Tracing the International Transmission of a Crisis Through Multinational Firms*

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Abstract

We study how multinational firms transmit shocks across countries. We identify a lending cut by a single German bank, which reduced the credit supply of multinational parents located in Germany. Using detailed data on internal capital markets, we show that multinationals adjusted internal capital flows toward affected parents and away from international affiliates. Affiliate sales fell sharply and recovered after three years. The results indicate that preexisting internal capital market positions can be used to predict the degree of cross-country shock transmission and that idiosyncratic shocks to lending by a single "granular" bank in a single country affect growth internationally. (JEL E44, F23, F44, G01, G21)

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I Introduction

How do economic shocks in one country affect growth in other countries? Do multinational firms transmit shocks across countries through their internal capital markets? Which internal capital market positions contribute to shock transmission and how large are the effects? Internal capital markets of multinationals have the potential to affect aggregate growth, since internal capital flows account for over half of total capital inflows into the median country and since foreign-owned affiliates produce 7 percent of value added in the US, 24 percent in the EU, and 10 percent globally.[1]

In this paper, we analyze a natural experiment, an exogenous lending cut by a large German bank in 2008/09. This lending cut reduced the credit supply of certain multinational parents located in Germany. Detailed data allow us to directly observe internal capital market positions between German parents and their international affiliates. We find that multinationals adjusted capital flows (internal loans and equity investments) toward the parent and away from affiliates after the parent was affected by the lending cut. Internal trade credit also fell, indicating that parents and affiliates were trading less. Affiliates had lower sales for three years before recovering. The reduction in sales was stronger for affiliates with larger preexisting internal capital market positions to the parent. This implies that large internal capital market positions are strong predictors for the degree of shock transmission across countries.

Using back-of-the-envelope calculations, we find that the lending cut in Germany reduced aggregate sales in some European countries by around 0.3 percent. This result suggests that "granular" banks matter internationally: An idiosyncratic shock to lending by a single bank in a single country affected real outcomes in other countries. Furthermore, the estimates imply that shock transmission through multinationals can also matter in the US. A hypothetical banking crisis in all countries except the US could reduce aggregate US sales by one percent, solely because internal networks of multinationals transmit the crisis to foreign-owned affiliates located in the US.

Identifying whether multinational firms transmit shocks across countries is difficult. The key empirical challenge is that parents and their affiliates are subject to common shocks. For example, parents and affiliates frequently use similar raw materials and sell similar products. Shocks to input prices or product demand could generate comovement between parents and affiliates, even if shocks to the parent are not transmitted to 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).

[1] Data for value added is from BEA, Eurostat, and OECD for 2014. Data for capital flows is from Broner et al. (2010) for the 2000s. Multinational parents and affiliates together produced one-third of global value added. In the EU, 13.3 percent of value added was produced by affiliates with parents located in another EU state and 11 percent by affiliates with non-EU parents. Internal capital flows through multinationals amounted to 3.6 percent of GDP for the median country.

We overcome the empirical challenge by analyzing a credit supply shock to certain German parents that did not simultaneously affect international affiliates. The shock was a lending cut by Commerzbank, a large German bank, during the 2008/09 financial crisis. After experiencing significant losses on its financial investments, Commerzbank reduced lending to German firms. Existing evidence suggests that European firms of all sizes, including multinationals, find it difficult to raise financing when a relationship bank cuts lending (Bentolila et al. 2018; Huber 2018). Consistent with this evidence, we show that 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.[2]

In the first set of main results, we compare the sales growth of affiliates whose German parents were dependent on Commerzbank to the sales growth of affiliates whose German parents were less dependent on Commerzbank. We show that there was no association between parent Commerzbank dependence and affiliate sales before 2008. Once Commerzbank reduced lending in 2008, sales of affiliates whose parents were more dependent on Commerzbank dropped sharply. Their sales began to recover slowly in the subsequent years but remained lower for three years. After 2011, the recovery was complete, with no more association between parent Commerzbank dependence and affiliate sales. We find weaker effects on sales of affiliates with higher pre-crisis growth. This implies that parents were less likely to transmit the effects to affiliates with high growth potential, consistent with theoretical predictions.[3] The point estimate is larger for affiliates in countries with underdeveloped financial markets. This suggests that better financial conditions in the affiliate host country can ease the extent of international shock transmission. Sales growth is an interesting outcome because it indicates constraints faced by firms in producing and distributing their output to points of sales and 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 although the estimated effects are weaker. There was no effect on exit or entry of affiliates.

In the second set of results, we study the effect on internal capital market positions. We analyze detailed data from the Deutsche Bundesbank. The data report individual internal capital market positions between German parents and each international affiliate.[4] We find that affiliates raised long-term lending to affected parents and that affected parents invested less equity into their affiliates from 2008 to 2015. These findings imply that net internal capital provision

[2]Influential work by Amiti and Weinstein (2011) uses a similar empirical approach to study the effect of Japanese banking crises on exports by domestic Japanese firms. Huber (2018) analyzes the effect of Commerzbank's lending cut on domestic German firms whose sales were mostly concentrated in Germany. In contrast to these papers, we focus on the growth of firms in other countries after a banking shock in Germany, by studying the international transmission through multinationals.

[3]A simple model in Appendix B shows how internal capital markets reallocate resources following a lending cut to the parent. The model is based on important work by Stein (1997), Inderst and Mueller (2003), and Matvos and Seru (2014).

[4]None of the information on individual German banks was provided by the Deutsche Bundesbank. Sources for bank-specific information are publicly available bank annual reports and financial analyst reports listed in Appendix A.

by affiliates increased. We find no evidence that affiliates raised more external financing (i.e., liabilities or equity from non-parents). This suggests that external credit market frictions made it difficult for affiliates to compensate for the loss of internal financing. The combination of higher lending to parents, less internal equity financing, and no change in external financing suggests that affiliates became more financially constrained following the credit supply shock to their parent.

The final internal capital market position that we examine are short-term claims by affiliates on their parent. These claims are a commonly used proxy for internal trade credit.[5] 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 parents were hit by the lending cut, and so internal trade plummeted. This result suggests that internal capital market positions cannot be considered in isolation from internal trade. When internal trade is financed through short-run claims, shocks that reduce internal trade will also impact internal capital positions.

We examine other affiliate balance sheet positions that were not related to the parent. There was no effect on other long-term loans, which implies that affiliates did not reduce lending to non-parents to compensate for increased lending to the parent. Short-term assets held by affiliates (excluding claims to parents) 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 again indicates that affiliates reduced their productive activities following the shock to their parent.

Next, we investigate how changes on internal capital markets were related to changes in the growth of affiliates. We study two types of affiliates. First, we consider 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 the lending cut. Indeed, we show that these affiliates strongly increased lending to their parent after 2008. Second, we consider affiliates that had issued short-term claims to their parent before 2008. These affiliates had traded more with their parent before 2008 and were therefore more affected by the reduction in internal trade after 2008. For both types of affiliates, we find larger decreases in sales from 2008 to 2010 if their parent was dependent on Commerzbank.[6] Hence, affiliates with stronger financial linkages and stronger trade linkages to the parent, as measured by internal capital market positions, were more severely affected.[7] This suggests that policymakers in affiliate host countries can use in-

[5] We confirm the high correlation between internal short-term claims and internal trade credit using German firm data, as described below.

[6] 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).

[7] We confirm that the effect of parent Commerzbank dependence was not exclusively driven by a reduction in internal trade. For instance, we find similar effects for vertical affiliates, for affiliates in the service sector, and

ternal capital market positions to predict how strongly foreign shocks will affect foreign-owned affiliates in their countries.

Several additional analyses imply that Commerzbank's lending cut to affected German parents caused the effect on affiliate sales. First, we find weaker effects for affiliates whose parents could rely on other relationship banks for credit. Second, affiliates did not reduce external borrowing and the effects are similar when controlling for local Commerzbank branches and for cross-border lending. This confirms that affiliates were not directly exposed to Commerzbank's lending cut. Third, tax shifting does not drive the results, since the effects are similar when excluding tax havens and allowing for heterogeneity by corporate tax rates. Finally, all findings are robust to controlling for common shocks to affiliates located in a country, affiliate industry, size, and leverage.

The final step of our empirical analysis is to approximate the consequences of Commerzbank's lending cut on aggregate sales in several countries. The average affiliate in a country outside Germany experienced a sales decrease of approximately 10 percent, due to the international transmission of Commerzbank's lending cut from parents to affiliates. Using back-of-the-envelope calculations, we approximate the aggregate sales change in affiliate host countries that was caused by the reduction in affiliate sales. Our calculations are approximate since we abstract from general equilibrium effects, policy changes, or exchange rate adjustments that may have affected other firms because of the decrease in affiliate sales.[8] Despite the abstractions, the calculations are informative because they measure the aggregate implications of the direct affiliate-level effects and because they allow assessing the relative magnitude of effects across countries.

We calculate large effects in countries where German affiliates were responsible for large shares of aggregate sales. For example, aggregate sales in the Czech Republic fell by 0.37 percent, in Austria by 0.30 percent, and in Poland by 0.28 percent. These numbers suggest that a single shock to lending by a large "granular" bank in a single country can affect aggregate outcomes not just in the home country, but also internationally. We also approximate the effects of a more widespread financial shock. For example, consider a hypothetical banking crisis of similar size to Commerzbank's lending cut that hits all parents located outside the US. Such a shock could reduce aggregate sales in the US by 1.03 percent, solely because internal networks of multinationals transmit the shock to affiliates located in the US. A similar shock hitting parents outside the EU could lower aggregate sales in the EU by 2.49 percent. These numbers suggest that the international transmission of shocks through multinationals can have significant effects on aggregate outcomes even in large economies.

when we drop affiliates that were more likely to primarily resell their parent's products.

[8]The model in Chodorow-Reich (2014) suggests that general equilibrium effects in response to a financial shock exacerbate the initial shock or have at most a modest attenuating effect. Huber (2018) estimates that general equilibrium effects exacerbate losses at the regional level.

II Literature Review

This paper contributes to the literature on shock transmission across countries. Cross-country evidence shows that comovement is greater for countries with greater bilateral trade (Frankel and Rose 1998) and production linkages (Burstein et al. 2008).[9] However, economic linkages are endogenous and may not actually reflect shock transmission (Imbs 2004; Abiad et al. 2013). To overcome the endogeneity concern, several papers use more disaggregated data, for example at the country-sector level (di Giovanni and Levchenko 2010), the regional level (Kleinert et al. 2015), and the firm level (di Giovanni et al. 2014).[10] Budd et al. (2005), Desai and Foley (2006), and di Giovanni et al. (2018) find that the growth of multinational parents and affiliates is correlated across countries.[11] Cravino and Levchenko (2017) take an important step forward by showing that a 10 percent increase in parent sales is associated with a 2 percent increase in affiliate sales, controlling for country and sector trends.

We use a different approach to analyze how shocks are transmitted across countries: We identify a natural experiment and estimate whether a shock to firms in one country *causes* changes in firm growth in other countries over several years. Our approach has several advantages. First, we overcome the endogeneity concern that common shocks affect linked firms, because only parents were directly affected by Commerzbank's lending cut. Second, we can directly document which cross-country internal capital market positions adjust in response to a shock. Third, we establish that preexisting internal capital market positions predict the degree of cross-country shock transmission. Fourth, we analyze how effects evolve over time, from the initial shock through the recovery until seven years later. Taking the point estimates literally, we find that a shock lowering parent sales by 10 percent reduced affiliate sales by 6.6 percent, a large effect compared to most previous work.

The findings of this paper also contribute to the literature on "granular" firms. Models by Gabaix (2011), Acemoglu et al. (2012), di Giovanni and Levchenko (2012), Grassi (2017), Magerman et al. (2017), and Carvalho and Grassi (2019) argue that idiosyncratic shocks to individual firms can shape aggregate growth in one country, while di Giovanni et al. (2014; 2019a), Friberg and Sanctuary (2016), and Amiti and Weinstein (2018) provide empirical evidence from individual countries. We extend the geographic reach of the "granular" hypothesis.

[9] Further evidence is in Clark and van Wincoop (2001), Baxter and Kouparitsas (2005), Calderón et al. (2007), Liao and Santacreu (2015), Ng (2010). The determinants of trade and production linkages are studied in Buch and Lipponer (2005), Garetto (2013), Irarrazabal et al. (2013), Ramondo et al. (2013), Lewis (2014), Alfaro et al. (2019b), and Garetto et al. (2019).

[10] A literature shows that banks can transmit financial crises internationally but does not analyze non-financial multinationals (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).

[11] Other papers on multinationals study the performance of foreign affiliates during the Great Recession (Alfaro and Chen 2012; Alviarez et al. 2017), the effect of firms' foreign direct investment on investment in the home country (Desai et al. 2005; 2009), the riskiness of multinational firms (Fillat and Garetto 2015; Fillat et al. 2015), and the relationship between international production linkages and volatility (Bergin et al. 2009; 2011; Kurz and Senses 2016).

We show empirically that an idiosyncratic shock to a single firm in a single country, in our case a "granular" bank, can affect aggregate outcomes not just in one country, but in many countries all over the world.

We additionally contribute to the literature on internal capital markets of multinationals. Influential papers by Desai et al. (2004; 2008), Manova et al. (2015), and Kalemli-Özcan et al. (2016) argue that internal capital markets help foreign affiliates to outperform domestic firms. Consistent with the view that internal capital markets are important, Antràs et al. (2009) and Bilir et al. (2019) emphasize that financial frictions shape the structure of multinationals. Atalay et al. (2014) and Ramondo et al. (2016) report that internal trade does not play a dominant role in US and multinational firms, respectively, even though multinationals have many vertical affiliates (Alfaro and Charlton 2009).[12] Foley and Manova (2015) review the literature on the corporate finance of multinationals. We make several contributions to this literature. First, unlike existing papers, we can directly observe detailed internal capital market positions of multinationals over many years. Second, we show which internal capital market positions adjust in response to a shock. Third, we establish that larger preexisting positions are associated with stronger shock transmission across countries. Fourth, we study how a financial shock to the parent, i.e., to the core of the multinational, is transmitted across countries. Fifth, we document causal effects on internal capital market positions and real outcomes over several years, including the recovery period.

A theoretical literature argues that models with multinationals generate more business cycle comovement (Contessi 2010; Zlate 2016; Menno 2017).[13] A common modeling assumption is that shocks to the parent's production process affect affiliate growth.[14] Our paper provides causal evidence in favor of this assumption, by focusing on the transmission of a credit shock through internal capital markets. A related literature focuses on a different transmission channel from parents to affiliates, namely technology transfers (Javorcik 2004; Arnold and Javorcik 2009; Keller and Yeaple 2013; Bilir and Morales 2019; Fons-Rosen et al. 2019; Alfaro-Urena et al. 2019). Some models of multinationals imply that affiliate sales increase when only the parent experiences a negative shock to its production process (Tintelnot 2017). Our results indicate that, on the contrary, after a credit supply shock to the parent affiliate sales fall rather than acting as substitute for parent sales. Finally, our finding that internal trade credit matters

[12] A separate literature analyzes internal capital markets of domestic business groups, which are likely shaped by different frictions than multinationals' internal capital markets. Important recent contributions in this area by Matvos and Seru (2014) and Giroud and Mueller (2019) study how US business groups allocated resources during the Great Recession following credit and demand shocks, respectively. Other papers on resource allocation in domestic business groups include: Lamont (1997); Shin and Stulz (1998); Rajan et al. (2000); Gopalan et al. (2007); Boutin et al. (2013); Seru (2014); Almeida et al. (2015); Giroud and Mueller (2015); Santioni et al. (2019).

[13] 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 linkages (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).

[14] See also, 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 Rodriguez-Clare (2013); Antràs and Yeaple (2014); Ramondo (2014); Menno (2017); Alviarez (2019).

is related to a literature that shows how input-output linkages transmit shocks in the short run (Barrot and Sauvagnat 2016; Carvalho et al. 2016; Costello 2018; Boehm et al. 2019; Alfaro et al. 2019a). Our approach differs because our estimates incorporate all linkages between parent and affiliates, not just input-output trade, because we focus on cross-country linkages within the same multinational, and because we study dynamic effects over several years.

III Empirical Strategy and Institutional Details

III.A Empirical Strategy

This paper investigates how a credit supply shock to the parent of a multinational firm impacts international affiliates. The empirical challenge is that unobservable common shocks simultaneously affect parents and affiliates. For example, 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. Furthermore, size and productivity of parents and affiliates are positively correlated. Since firm growth differs by size and productivity, this again suggests that parents and affiliates are exposed to common shocks (Guadalupe et al. 2012; Fort et al. 2013; Foster et al. 2016).

This paper overcomes the empirical challenge by identifying a shock that affected a subset of multinational parents located in Germany. The shock is a lending cut by Commerzbank, a large German bank, during the global financial crisis 2008/09. German firms traditionally form close relationships with a few relationship banks.[15] Economic theory suggests that relationship banks have an informational advantage when dealing with relationship customers (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 makes firms dependent on their relationship banks' credit supply.

Existing evidence shows that German multinationals also depend on the credit supply of their relationship banks.[16] Commerzbank's lending cut reduced the credit supply of German parents for which Commerzbank was an important relationship bank. International affiliates of German multinationals were on average not directly exposed to Commerzbank and therefore

[15] Relationship banks are known as *Hausbanken*,"home banks," which indicates the tight relationships between firms and banks. The most common services provided by relationships banks are loans and payment transactions (Elsas 2005). Bank-firm relationships are durable, as only 1.7 percent of firms add a new relationship bank per year (Dwenger et al. 2015).

[16] 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). Bentolila et al. (2018) and Huber (2018) for Spain and Germany, respectively, show that firms of all sizes, including multinational parents, depend on their relationship banks' loan supply, unlike large US firms (Chodorow-Reich 2014).

did not reduce bank debt, because Commerzbank's corporate lending was concentrated on firms in Germany.

We use the pre-crisis Commerzbank dependence of German parents as proxy for parents' exposure to Commerzbank's lending cut. Our estimation sample contains international affiliates of German multinationals located all over the world. We compare the growth of affiliates, whose German parents were dependent on Commerzbank for financial services, to the growth of other affiliates, whose German parents did not have Commerzbank as a relationship bank before the lending cut.[17] Our empirical approach 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. The institutional details in the following subsection support this assumption, by showing that Commerzbank's lending cut was exogenous to German parents and their international affiliates.

III.B Commerzbank's Lending Cut

Commerzbank was the second-largest German bank before the Great Recession. Its market share among medium-sized (*Mittelstand*) and large firms in Germany was around 13 percent.[18] Commerzbank was strongly affected by the financial crisis of 2008/09. While Commerzbank's business model focused on Germany (with 96 percent of branches located in Germany, Commerzbank annual report 2009), the bank also ran trading and investment divisions that had invested heavily into international financial markets. From 2008 onward, Commerzbank suffered large losses in these divisions. Its equity capital fell by a total of 68 percent between December 2007 and December 2009 (Commerzbank and Dresdner Bank annual reports). The drop in equity capital was entirely due to write-downs on financial instruments and income losses (Figure I, panel A). Write-downs on financial instruments included, for example, changes in the valuation of derivatives held by the bank. Income losses were driven by trading and investment income (Figure I, panel B). Interest income, on the other hand, which includes what Commerzbank earned from lending to firms, remained on an upward trend up to 2009. This

[17] We estimate the reduced-form impact of a bank lending cut on parents and 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.

[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 in Appendix A. Throughout the paper, "Commerzbank" refers to all branches that were part of the Commerzbank network in 2009, including its acquisition Dresdner Bank. 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). Commerzbank had already decided to acquire Dresdner Bank before the crisis hit both banks severely. 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 Huber (2018, Appendix B) for a detailed narrative about the losses at Commerzbank and Dresdner Bank and effects on their respective borrowers.

suggests that the losses were not caused by the corporate lending portfolio. Further evidence on Commerzbank's lending cut comes from 110 financial analyst reports summarized in Table A.I. The analysts agree that Commerzbank's corporate loan portfolio was not riskier than other German banks'. It was, in fact, considered a source of strength before and during the crisis.

Until 2007, Commerzbank's total lending to German customers grew in parallel to lending by all other banks and lending by other commercial banks (Figure II). In 2008 and 2009, Commerzbank's lending stock fell sharply. The majority of other German banks were hardly exposed to international financial markets and therefore able to continue lending, as evidenced by the increase in lending by other banks in 2008 and 2009.[19] Following equity injections by the government, Commerzbank stabilized. Its lending growth from 2010 onward returned to a roughly parallel trend relative to the other commercial banks.

Commerzbank's lending cut affected its relationship customers in Germany. In a survey following Commerzbank's lending cut, firms dependent on Commerzbank reported more restrictive bank loan supply, compared to firms with other relationship banks (Table A.II). Firms dependent on Commerzbank took out less bank debt and their output grew more slowly (Huber 2018). For the purpose of this paper, we take as starting point the observation that Commerzbank's lending cut was an exogenous financial shock to German firms, including parents of multinational firms. We then trace how the shock was transmitted internationally through multinational firms, from parents dependent on Commerzbank to their international affiliates.

IV Data

This paper uses 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 balance sheets of German parents from Ustan (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:

$$\text{CB dep}_p^{parent} = \frac{\text{Number of parent's relationship banks that were CB branches}}{\text{Total number of parent's relationship banks}}. \quad (1)$$

[19] A few other German banks were also affected by the financial crisis. But, unlike in the case of Commerzbank, the customers of these banks were hit by other shocks during the crisis or the banks received sufficient financial support to stabilize lending. We analyze other banks in Section V.E below.

This variable 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).[20]

IV.B MiDi

The data underlying MiDi are collected by the Deutsche Bundesbank as part of its supervisory duties. German parents have to report an international affiliate to the 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.

MiDi includes annual data on affiliate balance sheets, sales, employment, and industry. A remarkable feature of the dataset 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.[21]

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. 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 affiliates in MiDi in 2006. Overall, there are 655 German parents and 2,695 international affiliates in our data.[22] 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 contains annual balance sheets of non-financial German firms (for details, see Becker et al. 2019). The data are collected by the Deutsche Bundesbank as byproduct of its lending activity. Ustan is also available for 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.

[20] We do not have data on the 2006 bank relationships of international affiliates. However, we show below using several tests that affiliates were not directly exposed to Commerzbank's lending cut.

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

[22] 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).

IV.D Summary Statistics

The average parent had 3.8 international affiliates in 2006 (Table I). Parent characteristics, including parent size, bank debt, trade credit (lending from other firms), and leverage were balanced across bins of parent Commerzbank dependence.[23]

The average affiliate was a medium-sized firm, with annual sales of 54 million Euro and 196 employees in 2006 (Table II). On average, parents held 87.6 percent of an affiliate's equity. Affiliate size, leverage, the degree of lending and financing through internal capital markets, and parents' ownership share were balanced across bins of parent Commerzbank dependence.

Affiliates of parents with positive Commerzbank dependence operated in similar industries as affiliates with zero parent Commerzbank dependence (Table A.III, top panel).[24] 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.III, bottom panel). 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 eleven most common countries were in Europe. This suggests that a gravity equation holds for the location of affiliates.

Overall, the balance of parent and affiliate characteristics across bins of parent Commerzbank dependence, as well as the balance of affiliate industries and locations, imply that affiliates with high parent Commerzbank dependence were not fundamentally different from other affiliates. This corroborates our empirical approach, which assumes that affiliates of parents with high Commerzbank dependence would have developed in parallel to other affiliates, had their parents not experienced Commerzbank's lending cut.

V Empirical Results

V.A The Effect of Commerzbank's Lending Cut on Parent Financing

The first empirical result shows that Commerzbank's lending cut reduced the bank debt of parents. We specify

$$\ln(y_{pt}) = \beta \times \text{CB dep}_p^{parent} \times \text{d}_t^{\text{08-15}} + \gamma_p + \lambda_t + \phi' \times \text{X}_p \times \text{d}_t^{\text{08-15}} + \varepsilon_{pt}, \tag{2}$$

where subscript p indexes the parent and t indexes the year. The sample contains only parents of German multinationals. The treatment variable of interest is CB dep_p^{parent}, which measures the fraction of the parent's relationship banks that were Commerzbank branches in 2006. The

[23] Parents with positive Commerzbank dependence were on average larger than parents with zero Commerzbank dependence. This relationship arises mechanically, since larger firms have more relationship banks, and are therefore also more likely to have a relationship to a Commerzbank branch.

[24] 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.

variable $d_t^{08\text{-}15}$ is an indicator for the years 2008 to 2015. The coefficient β is the average log difference in bank debt after 2008 for parents with higher Commerzbank dependence, relative to parents with zero Commerzbank dependence.

Parent fixed effects γ_p account for time-invariant differences across parents. Year fixed effects λ_t control for macroeconomic shocks that affect all parents in a given year. The controls in X_p are deciles of firm sales, industry fixed effects, indicators for whether the parent had a foreign affiliate in Asia, the EU, or the US, and deciles of firm leverage.[25] The controls are measured in 2006 and interacted with $d_t^{08\text{-}15}$. By including the control variables, we ensure that spurious correlations between parent Commerzbank dependence and these factors do not bias the estimates. Standard errors are clustered at the parent level.

The first outcome variable y_{pt} we analyze is parent bank debt.[26] We report effects for a parent with average Commerzbank dependence, which was 0.23. The specification with all controls suggests that the bank debt of the average parent in the sample fell by 34.7 log points due to Commerzbank's lending cut (Table III, column 3). The estimate is statistically different from zero at the 10 percent level. Adding the control variables makes little difference to the estimates (columns 1-2). Before the lending cut, parents with higher Commerzbank dependence were on similar trends to other firms (Figure IV). This also held during the 2003 recession, which implies that parents with higher Commerzbank dependence were not more cyclical. After Commerzbank cut lending, the bank debt of parents with higher Commerzbank dependence dropped sharply, compared to other parents, and subsequently remained low. Overall, the results on parent bank debt suggest that parents did not turn to other banks to compensate for Commerzbank's lending cut.[27]

Parents may have increased financing from non-bank external sources to compensate for

[25] Leverage is liabilities over total assets. Industries are defined according to the NACE 1.1 one-digit classification. They are mining and quarrying; manufacturing; electricity, gas, and water supply; wholesale and retail trade; transport, storage, and communication; financial intermediation; real estate, renting, and business activities; other community, social, and personal service activities; agriculture, hunting, and forestry; construction; hotels and restaurants.

[26] We winsorize all outcome variables at the 1st and 99th percentiles of their distribution to mitigate the impact of outliers. We find similar coefficients without winsorizing. Since some outcome variables contain some zeros, we add 1 unit (1,000 Euro) to all outcome variables throughout the paper. In a robustness check, we use a different transformation of the outcome variable, the inverse hyperbolic sine. Table A.V shows the results remain similar. The inverse hyperbolic sine of y is defined as $\text{IHS}(y) = ln(y + (y^2+1)^{\frac{1}{2}}) \approx ln(2) + ln(y)$ (except for very small 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).

[27] Commerzbank's lending stock fell by around 17 percent after 2008, relative to other German banks (Figure II). The narrative evidence and a survey suggest that Commerzbank's loan supply recovered after 2011 (Section III and Table A.II). Therefore, the point estimates in Table III and Figure IV 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, 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.

Commerzbank's lending cut. We first test whether parents raised trade credit from firms outside the multinational. We find no significant association between Commerzbank dependence and external trade credit before 2010, but a positive association from 2011 to 2015 (Figure A.I). The increase from 2011 to 2015 was statistically significant at the 1 percent level (Table A.IV, column 1). We report that parents did not significantly raise financing through bonds and other debt or through equity, neither from 2008 to 2010 nor after 2011 (columns 2-3). Taken together, the results suggest that parents did not raise external financing from 2008 to 2010. However, after 2011, parents compensated for around 79 percent of the lost bank debt using external trade credit, taking the point estimates literally. This suggests that it took parents until 2011 to overcome frictions on external credit markets.[28] Accordingly, parent sales were significantly lower from 2008 to 2010, but recovered after 2011 (column 4).

V.B The Effect on Affiliate Sales

This section investigates whether the disruption to parents' credit supply affected their international affiliates. We estimate the following specification for affiliate a of parent p, located in country c, in year t:

$$\ln(y_{apct}) = \sum_{\tau=2002}^{2015} \beta_\tau \times \text{CB dep}_p^{parent} \times \mathbb{1}(t=\tau) + \gamma_a + \lambda_t + \sum_{\tau=2002}^{2015} \phi_\tau' \times \text{X}_{ac} \times \mathbb{1}(t=\tau) + \varepsilon_{apct}. \tag{3}$$

The treatment variable of interest is CB dep_p^{parent}, which measures the fraction of the parent's relationship banks that were Commerzbank branches in 2006. We estimate the effect of 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. We include fixed effects for deciles of sales; for industry; for affiliates located in Asia, the EU, or the US; and for deciles of leverage. Standard errors are two-way clustered at the level of the country and the parent.

The first outcome variable y_{apct} we consider is affiliate sales.[29] 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

[28] Consistent with our findings on trade credit, Paravisini et al. (2015) show 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.

[29] As for parents, we winsorize all outcome variables at the 1st and 99th percentile and add 1 unit (1,000 Euro) to the outcome variable. The results are robust to not winsorizing and to using the inverse hyperbolic sine instead of adding 1 unit (see Table A.V).

(Figure V). There are no statistically significant coefficients for the years before 2008 and the point estimates are small. This finding 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 higher parent Commerzbank dependence fell sharply compared to sales of other affiliates. The sharp drop in 2008 suggests that the shock to parents raised constraints for affiliates relatively quickly, for example by reducing their supply of working capital, their ability to distribute their products to points of sales, or their ability to finance variable inputs and labor. A slow recovery process began in 2009, although affiliate sales remained significantly lower until 2010. The individual point estimate for 2008 is statistically significant at the 5 percent level and the point estimates for the years 2009 and 2010 are significant at the 10 percent level. From 2011 onward, the coefficients on parent Commerzbank dependence are small and insignificant. The full recovery suggests that affiliates did not reduce investments that harmed their long-run growth prospects. Overall, the graph shows that Commerzbank's 2008 lending cut lowered the sales of international affiliates from 2008 to 2010 and that affiliate sales recovered after 2011.[30]

We investigate the robustness of the graphical analysis by estimating the effect separately for two periods, 2008 to 2010 and 2011 to 2015:

$$\begin{aligned}\ln(\text{sales}_{apct}) = \beta_1 \times \text{CB dep}_p^{parent} \times \text{d}_t^{\text{08-10}} + \beta_2 \times \text{CB dep}_p^{parent} \times \text{d}_t^{\text{11-15}} \\ + \gamma_a + \lambda_t + \phi_1' \times \text{X}_{ac} \times \text{d}_t^{\text{08-10}} + \phi_2' \times \text{X}_{ac} \times \text{d}_t^{\text{11-15}} + \varepsilon_{apct}.\end{aligned} \tag{4}$$

We interact the measure of parent Commerzbank dependence with an indicator for 2008 to 2010, $d_t^{\text{08-10}}$, and an indicator for 2011 to 2015, $d_t^{\text{11-15}}$. The vector X_{ac} contains fixed effects for size deciles, industry, country, and leverage deciles. All controls are interacted with the indicator variables for the two periods.

The specification with all controls 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 IV, column 3). 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 controls have little impact on the point estimates but standard errors become smaller (columns 1-2).

A theoretical model in Appendix B predicts that the effect on affiliates with high marginal product of capital should be lower. We use affiliates' pre-crisis sales growth from 2006 to 2007 as proxy for high growth potential and high marginal product. We find that affiliates with faster pre-crisis growth were less affected by their parent's Commerzbank dependence (column

[30]Figure A.II controls for country fixed effects instead of fixed effects for Asia, the EU, and the US. The pattern of results is similar.

4). 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.

We find no significant difference in sales growth between affiliates with zero parent Commerzbank dependence and affiliates with parent Commerzbank dependence greater than 0 and up to 0.3 (column 5). These parents faced a relatively small financial shock because they could borrow from a relatively large number of other relationship banks after Commerzbank's lending cut. The estimate implies that not all affiliates with positive parent Commerzbank dependence experienced significantly lower sales. This finding supports our identification assumption, which requires that affiliates whose parents had Commerzbank as their relationship bank were not exposed to other unobservable shocks. The point estimate is larger for affiliates with parent Commerzbank dependence greater than 0.3 and up to 0.5 (significant at the 1 percent level) and largest for affiliates with parent Commerzbank dependence greater than 0.5 (significant at the 5 percent level). The coefficients on affiliates with parent Commerzbank dependence greater than 0.3 are significantly different (at the 10 percent level) from the coefficient on the group with parent Commerzbank dependence greater than 0 and up to 0.3. Hence, the ease with which parents could find alternative sources of bank credit affected the magnitude of the effect on affiliates.

We find that parents with higher Commerzbank dependence did not experience more exits of existing affiliates (Table A.VI, column 1) or fewer entries of new affiliates (column 2). Parents were also not more likely to exit themselves (column 3). These findings are not surprising, given that affiliates were able to recover from the effects of the lending cut after 2011.

Next, we consider whether the macroeconomic environment in the affiliate host country influenced the effect. We find that affiliates in host countries with underdeveloped financial markets (low private credit relative to GDP) experienced a larger reduction in sales compared to affiliates in host countries with strong financial markets (Table A.VII, column 1). A likely reason is that affiliates in countries with underdeveloped financial markets could not easily find alternative external sources of financing when their parents became financially constrained. We find no evidence that the effects differed in countries with high or low GDP per capita growth from 2007 to 2009 (column 2) or in countries with high or low national house price growth from 2007 to 2009 (column 3). Both GDP per capita growth and house price growth indicate the depth of the Great Recession in a country. There was also no significant difference in the effects between affiliates located in Asia, the EU, and the US (Table A.VIII). Overall, the results suggest that cross-country differences in financial market development affected the magnitude of the effects, while macroeconomic growth or the global location of affiliates did not. In robustness checks, we control for the number of the parent's relationship banks (Table A.IX, columns 1), parent industry (column 2), and we use a fully balanced panel (column 3). We find similar coefficients.

The pattern of results for affiliate employment resembles the pattern for affiliate sales. The

point estimates are generally smaller than for sales, implying an employment drop of 4.5 log points for 2008 to 2010 and a full recovery after 2011 (Table A.X, column 3). The coefficient on the baseline measure of parent Commerzbank dependence is insignificant (column 3), but the coefficients on higher pre-crisis sales growth (column 4) and on affiliates with parent Commerzbank dependence between 0.3 and 0.5 (column 5) are significant at the ten percent level.

V.C The Effect on Internal Capital Markets

Having analyzed the effect of parent Commerzbank dependence on affiliate sales, we now investigate how internal capital markets between parents and affiliates reacted to Commerzbank's lending cut. We estimate versions of equation 4, using internal capital market positions from affiliate balance sheets as outcome variables.

We first examine the effect on internal long-term loans from affiliates to their parent (with maturity above one year). The point estimate implies that affiliates with average parent Commerzbank dependence increased long-term loans to their parent by 8.7 log points from 2008 to 2010 (significant at the 10 percent level), relative to affiliates with zero parent Commerzbank dependence (Table V, column 1). Hence, consistent with the theoretical model in Appendix B, after parents were hit by a credit supply shock, affiliates increased lending to their parent. The effect from 2011 to 2015 is of similar magnitude but statistically insignificant.

We also find that parents with average Commerzbank dependence invested less equity into their affiliates, relative to parents with zero Commerzbank dependence (column 2). This is again consistent with the prediction of the theoretical model that affiliate net internal capital provision would rise. The point estimates imply that parent equity financing was 4.7 log points lower from 2008 to 2010 (insignificant) and 7.4 log points lower from 2011 to 2015 (significant at the 10 percent level).[31] There was no corresponding decrease in debt financing, as the point estimates for liabilities owed to parents are insignificant and positive (column 3).[32]

The final internal position that we examine are short-term claims by affiliates on their parent (with maturity less than a year). Internal short-term claims by affiliates on their parent are a commonly used proxy for internal trade credit and hence for internal trade flows from affiliates to the parent.[33] The estimate implies that affiliates with average parent Commerzbank dependence reduced short-term claims on parents by 18.8 log points from 2008 to 2010 (significant at the 5 percent level), relative to parents with zero Commerzbank dependence (Table V, col-

[31]Parent equity financing was 13.4 log points higher from 2011 to 2015 for the average affiliate. This implies that, on average, parent equity did not fall in absolute terms after Commerzbank's lending cut, but grew by less.

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

[33]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.

umn 4). A likely explanation for the response of short-term claims is that parents' demand for production inputs delivered by affiliates decreased after parents became financially constrained. This reduced internal trade and therefore short-term claims by affiliates on their parent. The point estimate for 2011 to 2015 is insignificant, but only slightly smaller at 14.4 log points. This suggests that internal trade slightly recovered after 2011, but also that the persistent reduction in parent equity financing (right-hand side of affiliate balance sheet) was matched by a persistent decrease in short-term claims from affiliates on their parent (left-hand side). The results on short-term claims imply that internal capital markets cannot be considered in isolation from internal trade. When internal trade is financed through short-run claims, shocks that reduce internal lending will also impact capital flows.

In principle, affiliates may have compensated for the shocks to internal loans, equity financing, and trade by adjusting external financial positions. However, we find no evidence that external adjustments undid the effects of the internal shocks. The point estimates for long-term loans to non-parents are positive and insignificant (Table VI, column 1). Hence, affiliates did not cut lending to non-parents. Equity from non-parents (column 2) and liabilities owed to non-parents (column 3) also hardly changed. This implies that affiliates were not able to use other sources of funding to compensate for the lost parent equity, likely due to frictions in external financial markets.

Instead of reducing other loans or raising external funding, affiliates reduced short-term asset holdings that were not claims on parents from 2008 to 2010 (Table VI, column 4). The point estimate implies a decrease of 4.9 log points (significant at the 5 percent level). One reason for the reduction in short-term assets could be that affiliates decreased their holdings of raw materials, working capital, and other variable inputs required to produce and to distribute their output to points of sales. Another reason could be that affiliates granted less trade credit to non-parent trading partners after Commerzbank's lending cut. In general, the reduction in short-term assets is consistent with the reduction in affiliates sales from 2008 to 2010. The effect on other short-term assets disappeared after 2011, as the coefficient for 2011 to 2015 is small, positive, and insignificant.

V.D The Relevance of Internal Capital Market Positions for the Effect on Affiliate Sales

The evidence on internal capital markets indicates that, after Commerzbank's lending cut, affected affiliates had to lend more to their parent, affiliates received less parent equity financing, and internal trade fell. Next, we investigate whether the effect on affiliate sales was stronger for affiliates that had larger internal capital market positions. We test for heterogeneous treatment effects by specifying

$$\begin{aligned}\ln(\text{sales}_{apct}) = {} & (\beta_1 + \beta_1' \times \text{het}_{ac}) \times \text{CB dep}_p^{parent} \times \text{d}_t^{\text{08-10}} + \beta_2 \times \text{CB dep}_p^{parent} \times \text{d}_t^{\text{11-15}} \\ & + \gamma_a + \lambda_t + \phi_1' \times \text{X}_{ac} \times \text{d}_t^{\text{08-10}} + \phi_2' \times \text{X}_{ac} \times \text{d}_t^{\text{11-15}} + \varepsilon_{apct}. \end{aligned} \quad (5)$$

The indicator variable het_{ac} identifies whether a firm falls into a given heterogeneity category. The coefficient β_1 estimates the effect of 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.

We do not define heterogeneity categories using actual changes in internal capital market positions because actual changes are endogenous to affiliate sales. Instead, we use preexisting affiliate characteristics. The first heterogeneity category we consider is whether affiliates had lent long-term to their parent before 2008. Parents had already set up a financial infrastructure to borrow from these affiliates, making it easier to quickly shift capital after Commerzbank's lending cut. Indeed, such affiliates increased lending to their parent by more from 2008 to 2010 (Table A.XI, column 1). We find that the additional sales reduction for affiliates with previous long-term loans was large and significant at the 1 percent level (Table VII, column 1). This suggests that affiliates that lent more to their parents after 2008 were more affected by the shock to the parent.

The second heterogeneity category we consider is whether affiliates had positive short-term claims on their parents before 2008. Such affiliates had likely delivered goods to their parent and were more reliant on parents' demand for internal trade. Naturally, short-term claims could only decrease after 2008 for affiliates with positive short-term claims before 2008 (Table A.XI, column 2). We find that the additional effect on affiliates with previous short-term claims was negative and significant at the 10 percent level (Table VII, column 2).[34] This suggests that affiliates with greater trade linkages to the parent were more affected by the shock to the parent.

When we include both heterogeneity categories in one specification, the effects on affiliates with previous long-term loans and with previous short-term claims remain large and significantly different from zero, relative to affiliates with zero parent Commerzbank dependence (VII, column 3). These findings are consistent with the view that increased internal lending and lower internal trade played important roles in the transmission of the lending cut to affiliates.[35] Furthermore, the results show that affiliates with larger preexisting internal capital market positions are more likely to be affected by shocks to the parent. This fact may be useful for policymakers in affiliate host countries when they assess the likelihood that affiliates in their

[34]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 short-term claims to the parent and long-term lending 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.

[35]In unreported results, we do not find heterogeneous effects (on parent equity investments into the affiliate or on affiliate sales) with respect to the preexisting ratio of parent equity over affiliate total assets or the ratio of parent equity over affiliate total equity. This implies that parents reduced equity investments homogeneously across affiliates after Commerzbank's lending cut.

countries will be affected by shocks to the multinational parent.

V.E Alternative Explanations for the Results

We investigate whether alternative hypotheses can explain the correlation between parent Commerzbank dependence, affiliate sales, and internal capital market positions.

We first consider whether affiliates could have been directly exposed to Commerzbank's lending cut. If this hypothesis holds, bank debt of affiliates with higher parent Commerzbank dependence should have fallen by more. But we find that affiliate liabilities toward banks and other non-parents did not change significantly, suggesting affiliate bank debt was not affected (Table VI, column 1). We investigate the hypothesis further in Table A.XII. First, we exclude from the sample all countries where Commerzbank had a branch. The point estimate becomes slightly larger and remains statistically significant (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.[36] We do not have data on the 2006 relationship banks of international affiliates, but we have data on their contemporary relationship banks from Orbis. Using this contemporary data, we find that the correlation between parent and affiliate Commerzbank dependence is only 0.025 and that only 3 percent of foreign affiliates have a 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.

Second, we test whether tax shifting between parents and affiliates drives the results. We drop all affiliates located in countries defined as tax havens by Gumpert et al. (2016) (Table A.XIII, 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 for countries with low corporate tax rates.

Third, we 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

[36]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.

in wholesale and retail (Table A.XIII, column 4). The coefficient becomes slightly larger and remains significant. This suggests that affiliates that primarily resell their parent's output do not drive the effect.

Fourth, we consider whether internal trade between affiliates and parents was exclusively responsible for the entire effect on affiliate sales. We find no significant difference between the effect on vertical affiliates and the effect on other (horizontal) affiliates (Table A.XIV, column 1). Vertical affiliates operated in different industries than their parent and were therefore more likely to internally trade with the parent. 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. These results suggest that input trade between affiliates and parents does not explain the entire effect.

Finally, we study whether parent dependence on other German banks affected affiliates from 2008 to 2010. We study three groups of other banks that were affected by the financial crisis 2008/09: Landesbanken with trading losses, savings banks that 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.XV).[37]

V.F Aggregate Implications of the International Transmission Through Multinationals

We approximate aggregate effects using a back-of-the-envelope calculation. Specifically, we calculate the aggregate sales change in country c due to the effects on affiliates of German multinationals located in country c:

$$\begin{aligned}&\text{(Change in aggregate sales due to CB dep of German parents)}_c = \\ &\hat{\beta}_1 \times \text{(Average parent CB dep for affiliates of German parents)}_c \\ &\times \text{(Total sales of affiliates of German parents in 2006)}_c.\end{aligned} \tag{6}$$

Estimate $\hat{\beta}_1$ measures the effect of parent Commerzbank dependence on affiliate sales from 2008 to 2010. We multiply $\hat{\beta}_1$ by the average parent Commerzbank dependence of affiliates of German multinationals in country c. This approximates the effect of Commerzbank's lending cut on the average affiliate of German multinationals in country c. We then multiply this effect by total sales of affiliates of German multinationals in country c in 2006.[38]

The calculation identifies the change in aggregate sales due to the transmission of Commerzbank's lending cut through internal networks of German multinationals under strict assumptions. We need to assume that changes in affiliate sales had no general equilibrium effects

[37] The affected Landesbanken were BayernLB, HSH Nordbank, Landesbank Baden-Württemberg, Sachsen LB, and WestLB (Hochfellner et al. 2015; Popov and Rocholl 2018). Other affected banks are Deutsche Bank, DZ Bank, IKB, HypoVereinsbank, and KfW, as listed in Hüfner (2010). These results are consistent with Huber (2018, Appendices E and F) who discusses why trading losses at other German banks did not have real effects on firms.

[38] We use the estimate $\hat{\beta}_1$ from Table IV, column 3 and measure total sales of affiliates using MiDi.

on other firms in country c, that policy did not endogenously respond to the decrease in affiliate sales, and that exchange rates did not adjust (as in the case of Eurozone countries). The calculation could underestimate the aggregate change if input-output linkages propagated the reduction in affiliate sales to other firms in country c (Acemoglu et al. 2016; di Giovanni et al. 2018). On the other hand, the calculation could overstate the aggregate change if demand shifted from affected affiliates to unaffected domestic firms, if monetary and fiscal policy became expansive, or if the exchange rate adjusted. While the assumptions are unlikely to hold exactly, the aggregation exercise provides a useful way to gauge the magnitude of aggregate changes implied by the affiliate-level estimates and to compare the magnitude across countries.

We present the results of the aggregation exercise in Table VIII. We scale the sales change in a given country by sales of non-financial firms in 2007. The impact of Commerzbank's lending cut on proportional sales growth is strongest in countries close to Germany, where German affiliates account for a large fraction of aggregate sales. For example, aggregate sales fell by 0.37 percent in the Czech Republic, by 0.30 percent in Austria, and by 0.28 percent in Poland. The aggregate change is modest in the US (0.03 percent), because German affiliates play a small role in the US economy. The mean sales decrease in the nine most common locations of German affiliates was 0.14 percent and the median was 0.08 percent.

We can also use our estimates to calculate the decrease in aggregate sales in one country due to a shock that simultaneously hits parents of multinationals in many countries (not just German parents). A global rise in the price of oil or simultaneously occurring domestic banking crises are examples of such shocks. As a thought experiment, consider a shock that affected all parents of affiliates located in the US to the same extent that Commerzbank's lending cut affected German parents. The shock would lower sales of the average international affiliate located in the US by roughly 9.7 percent (Table IV, column 3). The share of non-financial private sector sales by international affiliates located in the US was 10.68 percent in 2007 (BEA and Census Bureau). Therefore, the financial shock hitting all parents would reduce aggregate non-financial private sector sales in the US by roughly 1.03 percent, solely due to the international transmission of the shock through internal networks of multinationals. A similar calculation for the EU implies that sales in the EU non-financial private sector would fall by 2.49 percent. These numbers suggest that the international transmission of shocks through multinationals can have economically significant effects on aggregate outcomes.

VI Conclusion

Internal capital markets of multinational corporations connect firms in countries all over the world. In this paper, we investigate whether multinationals transmit shocks across countries through their internal capital markets. We identify a natural experiment: Certain multinational parents located in Germany were exposed to an exogenous shock to their credit supply when Commerzbank, a large German bank, cut lending. The natural experiment allows us to assess

how a shock to parents causally affected internal capital markets and affiliate outcomes.

We analyze a detailed dataset that reports internal capital market positions between German parents and each one of their international affiliates. We find that multinationals adjusted net capital flows (internal loans and equity investments) away from international affiliates and toward the parent after the parent was hit by the credit supply shock. We also find that short-term claims by affiliates on their parent fell, indicating a decrease in internal trade from affiliates to their parent. Affiliate sales dropped sharply and recovered slowly in subsequent years. Sales of affiliates with larger preexisting internal capital market positions were more strongly affected after the parent was hit. The results suggest that internal capital market positions have strong predictive power for how shocks are transmitted through multinational firms.

The natural experiment in this paper shows that shocks to a single "granular" bank in one country can affect real outcomes all over the world. Furthermore, approximate calculations imply that shock transmission through multinationals can have significant effects on aggregate outcomes. In European countries where German affiliates were responsible for large shares of aggregate sales, the effects of Commerzbank's lending cut on German-owned affiliates reduced aggregate sales by around 0.3 percent. A more synchronized shock that hits multinational parents in many countries at the same time could affect aggregate outcomes in large economies. For example, the estimates imply that aggregate sales in the US could fall by over 1 percent if a large global banking crisis gets transmitted to the US through internal networks of multinationals.

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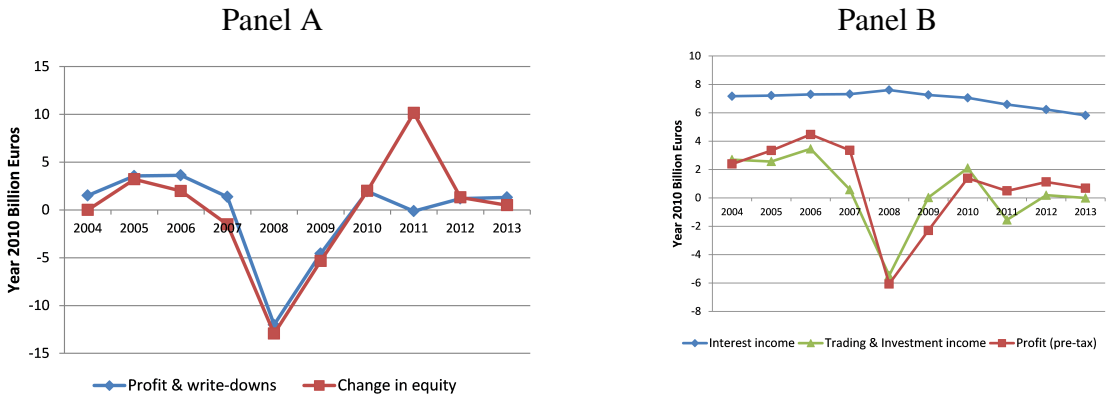
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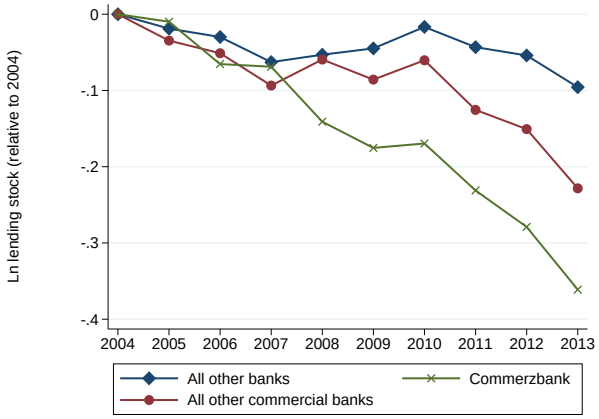
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Figure I: Commerzbank's equity capital, write-downs, and profits



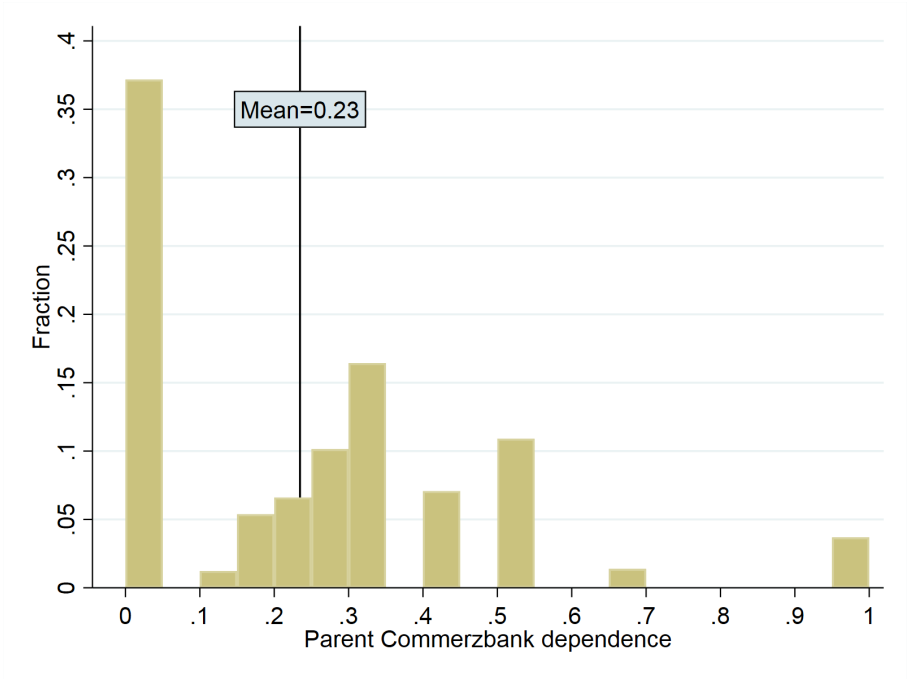
Notes: The left panel shows Commerzbank's profits and write-downs and equity capital. Write-downs arise from changes in revaluation reserves, cash flow hedges, and currency reserves. Panel B shows the composition of Commerzbank's profits. Interest income is interest received from loans and securities 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. The figure is taken from Huber (2018). Data source: bank annual reports, own calculations.

Figure II: The lending stock of German banks



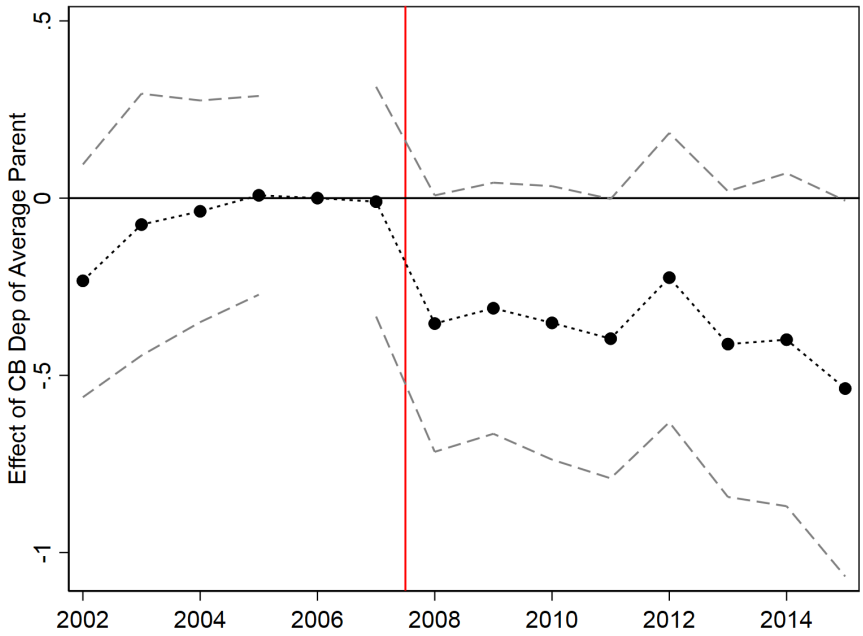
Notes: The figure plots the log lending stock to German non-financial customers for different groups of banks, relative to 2004. The values are in year 2010 billion Euro. We include lending by branches of Commerzbank and Dresdner Bank to calculate lending by Commerzbank (provided in the bank annual reports). 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. The figure is taken from Huber (2018).

Figure III: Parent Commerzbank dependence



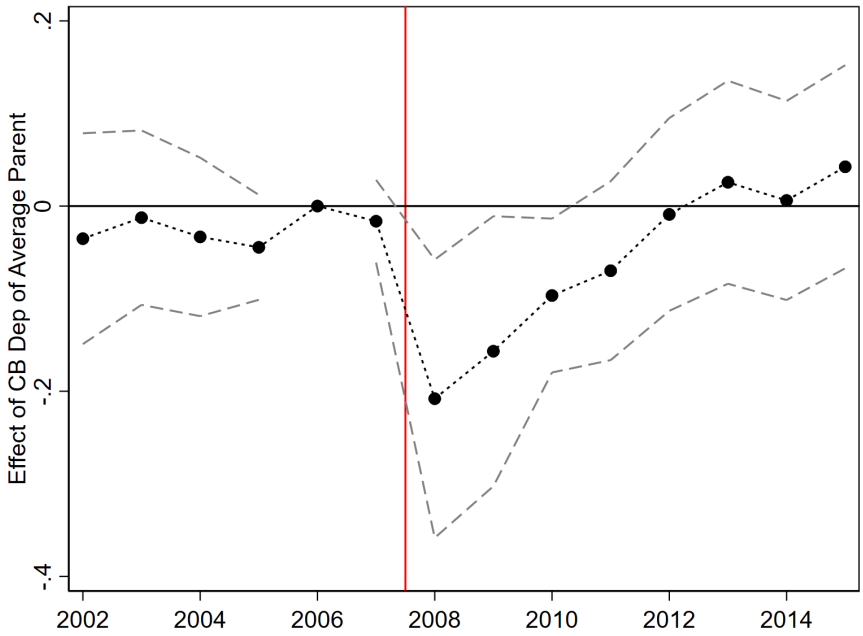
Notes: The figure shows a histogram of Commerzbank dependence for the 655 German parents in our dataset in 2006. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Figure IV: Impact of Commerzbank dependence on parent bank debt



Notes: This figure plots coefficients on parent Commerzbank dependence, interacted with year fixed effects, and 90 percent confidence intervals. The outcome variable is log parent bank debt. The coefficients are scaled to reflect the effect on a parent with average CB dep, which was 0.23. The following time-invariant control variables are calculated for parents in the year 2006 and interacted with a full set of year fixed effects: industry fixed effects, fixed effects for size deciles using the distribution of sales, fixed effects for deciles of leverage, and fixed effects for whether the parent had an affiliate in Asia, the EU, or the US. 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 V: Impact of parent Commerzbank dependence on affiliate sales



Notes: This figure plots coefficients on parent Commerzbank dependence, interacted with year fixed effects, and 90 percent confidence intervals. The outcome variable is log affiliate sales. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, which was 0.23. 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 size deciles using the distribution of sales, fixed effects for deciles of leverage, and fixed effects for whether the affiliate is in Asia, the EU, or the US. 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: Parent summary statistics by bins of Commerzbank dependence

	Range of parent Commerzbank dependence				
	0	0.01-0.30	0.31-0.50	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	388,961	486,493	152,829	395,394
	(1,527,767)	(1,608,385)	(1,881,804)	(515,649)	(1,641,595)
Total assets	535,864	636,072	1,322,907	578,200	831,892
	(2,929,303)	(3,274,836)	(5,253,431)	(2,184,213)	(3,934,859)
Number of affiliates	2.95	3.87	4.56	4.89	3.82
	(4.56)	(6.56)	(6.88)	(9.18)	(6.23)
Bank debt	73,915	46,438	60,743	54,447	59,895
	(197,131)	(151,148)	(145,504)	(96,847)	(161,721)
Trade credit	44,047	38,768	46,579	23,139	42,693
	(159,189)	(174,204)	(142,832)	(64,090)	(155,222)
Leverage (%)	46.38	50.41	48.66	43.67	47.97
	(29.01)	(21.28)	(22.86)	(25.67)	(25.12)
Number of parents	242	153	225	35	655

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

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

	Range of parent Commerzbank dependence				
	0	0.01-0.30	0.31-0.50	0.51-1	Total
Sales	42,184	50,003	65,453	52,495	54,400
	(107,225)	(131,105)	(178,741)	(128,354)	(147,351)
Employment	162	222	200	211	196
	(434)	(530)	(518)	(452)	(496)
Total assets	69,818	75,754	118,448	97,095	93,160
	(280,584)	(303,448)	(426,236)	(353,319)	(357,546)
Leverage (%)	52.10	50.69	52.82	49.18	51.83
	(33.75)	(32.18)	(34.62)	(32.74)	(33.65)
Long-term loans to parent (%)	0.38	0.15	0.44	1.92	0.46
	(3.28)	(2.19)	(3.54)	(7.04)	(3.60)
Equity from parent (%)	14.11	14.07	15.37	15.13	14.69
	(22.82)	(19.26)	(22.45)	(21.33)	(21.71)
Liabilities toward parent (%)	11.24	13.74	13.39	8.37	12.54
	(21.01)	(22.26)	(22.26)	(16.56)	(21.60)
Short-term claims on parent (%)	4.40	4.80	3.81	3.45	4.19
	(12.51)	(12.80)	(11.17)	(10.40)	(11.91)
Ownership share of parent in affiliate	0.878	0.869	0.885	0.842	0.876
	(0.240)	(0.235)	(0.236)	(0.276)	(0.240)
Number of affiliates	721	676	1,100	198	2,695

Notes: The table shows means (standard deviations) by bins of parent Commerzbank dependence. Leverage is defined as liabilities divided by total assets. The reported percentages are percentages of total assets of the affiliate. Sales and total assets are in thousand Euro. The number of affiliates in the bottom row refers to the number of affiliates in MiDi in 2006. The data are from 2006. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table III: Impact of parent Commerzbank dependence on parent bank debt

	(1)	(2)	(3)
CB $\text{dep}_p^{parent} \times d_t^{08\text{-}15}$	−0.3084	−0.3617	−0.3470
	(0.2011)	(0.1920)	(0.1962)
R^2	0.007	0.030	0.041
Number of firms	407	407	407
Observations	4,495	4,495	4,495
Parent FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Size bin FE $\times d_t^{08\text{-}15}$	No	Yes	Yes
Industry FE $\times d_t^{08\text{-}15}$	No	Yes	Yes
Affiliate location FE $\times d_t^{08\text{-}15}$	No	No	Yes
Leverage bin FE $\times d_t^{08\text{-}15}$	No	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log parent bank debt. CB dep_p^{parent} measures the fraction of the parent's bank relationships that were with Commerzbank branches in 2006. The coefficients are scaled to reflect the effect on a parent with average CB dep, which was 0.23. $d_t^{08\text{-}15}$ is a dummy for the years from 2008 to 2015. The following time-invariant control variables are calculated for parents in the year 2006 and interacted with $d_t^{08\text{-}15}$: industry fixed effects, fixed effects for size deciles using the distribution of sales, fixed effects for deciles of leverage, and fixed effects for whether the parent had an affiliate in Asia, the EU, or the US. 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 IV: Impact of parent Commerzbank dependence on affiliate sales

	(1)	(2)	(3)	(4)	(5)
CB $\text{dep}_p^{parent} \times d_t^{08\text{-}10}$	–0.1286	–0.1403	–0.0967	–0.0953	
	(0.0979)	(0.0806)	(0.0489)	(0.0490)	
CB $\text{dep}_p^{parent} \times d_t^{08\text{-}10} \times$ Sales $\text{growth}_{apc}^{06\text{-}07}$				0.0597	
				(0.0280)	
$(0 < \text{CB dep}_p^{parent} \leq 0.3) \times d_t^{08\text{-}10}$					–0.0147
					(0.0258)
$(0.3 < \text{CB dep}_p^{parent} \leq 0.5) \times d_t^{08\text{-}10}$					–0.0554
					(0.0206)
$(0.5 < \text{CB dep}_p^{parent} \leq 1) \times d_t^{08\text{-}10}$					–0.1060
					(0.0564)
CB $\text{dep}_p^{parent} \times d_t^{11\text{-}15}$	0.0574	0.0486	0.0298	0.0333	0.0172
	(0.0527)	(0.0523)	(0.0422)	(0.0427)	(0.0418)
R^2	0.011	0.038	0.092	0.117	0.092
Number of firms	2,695	2,695	2,695	2,244	2,695
Observations	24,941	24,941	24,941	23,143	24,941
Affiliate FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	Yes	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	Yes	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	No	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	No	Yes	Yes	Yes
Sales $\text{growth}_{apc}^{06\text{-}07} \times d_t^{08\text{-}10}$	No	No	No	Yes	No

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. CB dep_p^{parent} measures the fraction of the parent's bank relationships that were with Commerzbank branches in 2006. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, which was 0.23. $d_t^{08\text{-}10}$ and $d_t^{11\text{-}15}$ are indicators for the years from 2008 to 2010 and from 2011 to 2015, respectively. Sales $\text{growth}_{apc}^{06\text{-}07}$ is the affiliate's log sales growth from 2006 to 2007. The following time-invariant control variables are calculated for affiliates in the year 2006 and interacted with both $d_t^{08\text{-}10}$ and $d_t^{11\text{-}15}$: industry fixed effects, fixed effects for size deciles using the distribution of sales, fixed effects for deciles of leverage, and fixed effects for the country of the affiliate. 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: Impact on internal capital market positions between affiliates and parents

	(1) LT loans to parent	(2) Equity from parent	(3) Liabilities toward parent	(4) ST claims on parent
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	0.0867	−0.0465	0.0788	−0.1878
	(0.0508)	(0.0354)	(0.0948)	(0.0929)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	0.1015	−0.0743	0.0050	−0.1437
	(0.0696)	(0.0436)	(0.1410)	(0.1062)
R^2	0.031	0.100	0.043	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
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome in column 1 is log long-term loans by the affiliate to the parent, in column 2 log equity invested into the affiliate by the parent, in column 3 log liabilities of the affiliate owed to the parent, and in column 4 log short-term claims on the parent by the affiliate. The independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, 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: Impact on financial positions between affiliates and non-parents

	(1) LT loans excl. to parent	(2) Equity excl. from parent	(3) Liabilities excl. toward parent	(4) ST assets excl. claims on parent
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	0.0898	0.0153	0.0008	−0.0487
	(0.0774)	(0.0441)	(0.0349)	(0.0197)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	0.0504	0.0024	0.0289	0.0024
	(0.0829)	(0.0526)	(0.0499)	(0.0337)
R^2	0.047	0.074	0.067	0.089
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
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome in column 1 is log long-term loans of the affiliate excluding long-term loans to the parent, in column 2 log equity invested by non-parents, in column 3 log liabilities of the affiliate excluding liabilities owed to the parent, and in column 4 log short-term assets of the affiliate excluding short-term claims on the parent by the affiliate. The independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, 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: Heterogeneous impact by internal capital market positions between affiliates and parents

	(1)	(2)	(3)
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	–0.0647	–0.0305	–0.0265
	(0.0408)	(0.0434)	(0.0415)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Previous long-term loans to $parent_{apc}$	–0.5414		–0.5094
	(0.1774)		(0.1824)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Previous short-term claims on $parent_{apc}$		–0.1244	–0.0751
		(0.0668)	(0.0604)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	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
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Previous long-term loans to $parent_{apc} \times d_t^{08\text{-}10}$	Yes	No	Yes
Previous short-term claims on $parent_{apc} \times d_t^{08\text{-}10}$	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 positive long-term loans to its parent in any year between 2002 and 2007. Column 2 analyzes heterogeneity by whether the affiliate had positive short-term claims on its parent in any year between 2002 and 2007. The remaining independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, 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 VIII: Impact on aggregate sales in affiliate host countries

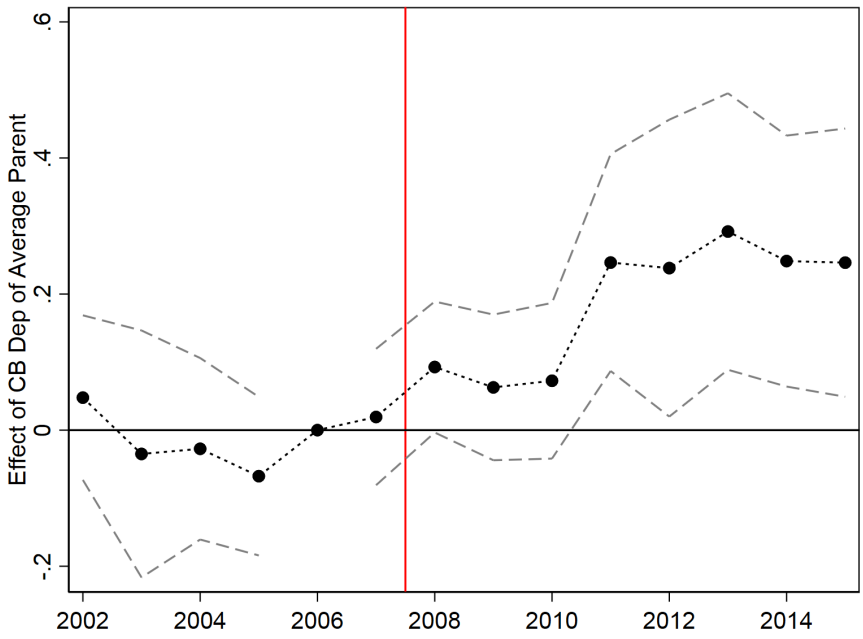
Affiliate country	
Czech Republic	0.37
Austria	0.30
Poland	0.28
Netherlands	0.09
Spain	0.08
France	0.06
United Kingdom	0.05
Italy	0.04
United States	0.03
Mean	0.14
Median	0.08

Notes: The table reports the estimated percent decrease in aggregate sales by non-financial firms due to the effect of Commerzbank's lending cut on affiliates of German multinationals located in the listed country. The mean and median are for the countries listed in the table. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, Eurostat, US Census Bureau, own calculations.

Online Appendix

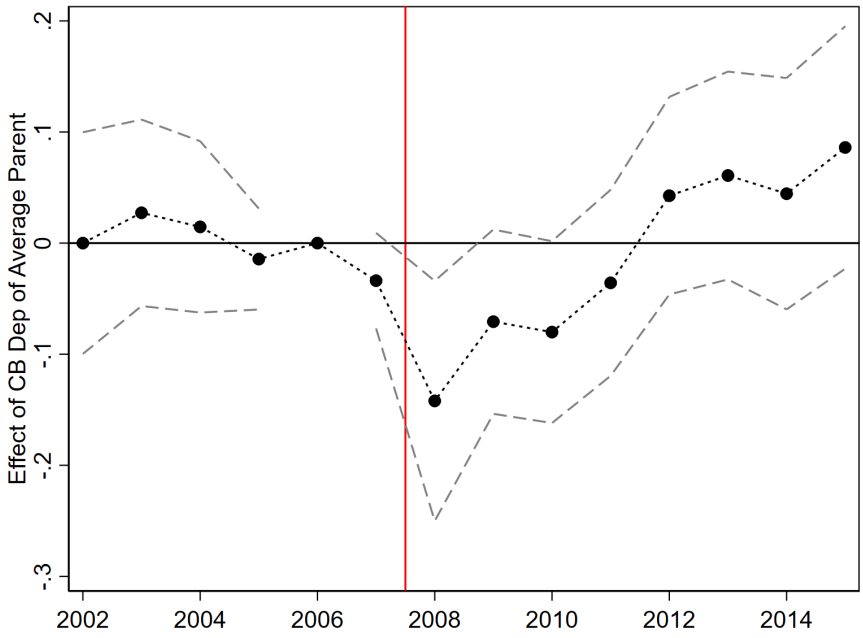
Appendix A: Supplementary Figures and Tables

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



Notes: This figure plots coefficients on parent Commerzbank dependence, interacted with year fixed effects, and 90 percent confidence intervals. The outcome variable is log parent external trade credit. The coefficients are scaled to reflect the effect on a parent with average CB dep, which was 0.23. The following time-invariant control variables are calculated for parents in the year 2006 and interacted with a full set of year fixed effects: industry fixed effects, fixed effects for size deciles using the distribution of sales, fixed effects for deciles of leverage, and fixed effects for whether the parent had an affiliate in Asia, the EU, or the US. Data source: Research Data and Service Centre of the Deutsche Bundesbank, Ustan 2002-2015, Orbis Historical Financials, own calculations.

Figure A.II: Impact of parent Commerzbank dependence on affiliate sales with different controls



Notes: This figure plots coefficients on parent Commerzbank dependence, interacted with year fixed effects, and 90 percent confidence intervals, like Figure V. The controls include country fixed effects instead of fixed effects for Asia, the EU, and the US. The outcome variable is log affiliate sales. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, which was 0.23. 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 size deciles using the distribution of sales, fixed effects for deciles of leverage, and country fixed effects. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

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

Question	Number of relevant reports	Answer yes	Answer no	Answer unclear
1) Was the trading income more volatile than at other German banks from 2004 to 2007?				
- at Commerzbank	11	0	2	9
- at Dresdner Bank	4	0	0	4
2) Was the loan portfolio to German firms and households riskier than at other German banks from 2004 to 2007?				
- at Commerzbank	11	0	11	0
- at Dresdner Bank	5	0	5	0
3) Does the report mention that the trading and lending divisions cross-hedged risk from 2004 to 2009?				
- at Commerzbank	85	0	85	0
- at Dresdner Bank	42	0	42	0
4) Does the report mention that the German loan portfolio contributed to Commerzbank's losses from 2008 to 2009?	83	0	83	0
5) Does the report mention that exposure to Iceland contributed to Commerzbank's losses from 2008 to 2009?	83	8	75	0
6) Does the report mention that exposure to asset-backed securities or the subprime mortgage crisis contributed to Commerzbank's losses from 2008 to 2009?	83	72	11	0
7) Does the report mention that exposure to Lehman Brothers contributed to Commerzbank's losses in 2009?	83	8	75	0
8) Judging in 2008, is Commerzbank's acquistion of Dresdner Bank a strategically sound move?	11	9	1	1
9) Did Commerzbank stabilise 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 nine questions listed in the table. For each question, the table lists the number of relevant reports, i.e., how many reports contain information relevant to the question. The reports for questions 1, 2, 8, and 9 either offer a clear conclusion (Answer yes or Answer no) or give information in support of both sides, without committing either way (Answer unclear). The reports for questions 3 to 7 either explicitly mention that a given factor caused Commerzbank's lending cut or they do not. Hence, there are no unclear relevant reports for questions 3 to 7. After 2008, most reports analyzed Commerzbank and its 2009 acquisition Dresdner Bank jointly, because the acquisition was announced in 2008. So, for the years from 2008 onward, the table lists results only for the enlarged Commerzbank. The table is taken from Huber (2018).

Table A.II: 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 variable 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. The control variables include fixed effects for 36 industries, 16 federal states, 4 size bins (1-49, 50-249, 250-999, and over 1,000 employees in the year 2006), log firm age, and the outcome variable measured in 2006. Standard errors are clustered at the level of the county. 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 table is taken from Huber (2018). Data source: Ifo Institute and own calculations.

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

	CB $\text{Dep}_p^{par} = 0$	CB $\text{Dep}_p^{par} > 0$	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
Other industries	5.27	7.50	6.90
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
Other countries	35.37	47.42	44.19
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.IV: Impact on non-bank external sources of parent financing and parent sales

	(1) Trade credit	(2) Bonds and other debt	(3) Equity	(4) Sales
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	0.0840	−0.0012	−0.0494	−0.1465
	(0.0585)	(0.1431)	(0.0461)	(0.0827)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	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 $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Affiliate location FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome in columns 1 is log parent trade credit, in column 2 log parent bonds and other debt, in column 3 log parent equity, and in column 4 log parent sales. The independent variables are explained in Table III and Table IV. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, which was 0.23. 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.V: Using the inverse hyperbolic sine as outcome variable

	(1) IHS(parent bank debt$_{pt}$)	(2) IHS(affiliate sales$_{apct}$)
CB dep$_p^{parent} \times d_t^{08\text{-}15}$	–0.3702	
	(0.2081)	
CB dep$_p^{parent} \times d_t^{08\text{-}10}$		–0.1034
		(0.0594)
CB dep$_p^{parent} \times d_t^{11\text{-}15}$		0.0282
		(0.0616)
R^2	0.041	0.084
Number of firms	407	2,695
Observations	4,495	24,941
Parent FE	Yes	No
Affiliate FE	No	Yes
Year FE	Yes	Yes
Size bin FE $\times d_t^{08\text{-}15}$	Yes	No
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	Yes
Industry FE $\times d_t^{08\text{-}15}$	Yes	No
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	Yes
Affiliate location FE $\times$ $d_t^{08\text{-}15}$	Yes	No
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}15}$	Yes	No
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variables are inverse hyperbolic sine transformations, defined as IHS(y) $= \ln(y + (y^2+1)^{\frac{1}{2}})$. The outcome variable in column 1 is IHS(parent bank debt). The outcome variable in column 2 is IHS(affiliate sales). The independent variables are explained in Table III (for column 1) and Table IV (for column 2). The coefficients are scaled to reflect the effect of average parent CB dep, which was 0.23. R^2 is the within-firm R^2. Standard errors are clustered at the level of the parent (column 1) and the level of the country and the parent (column 2). Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, Ustan 2002-2015, Orbis Historical Financials, own calculations.

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

	(1) Number of exiting affiliates	(2) Number of new affiliates	(3) Parent exit
CB dep_p^{parent}	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
Size bin FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Affiliate location FE	Yes	Yes	Yes
Leverage bin FE	Yes	Yes	Yes
Number of affiliates in 2006	Yes	Yes	Yes

Notes: The table reports estimates from OLS cross-sectional regressions. The outcome variable in column 1 is the number of the parent's affiliates that exited between 2008 and 2015. The outcome variable in column 2 is the number of affiliates newly added by the parent between 2008 and 2015. The outcome variable 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 independent variables are explained in Table III. We additionally control for the log number of affiliates in 2006. The coefficients are scaled to reflect the effect of average parent CB dep, 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.VII: Heterogeneous impact by economic conditions in affiliate host countries

	(1)	(2)	(3)
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	–0.1080	–0.0994	–0.1061
	(0.0632)	(0.0498)	(0.0472)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Private credit/GDP in 2006 in bottom 10%	–0.1984		
	(0.1225)		
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Private credit/GDP in 2006 in top 10%	0.0276		
	(0.0640)		
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ GDP per capita growth 2007-09 in bottom 10%		–0.0094	
		(0.1228)	
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ GDP per capita growth 2007-09 in top 10%		–0.0382	
		(0.0685)	
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ House price growth 2007-09 in bottom 10%			–0.0063
			(0.0602)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ House price growth 2007-09 in top 10%			–0.0068
			(0.0728)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	0.0298	0.0299	0.0568
	(0.0496)	(0.0496)	(0.0570)
R^2	0.073	0.074	0.065
Number of firms	2,661	2,664	1,906
Observations	24,681	24,718	17,624
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	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 private credit to GDP in 2006 (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 GDP per capita growth from 2007 to 2009 (based on World Bank data). Column 3 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 independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, 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.VIII: Heterogeneous impact by affiliate locations

	(1)	(2)	(3)
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	−0.1054	−0.0748	−0.0913
	(0.0420)	(0.0582)	(0.0539)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Affiliate in Asia	0.0525		
	(0.1122)		
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Affiliate in EU		−0.0393	
		(0.0618)	
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Affiliate in US			−0.0550
			(0.0519)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	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
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. The table analyzes heterogeneity by whether the affiliate was located in Asia, the EU, or the US. The remaining independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, 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.IX: Controlling for parent characteristics and using a balanced panel

	(1)	(2)	(3)
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	−0.0842	−0.1032	−0.1208
	(0.0405)	(0.0451)	(0.0561)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	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
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Parent number of banks FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	No	No
Parent industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	No	Yes	No

Notes: The table reports estimates from OLS panel regressions. The outcome variable 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 independent variables are explained in Table IV. The reported coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, 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: Impact on affiliate employment

	(1)	(2)	(3)	(4)	(5)
CB $\text{dep}_p^{parent} \times d_t^{08\text{-}10}$	–0.0313	–0.0355	–0.0447	–0.0461	
	(0.0312)	(0.0296)	(0.0307)	(0.0302)	
CB $\text{dep}_p^{parent} \times d_t^{08\text{-}10} \times$ Sales $\text{growth}_{apc}^{06\text{-}07}$				0.0249	
				(0.0141)	
$(0 < \text{CB dep}_p^{parent} \leq 0.3) \times d_t^{08\text{-}10}$					0.0040
					(0.0076)
$(0.3 < \text{CB dep}_p^{parent} \leq 0.5) \times d_t^{08\text{-}10}$					–0.0180
					(0.0093)
$(0.5 < \text{CB dep}_p^{parent} \leq 1) \times d_t^{08\text{-}10}$					–0.0555
					(0.0345)
CB $\text{dep}_p^{parent} \times d_t^{11\text{-}15}$	0.0064	0.0186	0.0109	0.0134	0.0057
	(0.0307)	(0.0283)	(0.0271)	(0.0271)	(0.0268)
R^2	0.010	0.036	0.078	0.085	0.079
Number of firms	2,695	2,695	2,695	2,244	2,695
Observations	24,941	24,941	24,941	23143	24,941
Affiliate FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Size bin FE $\times d_t^{08\text{-}10}, d_t^{11\text{-}15}$	No	Yes	Yes	Yes	Yes
Industry FE $\times d_t^{08\text{-}10}, d_t^{11\text{-}15}$	No	Yes	Yes	Yes	Yes
Country FE $\times d_t^{08\text{-}10}, d_t^{11\text{-}15}$	No	No	Yes	Yes	Yes
Leverage bin FE $\times d_t^{08\text{-}10}, d_t^{11\text{-}15}$	No	No	Yes	Yes	Yes
Sales $\text{growth}_{apc}^{06\text{-}07} \times d_t^{08\text{-}10}$	No	No	No	Yes	No

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate employment. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, which was 0.23. The independent variables are explained in Table IV. 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.XI: Previous internal capital market positions between affiliates and parents predict positions after Commerzbank's lending cut

	(1) LT loans to parent	(2) ST claims on parent
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	0.0544	–0.0843
	(0.0340)	(0.0690)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Previous long-term loans to $parent_{apc}$	0.5427	
	(0.2206)	
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Previous short-term claims on $parent_{apc}$		–0.1938
		(0.1094)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	0.0985	–0.1418
	(0.0689)	(0.1058)
R^2	0.035	0.059
Number of firms	2,695	2,695
Observations	24,941	24,941
Affiliate FE	Yes	Yes
Year FE	Yes	Yes
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes
Previous long-term loans to $parent_{apc} \times d_t^{08\text{-}10}$	Yes	No
Previous short-term claims on $parent_{apc} \times d_t^{08\text{-}10}$	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable in column 1 is log long-term loans to parent and in column 2 log short-term claims on parent. Column 1 analyzes heterogeneity by whether the affiliate had positive long-term loans to its parent in any year between 2002 and 2007. Column 2 analyzes heterogeneity by whether the affiliate had positive short-term claims on its parent in any year between 2002 and 2007. The remaining independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on an affiliate whose parent had average CB dep, 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: Controlling for direct lending by Commerzbank in affiliate host countries

	(1)	(2)	(3)
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	–0.1203	–0.1180	–0.1158
	(0.0642)	(0.0526)	(0.0525)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Lending to non-financials from top 3 German banks		0.0512	
		(0.0327)	
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Lending to financials from top 3 German banks			0.0019
			(0.0013)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	–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
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable 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 independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on a parent with average CB dep, 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.XIII: Controlling for incentives to shift taxes and excluding wholesale and retail

	(1)	(2)	(3)	(4)
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	–0.1036	–0.1130	–0.1109	–0.1484
	(0.0493)	(0.0471)	(0.0644)	(0.0773)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Corporate tax rate differential		–0.0020		
		(0.0031)		
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Corporate tax rate higher in Germany			0.0077	
			(0.0525)	
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	0.0114	0.0327	0.0324	0.0442
	(0.0413)	(0.0494)	(0.0493)	(0.0743)
R^2	0.076	0.069	0.069	0.099
Number of firms	2,414	2,393	2,393	1,788
Observations	22,371	22,185	22,185	16,161
Affiliate FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. Column 1 excludes from the sample affiliates in countries classified as tax havens in Gumpert et al. (2016). These locations 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). Column 4 excludes affiliates in wholesale and retail. The remaining independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on a parent with average CB dep, 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: Heterogeneous impact by proxies for internal trade

	(1)	(2)
CB $dep_p^{parent} \times d_t^{08\text{-}10}$	–0.1277	–0.0982
	(0.0733)	(0.0895)
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Vertical affiliate	0.0567	
	(0.0735)	
CB $dep_p^{parent} \times d_t^{08\text{-}10} \times$ Affiliate in service sector		0.0015
		(0.0866)
CB $dep_p^{parent} \times d_t^{11\text{-}15}$	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
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes
Vertical Affiliate FE $\times$ $d_t^{08\text{-}10}$	Yes	No
Services FE $\times$ $d_t^{08\text{-}10}$	No	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. Columns 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 independent variables are explained in Table IV. The coefficients are scaled to reflect the effect on a parent with average CB dep, 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: Impact of other German banks on affiliate sales

	(1)	(2)	(3)
CB $\text{dep}_p^{parent} \times d_t^{08\text{-}10}$	–0.0983	–0.0746	–0.1034
	(0.0476)	(0.0515)	(0.0484)
Landesbank in crisis $\text{dep}_p^{parent} \times d_t^{08\text{-}10}$	–0.0217		
	(0.0450)		
Affected savings bank $\text{dep}_p^{parent} \times d_t^{08\text{-}10}$		0.0820	
		(0.0329)	
Other banks with trading losses $\text{dep}_p^{parent} \times d_t^{08\text{-}10}$			–0.0398
			(0.0410)
CB $\text{dep}_p^{parent} \times d_t^{11\text{-}15}$	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
Size bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Industry FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Country FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes
Leverage bin FE $\times$ $d_t^{08\text{-}10}$, $d_t^{11\text{-}15}$	Yes	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable 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 (Hochfellner et al. 2015; Popov and Rocholl 2018). 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 independent variables are explained in Table IV. The coefficients are scaled by 0.23, which is the average dependence on Commerzbank of parents. 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
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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)

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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

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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.I. The list is taken from Huber (2018).

Appendix B: Theoretical Model

How can a credit supply shock to the parent of a multinational affect the growth of its international affiliates? This section presents a simple model to illustrate how an internal capital market can transmit shocks 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 $i \in \{2, ..., n\}$. Each firm (parent and affiliates) employs capital k_i to generate sales using the production function f_i. Firms belonging to the same multinational may have different production functions, so each production function is indexed by subscript i. 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 $\lim_{k_i \to \infty} f_{i,1}(k_i) = 0$.

Firms use externally borrowed capital b_i to finance production. The cost of borrowing is given by $r(b_i, c_i)$. It is increasing and convex in borrowed capital, i.e., $r_1(b_i, c_i) > 0$ and $r_{11}(b_i, c_i) > 0$, and satisfies $r(0, c_i) = 0$, $\lim_{b_i \to 0} r_1(b_i, c_i) = 0$, and $\lim_{b_i \to \infty} r_1(b_i, c_i) = \infty$. This implies that the marginal cost of borrowing increases with total firm borrowing. A firm's cost of borrowing also depends on credit supply disruptions to the firm, measured by c_i. A credit supply disruption is an increase in c_i. It raises both the total cost of borrowing and the marginal cost of borrowing, i.e., $r_2(b_i, c_i) > 0$ and $r_{12}(b_i, c_i) > 0$.

The objective of the multinational is to maximize the sum of parent and affiliate profits. The key assumption is that 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 in another country. Hence, the budget constraint of the multinational is given by $\sum_{i=1}^{n} [b_i - k_i]$. The optimization problem of the multinational is

$$max_{\{k_i, b_i, \lambda\}_{i=1}^{n}} \sum_{i=1}^{n} [f_i(k_i) - r(b_i, c_i)] + \lambda [\sum_{i=1}^{n} (b_i - k_i)]. \tag{7}$$

The optimization problem delivers the Kuhn-Tucker conditions

$$f_{i,1}(k_i) - \lambda = 0 \quad \forall i, \tag{8}$$

$$r_1(b_i, c_i) - \lambda = 0 \quad \forall i, \tag{9}$$

$$\lambda [\sum_{i=1}^{n} (b_i - k_i)] = 0 \quad \lambda \geq 0. \tag{10}$$

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 differentiate the Kuhn-Tucker conditions with respect to c_1.

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

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

$$\sum_{i=1}^{n}[\frac{db_i}{dc_1} - \frac{dk_i}{dc_1}] = 0. \tag{13}$$

We substitute equations (11) and (12) into equation (13). Solving for $\frac{d\lambda}{dc_1}$ gives

$$\frac{d\lambda}{dc_1} = \frac{r_{12}(b_1,c_1)}{r_{11}(b_1,c_1)}\big[\sum_{i=1}^{n}[\frac{1}{r_{11}(b_i,c_i)} - \frac{1}{f_{i,11}(k_i)}]\big]^{-1}. \tag{14}$$

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 shadow cost of a marginal unit of capital increases in response to the credit supply disruption. We can use this insight to pin down the sign of the partial derivatives of affiliate capital k_i and affiliate borrowed capital b_i:

$$\frac{dk_i}{dc_1} = \underbrace{\frac{d\lambda}{dc_1}}_{>0}\underbrace{\frac{1}{f_{i,11}(k_i)}}_{<0} < 0 \quad \forall i. \tag{15}$$

$$\frac{db_i}{dc_1} = \underbrace{\frac{1}{r_{11}(b_i,c_i)}}_{>0}\underbrace{\frac{d\lambda}{dc_1}}_{>0} > 0 \quad \forall i \neq 1. \tag{16}$$

These equations contain several predictions about the effect of the parent's credit supply shock on affiliates.

1. The production capital of each affiliate falls. Sales are a monotonic function of capital, so affiliate sales also fall. This means that the multinational smooths out the shock to parent credit supply by lowering production of each firm, not just the parent.

2. The reduction in affiliate capital is lower for affiliates where the second derivative of the production function is greater (in absolute terms). The second derivative is greater when the marginal product is greater. So, intuitively, the reduction in capital is lower for affiliates where an additional unit of capital is more productive.

3. Borrowing of each affiliate increases. To compensate for the parent's credit supply disruption, the multinational raises borrowing by all firms.

4. An affiliate's net provision of capital through the internal capital market is given by the difference between affiliate borrowing and affiliate capital. Net capital provision

increases for each affiliate, while it falls for the parent. In practice, increases in net capital provision could happen through higher lending from affiliate to parent or lower equity investments by the parent into the affiliate.