
Parent CB dep × 2008-10 × Affiliate in US			−0.0550
			(0.0519)
Parent CB dep × 2011-15	0.0302	0.0301	0.0300
	(0.0425)	(0.0423)	(0.0422)
R^2	0.092	0.092	0.092
Number of firms	2,695	2,695	2,695
Observations	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log affiliate sales. The table analyzes heterogeneity by whether the affiliate was located in Asia, the EU, or the US. The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XVI: Effects were similar for vertical and service sector affiliates

Outcome	(1) Affiliate sales	(2) Affiliate sales
Parent CB dep × 2008-10	−0.1277*	−0.0982
	(0.0733)	(0.0895)
Parent CB dep × 2008-10 × Vertical affiliate	0.0567	
	(0.0735)	
Parent CB dep × 2008-10 × Affiliate in service sector		0.0015
		(0.0866)
Parent CB dep × 2011-15	0.0296	0.0304
	(0.0425)	(0.0427)
R^2	0.092	0.092
Number of firms	2,695	2,695
Observations	24,941	24,941
Affiliate FE	Yes	Yes
Year FE	Yes	Yes
Controls × Time FE	Yes	Yes
Vertical Affiliate FE × 2008-10	Yes	No
Services FE × 2008-10	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log affiliate sales. Column 1 analyzes heterogeneity by whether the affiliate is vertical, i.e., active in a different industry than the parent. Column 2 studies heterogeneity by whether the affiliate is in the service sector, as defined in Eaton et al. (2016). The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on a parent with average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XVII: Excluding affiliates in wholesale and retail

Outcome	(1) Affiliate sales
Parent CB dep × 2008-10	−0.1484* (0.0773)
Parent CB dep × 2011-15	0.0442 (0.0743)
R^2	0.099
Number of firms	1,788
Observations	16,161
Affiliate FE	Yes
Year FE	Yes
Controls × Time FE	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log affiliate sales. The regression excludes affiliates in wholesale and retail. The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on a parent with average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XVIII: Controlling for tax-shifting incentives

	(1)	(2)	(3)
Outcome		Affiliate sales	
Parent CB dep × 2008-10	–0.1036**	–0.1130**	–0.1109*
	(0.0493)	(0.0471)	(0.0644)
Parent CB dep × 2008-10 × Corporate tax rate differential		–0.0020	
		(0.0031)	
Parent CB dep × 2008-10 × Corporate tax rate higher in Germany			0.0077
			(0.0525)
Parent CB dep × 2011-15	0.0114	0.0327	0.0324
	(0.0413)	(0.0494)	(0.0493)
R^2	0.076	0.069	0.069
Number of firms	2,414	2,393	2,393
Observations	22,371	22,185	22,185
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log affiliate sales. Column 1 excludes from the sample affiliates in countries classified as tax havens by Gumpert et al. (2016). These countries are Hong Kong, Ireland, Lebanon, Liberia, Panama, Singapore, Switzerland, Bermuda, British Virgin Islands, Cayman Islands, Cyprus, Channel Islands, Luxembourg, Malta, Andorra, Anguilla, Antigua and Barbuda, Bahamas, Bahrain, Barbados, Belize, Cook Islands, Dominica, Gibraltar, Grenada, Isle of Man, Jordan, Liechtenstein, Macau, Maldives, Marshall Islands, Montserrat, Netherlands Antilles, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos Islands, and Vanuatu. Columns 2 and 3 examine heterogeneity with respect to the corporate tax differential between Germany and the affiliate country (using data from the Oxford Centre for Business Taxation). The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on a parent with average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table A.XIX: Controlling for direct lending by Commerzbank in affiliate host countries

	(1)	(2)	(3)
Outcome		Affiliate sales	
Parent CB dep × 2008-10	–0.1203*	–0.1180**	–0.1158**
	(0.0642)	(0.0526)	(0.0525)
Parent CB dep × 2008-10 × Lending to non-financials from top 3 German banks		0.0512	
		(0.0327)	
Parent CB dep × 2008-10 × Lending to financials from top 3 German banks			0.0019
			(0.0013)
Parent CB dep × 2011-15	–0.0106	0.0279	0.0279
	(0.0719)	(0.0508)	(0.0509)
R^2	0.168	0.072	0.072
Number of firms	1,020	2,350	2,350
Observations	9,371	21,783	21,783
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log affiliate sales. Column 1 restricts the sample to affiliate locations in which Commerzbank did not have a branch. Column 2 tests for heterogeneity by the fraction of bank lending to non-financial firms in the affiliate's host country that came directly from German branches of the three largest German banks in 2006. Column 3 tests for heterogeneity by the fraction of bank lending to financial firms in the affiliate's host country that came directly from German branches of the three largest German banks in 2006. The remaining regressors are explained in Table II. The coefficients are scaled to reflect the effect on a parent with average Commerzbank dependence, which was 0.23. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, Austa and MiDi 2002-2015, BIS total credit statistics, own calculations.

Table A.XX: Impact of other German banks on affiliate sales

	(1)	(2)	(3)
Outcome	Affiliate sales		
Parent CB dep × 2008-10	–0.0983**	–0.0746	–0.1034**
	(0.0476)	(0.0515)	(0.0484)
Parent dep on Landesbank in crisis × 2008-10	–0.0217		
	(0.0450)		
Parent dep on affected savings bank × 2008-10		0.0820**	
		(0.0329)	
Parent dep on other banks with trading losses × 2008-10			–0.0398
			(0.0410)
Parent CB dep × 2011-15	0.0298	0.0289	0.0295
	(0.0423)	(0.0423)	(0.0423)
R^2	0.092	0.092	0.092
Number of firms	2,695	2,695	2,695
Observations	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome is log affiliate sales. The table tests whether parent dependence on other banks affected affiliate sales. Landesbanken in crisis were BayernLB, HSH Nordbank, Landesbank Baden-Württemberg, Sachsen LB, and WestLB. Affected savings banks owned these Landesbanken. Other banks with trading losses were Deutsche Bank, DZ Bank, IKB, HypoVereinsbank, and KfW, as listed in Hüfner (2010). The remaining regressors are explained in Table II. The coefficients are scaled by the average parent Commerzbank dependence, which was 0.23, to make them comparable to the previous results. R^2 is the within-firm R^2. Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Reference list of financial analyst reports

Year	Month	Day	Source of Report	Title of Report
2004	1	16	Deutsche Bank Equity Research	German Banks: The Re-Turn
2004	1	23	JPMorgan	Commerzbank : Management Meeting - Feedback On Outlook
2004	8	4	Morgan Stanley	Commerzbank: Quality Concerns
2005	1	7	CA Cheuvreux	Commerzbank: Refocusing On Core Business Following Securities Restructuring
2005	8	3	Deutsche Bank Equity Research	Commerzbank AG : A Nice Surprise
2005	9	5	Bear Stearns & Co. Inc.	CBKG.DE: Commerzbank: Last Man Standing
2006	2	7	Deutsche Bank Equity Research	Commerzbank AG : Back To Normality. Downgrade To Hold.
2006	11	6	Kepler Cheuvreux	Commerzbank : Upside After A Solid Quarter
2006	11	22	Natixis	Allianz - Dresdner Bank, A New Growth Driver For The Group
2007	1	10	UBS Equities	German Banks Revisited
2007	6	26	Bank Vontobel AG	Allianz - Once More Rumours Dresdner Bank Is Being Sold
2007	8	10	JPMorgan	Commerzbank - 2Q07: Good Domestic Trends, Disappointing Treasury
2007	10	30	fairesearch	Commerzbank - Subprime And Other One-Offs In 3Q07 - 30Th October, 2007.
2007	12	17	JPMorgan	Allianz : Allianz Is Oversold, In Our View; We Think The Only Downside Risk Is A Rights Issue - Very Unlikely
2008	1	2	Bear Stearns & Co. Inc.	CBKG.DE: Difficult Times Ahead For Commercial Real Estate
2008	1	2	Fox-Pitt Kelton Cochran Caronia Waller	European Banks: Credit Crisis - Stock Impact
2008	1	16	Natixis	Commerzbank - No Visibility In The Short Term
2008	1	17	JPMorgan	Allianz : Less Exposure To Credit Crunch, More Cost Cutting
2008	1	18	Bear Stearns & Co. Inc.	CBKG.DE: Tidying Up With More Sub Prime Provisions Amending Estimates
2008	1	18	Deutsche Bank Equity Research	German Banks : Quantifying The Revenue Risk
2008	1	28	UBS Equities	Commerzbank “Factoring In A Tougher Environment” (Neutral) Zieschang
2008	2	14	Thomson Reuters StreetEvents	Crzby - Event Transcript Of Commerzbank AG Conference Call, Feb. 14, 2008 / 8:15Am Et
2008	2	15	Bear Stearns & Co. Inc.	CBKG.DE: Q4 2007 Results Solid Results In Difficult Markets
2008	2	15	Societe Generale	Commerzbank-Target Price Downgrade Q4 07 - A Solid End To 2007 With Manageable “Crisis” Impact
2008	2	15	UniCredit Research	Commerzbank (Hold) - Q4 Numbers Lower Than Expected
2008	2	27	Auerbach Grayson & Co., Inc.	Allianz Holding - Excellent Results For Insurance Business And Asset Management (Germany)

Reference list of financial analyst reports (continued)

Year	Month	Day	Source of Report	Title of Report
2008	2	28	Deutsche Bank Equity Research	Allianz : Breaking The Bank?
2008	3	25	Credit Suisse - Europe	CBKG.F: Commerzbank - Resilience > Perception
2008	4	8	Moody's	Negative Outlook For German Banking System Reflects Impact Of Credit Crisis And Sectoral Challenges
2008	4	24	CA Cheuvreux	Allianz: Main Value Drivers Intact
2008	4	25	Natixis	Allianz - Strong Upside Potential Despite Crisis
2008	5	8	UniCredit Research	Commerzbank (Hold) - Unspectacular Q1 Numbers, In Our View
2008	5	13	Deutsche Bank Equity Research	German Banks : Amended: Still Facing Headwinds
2008	6	5	CA Cheuvreux	Commerzbank: (E)Merging Opportunites - The Resurrection Of German Banking Consolidation
2008	6	24	Natixis	Allianz - What Does The Future Hold For Dresdner
2008	8	6	JPMorgan	Commerzbank : Q208 First Glance- Good Underlying But Focus On Cre Large LLP - Alert
2008	8	6	Macquarie (formerly Oppenheim Research) — Historical	Strong Q2 Results
2008	8	7	Kepler Cheuvreux	Landsbanki Kepler Research: Reduce On Commerzbank (Q2 Earnings)
2008	8	7	UBS Equities	Commerzbank "As Good As It Gets?" (Neutral) Zieschang
2008	8	28	JPMorgan	Commerzbank : Working Through The Numbers Of A Potential Commerz /Dresdner Deal
2008	9	1	Morgan Stanley	Commerzbank: Dresdner Deal: Initial Take
2008	9	1	Warburg Research GmbH	Commerzbank
2008	9	2	Fortis Bank Financial Markets	Credit Research - Banks: All Recommendations Revised Down On Dresdner And Commerzbank
2008	9	2	Kepler Cheuvreux	Landsbanki Kepler Research: Reduce On Commerzbank (AGM)
2008	9	2	Macquarie (formerly Oppenheim Research) — Historical	No Guts, No Glory?
2008	9	2	Moody's	Moody's Downgrades Dresdner Bank's Ratings To Aa3
2008	9	4	MF Global (Historical)	Mf Global Securities - Commerzbank - Buy - €Tp25 - Initiation Report
2008	9	12	Natixis	Commerzbank - Integration Time
2008	10	31	UniCredit Research	Commerzbank (Hold) - Preview Of Q3/08 Figures
2008	11	3	Macquarie (formerly Oppenheim Research) — Historical	Superior Way To Raise Capital
2008	11	3	Raymond James Europe RJEE/RJFI	Commerzbank - Q3 2008 Earnings And Capital Raising.
2008	11	3	Thomson Reuters StreetEvents	Crzby Conference Call Final Transcript, 3-Nov-08 9:00Am Cet
2008	11	4	ESN/ equinet Bank	Equinet (4.11.2008): Commerzbank With Weak Q3 Results (Hold, Tp Eur 10)

Reference list of financial analyst reports (continued)

Year	Month	Day	Source of Report	Title of Report
2008	11	4	Natixis	Commerzbank - A Sound Move
2008	11	5	Warburg Research GmbH	Commerzbank
2008	11	13	CA Cheuvreux	Commerzbank: The Good, The Bad And The New Bank Integrating Complexity
2008	11	28	Natixis	Commerzbank - Revisions To Terms Of Dresdner Acquisition
2008	12	12	Macquarie (formerly Oppenheim Research) — Historical	Downgrade To Sell - Falling Behind
2008	12	12	Macquarie (formerly Oppenheim Research) — Historical	Falling Behind
2009	1	1	Global Markets Direct	Commerzbank AG - Financial And Strategic Analysis Review
2009	1	7	JPMorgan	Commerzbank : Challenges Ahead - Resuming Coverage With Uw
2009	1	7	UBS Equities	Commerzbank “Tough Times Ahead” (Neutral) Zieschang
2009	1	9	UBS Equities	Commerzbank “Taxpayer Steps In Again” (Neutral) Zieschang
2009	1	12	ESN	German Banks : German Banks: Still No Light At The End Of The Tunnel
2009	1	13	Moody’s	Moody’s Affirms Commerzbank’s Aa3 Long-Term Ratings, Stable Outlook
2009	1	13	Moody’s	Moody’s Affirms Dresdner Bank’s Aa3 Long-Term Ratings, Stable Outlook
2009	2	12	Morgan Stanley	Commerzbank: Many Hurdles & Very Little Visibility: Underweight
2009	2	19	Kepler Cheuvreux	Commerzbank - Yellow Submarine
2009	2	26	Credit Suisse - Europe	Credit Suisse Breakfast Banker - Financial News - Thursday, 26 February 2009
2009	2	26	JPMorgan	Commerzbank : Dresdner Q4 Numbers Cause Further Erosion Of Nav - Alert
2009	3	20	UniCredit Research	Sector Report - German Banks
2009	3	30	Deutsche Bank Equity Research	Commerzbank: Flirting With Disaster
2009	5	11	Macquarie (formerly Oppenheim Research) — Historical	Capital Position Worse Than Assumed
2009	5	12	Credit Suisse - Europe	CBKG.F: Commerzbank - Cash Is King
2009	5	12	Standard & Poor’s	Commerzbank AG And Dresdner Bank AG Outlooks To Negative On Worsening Credit Conditions; A/A-1 Ratings Affirmed
2009	5	12	Warburg Research GmbH	Commerzbank
2009	5	13	JPMorgan	Commerzbank : Capital Raising Required
2009	8	6	BHF-BANK AG	Commerzbank - Sell, Target Price: Eur 4.00
2009	8	6	Deutsche Bank Equity Research	Commerzbank : A Levered View On Abs Prices
2009	8	7	Auerbach Grayson & Co., Inc.	Auerbach Grayson: Commerzbank - Losses In Q2, But Without Any Nasty Surprises (Germany)
2009	8	7	JPMorgan	Commerzbank : Q209, Still In The Red

Reference list of financial analyst reports (continued)

Year	Month	Day	Source of Report	Title of Report
2009	8	7	Kepler Cheuvreux	Commerzbank - Not A Good Restructuring Play
2009	8	7	Societe Generale	Commerzbank - Quarterly Results - Too Early To Judge Whether Major Dilution Can Be Avoided
2009	8	10	Warburg Research GmbH	Commerzbank
2009	8	13	Fox-Pitt Kelton Cochran Caronia Waller	Questioning Capital Downgrade To Underperform
2009	8	20	UBS Equities	Commerzbank "Downgrade To Sell" (Sell) Zieschang
2009	11	5	Auerbach Grayson & Co., Inc.	Auerbach Grayson: Commerzbank - Weak Q3 Results (Germany)
2009	11	5	Deutsche Bank Equity Research	Commerzbank : Unconvincing Proposition Despite Subsidies
2009	11	5	JPMorgan	Commerzbank : Results Q309 - Alert
2009	11	5	Macquarie (formerly Oppenheim Research) — Historical	Quality Of Results Matters
2009	11	5	Natixis	Commerzbank - Earnings Boosted By A €435M Provision Release On Toxic Assets
2009	11	6	Natixis	Commerzbank - Too Many Balance Sheet Risks
2009	11	27	Deutsche Bank Equity Research	Commerzbank : Roadmap 2012 In Spotlight
2009	11	30	Warburg Research GmbH	Commerzbank
2010	2	23	JPMorgan	Q409 Results Snapshot Before The Call - Alert
2010	2	23	Macquarie (formerly Oppenheim Research) — Historical	Negative Earnings Surprise Driven By Trading
2010	2	23	Raymond James Europe RJEE/RJFI	Commerzbank: Worrying Q4 Figures But Upbeat Guidance
2010	2	24	Credit Suisse - Europe	CBKG.F: Commerzbank - Still Under Water
2010	2	24	Deutsche Bank Equity Research	Commerzbank : 2010 - Transition To Operating Profitability
2010	2	24	Societe Generale	Commerzbank - 12M Target Downgrade - Tangible Book Takes Another Hit In Q4. Soffin Repayment Still Unresolved
2010	2	24	UBS Equities	Commerzbank "Tough Quarter And Subdued 2010 Outlook" (Sell) Zieschang
2010	2	25	ESN/ equinet Bank	Commerzbank - Review Q4 Results (Reduce, Tp Eur 4.60)
2011	2	23	CA Cheuvreux	Commerzbank - 2/Outperform - Q4-10 Results Well Above Estimates
2011	2	23	JPMorgan	Commerzbank : Q4 Earnings Above Consensus, Focus On Soffin Repayment And Rwa Reduction - Alert
2012	2	23	Deutsche Bank Equity Research	Commerzbank : Cinderellabank Has Not Arrived At The Ball (Yet)
2012	2	23	JPMorgan	Commerzbank : Q411 Results: Better Than Expected Adj. Pbt But All Eyes Remain On Capital - Alert
2012	2	24	Morgan Stanley	Commerzbank: Capital Ok, Eps Still At Risk
2012	2	24	Societe Generale	Commerzbank - Full-Year Results - Capital Shortfall Reduced Poor Organic Capital Generation And Too Many Risks
2012	2	27	ESN/ equinet Bank	Commerzbank Q4 Results All In All In Line With Exp., Capital Increase Should Ease Investors' Concerns About CBK'S Capital Position - Company Update
2012	2	28	UBS Equities	Commerzbank "Sell Rating Reiterated" (Sell) Zieschang

Notes: The reference list includes all reports used for the analysis in Table A.II.

Appendix B: Institutional Details on German Banks

Commerzbank's Expansion Into International Financial Markets

German banks had relatively small trading and investment divisions until the early 2000s. In 2003, Germany was in recession and the banking sector was considered to be relatively weak. German politicians encouraged banks to increase their international activities, hoping that this would raise credit supply in Germany. However, unlike French, Spanish, and Italian banks, German banks did not grow internationally by establishing branches, taking retail deposits, and directly lending abroad. Instead, German banks expanded their international trading and investment divisions. Supporting this development, the 2003 Kleinunternehmerförderungsgesetz (small businesses promotion law) granted tax breaks for banks involved in securitization markets. Commerzbank participated in the expansion of trading and investment divisions, but not to a greater extent than other commercial banks.[48] For example, the share of trading assets at Commerzbank was 22 percent in 2005, Dresdner Banks' was 35, and Deutsche Banks' was 45. For two examples of publicly owned Landesbanken, HSH Nordbank and WestLB, the shares were 13.4 and 32.5 (Hardie and Howarth 2013).

While Commerzbank was growing its trading and investment divisions, the markets for US mortgage-related securities developed rapidly, peaking in 2006. Commerzbank invested heavily in securities with high ratings sold by American investment banks. At the same time, the banking sector in Iceland grew by more than sixfold between 2003 and 2007. Total assets of Icelandic banks amounted to 10 times of Icelandic GDP. The Icelandic banks relied to a large extent on interbank credit lines and wholesale market funding. Commerzbank provided that funding and became more exposed to Iceland than the other German banks. However, this was not considered a risky strategy by the analysts at the time (Flannery 2009).

The capital ratios of German banks support the view that Commerzbank was not following riskier strategies than other German banks. In 2005, the tier 1 capital ratio at Commerzbank was at 8 percent, Dresdner Bank was 10 percent, Deutsche Bank was at 8.7 percent, and the aggregate of German banks was 7.8 percent.

Commerzbank's 2009 Acquisition of Dresdner Bank

Dresdner Bank was acquired by Allianz, a large German insurance company, in 2001. Allianz wanted to generate synergies between banking and insurance divisions ("bankassurance"), but the plan was eventually unsuccessful. Analysts described the task of combining a large bank and insurance company as too complex and the execution by managers as flawed (2008 CA Cheuvreux report). Allianz refocused on its core insurance business in 2007 and to sell Dresdner Bank.

[48] None of the information on individual banks is provided by the Deutsche Bundesbank. Main sources are bank annual reports, financial analyst reports listed at the end of Appendix A, and reports by the European Commission.

Commerzbank was becoming worried about being a takeover target in 2007. It also wanted to enlarge its branch network. For both reasons, acquiring a large German bank was an attractive option. Dresdner Bank was the natural target, as it was for sale and had a large branch network. German politicians strongly encouraged Commerzbank's plans, in particular the Minister of Finance Steinbrück. He appeared on television promoting the planned deal. The government wanted to create a second German "banking champion," next to Deutsche Bank. Analysts also generally welcomed the deal as "making perfect strategic sense" (2008 Morgan Stanley report).

For the purposes of this paper, two factors are important. First, Commerzbank already decided to acquire Dresdner Bank before the crisis hit both banks severely. That means the trading losses and the lending cut did not affect the principal decision to acquire. Second, both banks suffered significant losses in 2008. Dresdner Bank was more exposed to asset-backed securities, while Commerzbank was more exposed to failing public and institutional debt (including the Icelandic crisis and the Lehman Brothers insolvency). Third, the effects of the lending cut on borrowers were similar, independent of whether they had originally banked with an old Dresdner Bank or old Commerzbank branch (Huber 2018). Hence, we construct the treatment variable based on relationships to either bank.

Losses at Landesbanken and Savings Banks

Landesbanken (translated as "banks of federal states") are public banks that are jointly owned by the federal state and the savings banks of their region. During the financial crisis, several Landesbanken announced large losses on international financial markets: Sachsen LB, HSH Nordbank, WestLB, Bayern LB, and Landesbank Baden-Württemberg. However, these losses did not translate into lending cuts at either the Landesbanken or their part-owners savings banks. The reason is that the Landesbanken were very quickly and generously supported by public funds from the state governments, the German federal government, and other Landesbanken. As a result, affected Landesbanken and savings banks did not suffer capital shortages and did not cut lending. We describe the various cases in more detail here.

Sachsen LB had invested into US mortgage-related securities (Kroes 2008). The bank struggled to access wholesale funding markets when it announced losses from mortgage-related securities on August 17. On the same day, a support package was announced. A national public bank called DekaBank and the other German Landesbanken purchased a large share of underperforming securities from Sachsen LB. Nine days later, on August 26, Landesbank Baden-Württemberg took over Sachsen LB and provided its lending operations with capital. Landesbank Baden-Württemberg received a guarantee that the state government of Sachsen would cover losses from mortgage-related securities. The public support measures were decided days after Sachsen LB encountered losses. As a result, Sachsen LB did not have to cut lending. There were also no effects on local savings banks in Sax-

ony, as they did not have to provide capital or guarantees. In their annual report, the savings banks state that "the sale of Sachsen LB produced no financial burden for the savings banks" (Sachsen Finanzgruppe Geschäftsbericht 2007, page 4). Their capital and lending grew in 2007.

HSH Nordbank also suffered from mortgage-related losses in 2008 (Almunia 2011a). The bank owners injected 5 billion Euro of capital and provided liquidity guarantees of 27 billion. 248 million of the capital injection came from the savings bank association of Schleswig-Holstein. Overall, the savings banks contributed less than one percent of the total rescue package. Their contribution amounted to 0.7 percent of the assets of savings banks. This modest contribution did not have an effect on the lending of the savings banks, which increased by 3.8 percent in 2008.

The North-Rhine Westphalian Landesbank WestLB held underperforming assets in a subsidiary called Phoenix Light (Almunia 2011b). It received support from the German government in the form of a 3 billion Euro capital injection in 2009. In addition, the federal state government provided a guarantee to secure underperforming assets of 4 billion Euro. The savings banks of North-Rhine Westphalia provided a guarantee of 1 billion Euro. The German government agreed to initially cover all losses resulting from a failure of WestLB. Only 25 years later would the savings banks have to cover any losses. Their contribution would be capped at a maximum of 4.5 billion Euro. This was a generous support package for the savings banks, since they were 50 percent owners of WestLB and would normally have to cover 50 percent of losses immediately. The support measures for WestLB occurred in 2008 and 2009. Between the end of 2007 and 2009, the aggregate equity capital of savings banks in North-Rhine Westphalia rose by 11 percent.

Bayern LB suffered losses on mortgage-related securities in early 2008 (Almunia 2013). It received a 10 billion Euro capital injection and a guarantee for losses of 4.8 billion from the Bavarian government. The Bavarian savings banks did not contribute to these measures and increased lending by 4 percent from 2007 to 2009.

After the Lehman Brothers insolvency, Landesbank Baden-Württemberg recorded serious losses on its international financial investments (Kroes 2009). On 21 November, the bank owners injected a total of 5 billion Euro. The savings banks contributed 1.8 billion Euro (Gubitz 2013). Despite this injection, the aggregate capital of savings banks in Baden-Württemberg increased by 6 percent and lending by 5 percent. This highlights that the savings banks were large enough to continue stable operations despite injecting capital.

Other German Banks With Trading Losses

Other banks also suffered trading and investment losses during the 2008/09 financial crisis, as listed in Hüfner (2010): Deutsche Bank, DZ Bank, IKB, HypoVereinsbank, and KfW. However, these banks either did not cut lending in response to the losses or their borrowers were on different growth paths than borrowers of other banks. In either case, it is not possible

to create a quasi-experimental research design of a lending cut around the developments at these other banks. We explain the individual cases here.

Deutsche Bank hedged its portfolio of mortgage-related securities more carefully than Commerzbank. It shorted the US mortgage market already in 2007 (2008 Fox-Pitt Kelton Cochran Caronia Waller report). As a result, Deutsche Bank could expand its lending in Germany during the financial crisis. For instance, mortgage issuance in the private customer division increased by 21.7 percent between 2007 and 2010. In line with this narrative, firms dependent on Deutsche Bank did not grow more slowly during and after the financial crisis, as shown by Huber (2018). DZ Bank and HypoVereinsbank were relatively large institutions with sizable capital ratios of 14 and 15.7 percent, respectively. In addition, both banks were part of a large banking network. DZ Bank could rely on funding from all German cooperative banks, which were not exposed to financial markets. DZ bank is the central bank of cooperatives. HypoVereinsbank belonged to the international UniCredit Group, which also provided additional funding.

IKB was a small bank specialized in real estate financing and markets. It suffered large losses when US mortgage markets crashed. However, its borrowers were also more likely to be involved in real estate financing. This makes it difficult to argue that IKB's borrowers were on parallel growth paths to other firms around the financial crisis. In any case, IKB played a small role in corporate lending in Germany. Only 0.1 percent of firms have IKB as one of their relationship banks in the Creditreform data. Among these firms, over 90 percent had at least two other relationship banks. That means that almost all borrowers of IKB were able to switch to other lenders when IKB became distressed.

KfW is a government-owned development bank. Similar to the Landesbanken, KfW was immediately supported by the government when it suffered losses. KfW carried out large-scale public credit programs during the crisis and increased its household mortgage lending by 26.5 percent.