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# Tracing the International Transmission of a Crisis Through Multinational Firms

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MULTINATIONAL FIRMS

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**ABSTRACT**

We show that multinational firms transmit shocks across countries through their internal capital markets. We study a credit supply shock to parent firms in Germany. International affiliates outside Germany supported their parents through internal lending, became financially constrained themselves, and experienced lower real growth. We find that managers were "Darwinist" with respect to international affiliates but "Socialist" in the home country, that internal capital markets transmitted the credit shock more strongly than a non-financial shock, and that access to developed credit markets attenuated the real effects. The total real impact of shock transmission through multinationals on foreign economies was large.

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## I Introduction

The internal capital markets of multinational firms are a key determinant of global capital movements. In recent years, internal capital flows between multinational parent firms and their international affiliates accounted for over 50 percent of total capital inflows in the median country. Internal capital flows are also large relative to aggregate output, amounting to 3.6 percent of GDP in the median country.<sup>1</sup>

Despite their size and ubiquity, it has not been fully established how internal capital markets of multinationals operate and whether they impact the real economy. Do internal capital markets transmit shocks across countries? Which mechanisms and frictions play a role, for example managerial biases, access to external credit markets, different currencies, and geographic distance? Do internal capital markets transmit financial and non-financial shocks differently? How large and persistent are the real effects of internal capital market shocks? Evidence on these questions has been limited because causal identification is challenging and data on internal capital flows are scarce.

We address these questions by combining a quasi-experimental research design with detailed micro data on internal capital positions of German multinationals. We study a lending cut by Commerzbank, a large German bank, which directly reduced the credit supply of parent corporations of multinationals located in Germany, but not the credit supply of international affiliates of these multinationals. We show that German parents indirectly transmitted the credit shock to their international affiliates. Sales and employment of international affiliates with affected parents fell sharply and remained low for three years, relative to unaffected affiliates.

We argue that internal capital markets contributed to shock transmission, as the real effects were concentrated among affiliates that increased internal lending to their parent and became financially constrained themselves. Weak international affiliates were hit more strongly, suggesting that managers of multinationals are relatively "Darwinist" with respect to international affiliates. In contrast, affiliates within Germany were not significantly harmed, even if they were weak, implying that managers are home biased and have relatively "Socialist" preferences toward home country affiliates. Frictions due to currency, geography, and capital controls were not important, but developed external credit markets helped affiliates to partially attenuate the negative real effects.

We calculate that the transmission of Commerzbank's lending cut through multinationals had large effects on countries outside Germany. For instance, the total impact amounted

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<sup>1</sup>Parents and international affiliates together produce 36 percent of global output. Foreign-owned affiliates alone produce 11 percent of output globally, 8 percent in the US, and 21 percent in the EU (OECD Analytical AMNE database for 2016). See Broner et al. 2010 and IMF data.

to roughly 0.4 percent of aggregate sales in Austria and the Czech Republic and 0.1 percent in Spain and the UK. In comparison, a non-financial flooding shock to parents did not have significant effects, suggesting that the internal capital markets transmit financial shocks more strongly.

Identifying the role of multinationals and internal capital markets in shock transmission 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, sell similar products, and share similar productivity, size, and other characteristics (Guadalupe et al. 2012; Fort et al. 2013; Foster et al. 2016). Shocks to common input prices, to common product demand, and to firms with correlated characteristics could generate comovement between parents and affiliates, even if shocks to the parent are not transmitted to affiliates. Common shocks also affect internal capital flows, for example if affiliates transfer revenue to their parent after a common demand shock. In this case, internal capital flows would spuriously co-occur with a demand shock to the parent, but we could not conclude that internal capital markets contributed to shock transmission from parent to affiliate.

We overcome the empirical challenge by studying a shock that directly affected only parents of German multinationals and not their international affiliates. The shock was a lending cut by Commerzbank, a large German bank. Commerzbank experienced significant losses on its financial investments during the 2008/09 financial crisis. The losses were caused by a combination of misjudgments and bad luck in the international investment and trading divisions. Crucially, the origin of the losses was independent of Commerzbank's corporate lending division. We present a range of evidence that firms borrowing from Commerzbank would have been on similar growth paths as borrowers of other German banks, had the lending cut not happened. The lending cut eventually affected corporate borrowers, however, because the losses forced Commerzbank to reduce loan supply to its borrowers.

Commerzbank's exposure to the crisis and its lending cut were severe compared to other German banks.<sup>2</sup> Existing evidence shows that European firms of all sizes, including multinationals, struggle to raise financing when a relationship bank cuts lending (Bentolila et al. 2018; Huber 2018). As a result, Commerzbank's lending cut was an exogenous shock to the credit supply of German firms with a preexisting relationship to Commerzbank, relative to German firms borrowing from other banks. Parents with higher pre-crisis dependence on Commerzbank reduced bank debt, did not use alternative sources of external financing, and experienced lower

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<sup>2</sup>The vast majority of German banks had not invested in international financial markets. A few other banks also suffered losses in 2008/09 (Puri et al. 2011). For idiosyncratic reasons, these other banks did not cut lending or are not well suited to identifying a quasi-experimental shock to firm credit supply, as we discuss in Sections II, VII.G, and Appendix C.

sales from 2008 to 2010. In contrast, the credit supply of international affiliates of these multinationals was not directly affected, since Commerzbank's corporate lending was concentrated in Germany.

We investigate whether Commerzbank's lending cut was indirectly transmitted abroad by German multinationals. We study international affiliates whose German parents were directly hit by the lending cut. Our estimation sample exclusively contains affiliates of German parents in other countries. We test whether affiliates whose German parents were more dependent on Commerzbank grew differently relative to other affiliates. We always compare affiliates located in the same country at the same point in time, so that differences in demand or other country-specific shocks do not affect the estimates.

In the first set of affiliate-level results, we analyze measures of affiliate growth, starting with sales. Capital constraints may lower sales in the short-run through various channels: working capital may pay for variable inputs and labor, fund the distribution of output to points of sales (Chari et al. 1995), and be used to rebuild liquidity buffers (Fazzari and Petersen 1993; Calomiris et al. 1995) at the expense of expenditures generating short-run sales (such as on marketing, distribution, variable inputs). We find that sales of affiliates with greater parent Commerzbank dependence dropped sharply once Commerzbank reduced lending in 2008 and took until 2011 to fully recover. Similarly, employment and holdings of short-term, production-related assets were lower from 2008 to 2010 and recovered after 2011. Short-term assets include, for example, holdings of raw materials, working capital, and other variable inputs into the production and distribution of output. There were no significant effects on external financing (e.g., bank debt or external equity), consistent with the view that financial frictions make it difficult for affiliates to raise funding in the short run (Banerjee and Duflo 2014; Catherine et al. 2022). Taken together, the results show that real outcomes of international affiliates, without a direct borrowing relationship to Commerzbank, were harmed by the shock to Commerzbank.

Several findings suggest that affiliates with greater parent Commerzbank dependence would have evolved in parallel to other affiliates, had Commerzbank's lending cut in Germany not happened. We find no effect for affiliates with positive but low parent Commerzbank dependence because their parents could borrow from other relationship banks. This shows that parent Commerzbank dependence was not generally associated with slow growth. The results are also robust to controlling for country-industry-time fixed effects as well as other characteristics of affiliates and parents (e.g., size, financial ratios, and number of banks) interacted with time. In addition, affiliates with greater parent Commerzbank dependence were not different on observable characteristics, were not on different growth paths before the lending cut, did not borrow directly from Commerzbank, and did not face a credit shock themselves.

In the second set of affiliate-level results, we investigate the response of internal capital market flows through multinationals. Unique data from the Deutsche Bundesbank report detailed internal capital market positions between each international affiliate and their German parent. There is significant heterogeneity in how much affiliates financially interact with the parent. Some affiliates raise funding in their host countries and lend to the parent, while others do not lend internally. We begin by considering affiliates that had issued internal long-term loans to their parent before 2008. Parents had already set up a financial infrastructure to borrow from these affiliates, making it possible to quickly shift capital from these affiliates toward affected parents after 2008. We show that affiliates with previous internal loans strongly increased lending to their parent after the lending cut, but other affiliates did not. Investigating real effects, we find that the reduction in affiliate sales was large and significant for affiliates that had previous internal loans and increased internal lending, but insignificant for other affiliates. This pattern is not driven by other affiliate and parent characteristics. Overall, the results suggest that increases in internal lending played a role in transmitting the lending cut to affiliates.

We also study whether declines in internal trade contributed to decreases in affiliate sales. We construct a proxy for affiliates that traded internally by selling goods to the parent.<sup>3</sup> We find evidence that lower internal sales from affiliates to parent contributed to the sales decline at affected affiliates. At the same time, we show that internal trade does not explain the entire effect. For instance, we control for internal trade credit to the parent and analyze only affiliates that were unlikely to trade with the parent (e.g., affiliates in the same industry as the parent, in the service sector, and not in wholesale and retail industries). In all these specifications, affiliates with greater internal lending suffered large and significant sales declines, while the effects on other affiliates were relatively small and insignificant. Taken together, the results suggest that both internal capital flows and internal trade transmitted the shock to affiliates.<sup>4</sup>

In the third set of affiliate-level results, we examine mechanisms and frictions that shape the response and real effect of internal capital markets. In a standard model, such as the model we present in Appendix B, managers of parents treat international affiliates in a "Darwinist" manner and favor affiliates with the greatest growth potential (Stein 1997; Inderst and Mueller 2003). Consistent with this model, we find that international affiliates with higher growth before the lending cut were significantly less affected by the lending cut to their parent. However,

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<sup>3</sup>The proxy indicates whether affiliates had issued internal short-term claims, a measure for internal trade credit, to their parent before 2008 (Overesch 2006). Below, we confirm the high correlation between internal short-term claims and internal trade credit using German firm data.

<sup>4</sup>Since we analyze multiple outcomes, we show that the results are not driven by a multiple inference problem, using the p-value adjustment developed by Anderson (2008). All adjusted p-values remain below 0.1 if they were below 0.1 without adjustment.

managers seemed to follow a different model within Germany. The negative effects on affiliates located within Germany were relatively weak on average, suggesting that parent managers have home bias. In addition, effects on affiliates within Germany were not associated with growth potential, implying a managerial preference for "Socialism" in the home country (Matvos and Seru 2014). These findings are consistent with models where managers are exposed to power struggles and rent-seeking by affiliates in their home country (Scharfstein and Stein 2000, Rajan et al. 2000), but where these forces are weaker in the case of international affiliates.

We show that credit market frictions shaped the real effects on affiliates, as the effects were weaker in countries with developed credit markets (high credit-GDP ratio). However, we still find a significant decline in affiliate sales in high-credit countries, consistent with the view that affiliates are also borrowing-constrained in developed markets (Lian and Ma 2020). Frictions due to different currencies, geographic distance between parent and affiliate, or local business cycles did not significantly affect the transmission to affiliates, suggesting that multinationals are able to shift capital relatively freely across the world. Moreover, regulation on capital flows did not play an important role, likely because regulation typically does not strictly limit internal capital flows.

In the fourth set of affiliate-level results, we examine how internal capital markets adjusted after a different, non-financial shock to parents in Germany. We identify parents that were hit by a large-scale flood in 2013 but whose relationship banks were still able to lend to them. These parents experienced a reduction in assets, but an increase in bank debt, implying that flooded parents were not financially constrained. We find that international affiliates did not increase internal lending to their flooded parent and that affiliate sales did not significantly fall. These results suggest that internal capital markets transmit financial shocks (like Commerzbank's lending cut) more strongly than non-financial shocks.

In the final step of our analysis, we discuss in which countries the transmission of Commerzbank's lending cut through German multinationals had the largest real impact. Specifically, we calculate how much greater total sales of German affiliates in a given country would have been if affiliates with positive parent Commerzbank dependence had grown at the same rate as affiliates with zero parent Commerzbank dependence. This measure of "impact" amounted to 0.49 percent of aggregate sales in the Czech Republic, 0.36 percent in Austria, and 0.31 percent in Poland.<sup>5</sup> These numbers highlight that a shock to an individual firm in one country (Commerzbank in Germany) can have first-order effects on the distribution of firm

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<sup>5</sup>The impact numbers reported here may not equal aggregate changes because of general equilibrium effects, as we detail below. However, recent research suggests that aggregate changes may be of the same order of magnitude or larger than the negative impacts reported by us (Chodorow-Reich 2014; Huber 2018; Herreño 2020; Sraer and Thesmar 2022).



growth in many other countries, solely because of transmission through the internal networks of multinationals.

## **Related Literature**

A large literature analyzes capital allocation within domestic business groups (Lamont 1997; Shin and Stulz 1998; Gopalan et al. 2007; Boutin et al. 2013; Matvos and Seru 2014; Seru 2014; Almeida et al. 2015; Giroud and Mueller 2015; 2019; Santioni et al. 2020; Giroud et al. 2021). A literature on multinationals shows that affiliates of multinationals outperform domestically owned firms during domestic crises and when domestic capital markets are weak (Desai et al. 2004; 2008; Foley and Manova 2015; Manova et al. 2015; Kalemlı-Özcan et al. 2016). Recently, Boehm et al. (2019) and Bena et al. (2022) find that multinationals transmit shocks across countries, but do not focus on the role of internal capital markets and financial shocks.

Our paper makes several contributions relative to existing work. First, we present evidence that internal capital market flows on their own can transmit shocks across affiliates. Most previous work is consistent with the view that other transmission channels or differences across affiliates are responsible for shock transmission across firms and countries, instead of internal capital markets.<sup>6</sup> We are able to take a step toward isolating the role of internal capital markets because we combine direct data on which affiliates lend internally with a quasi-experiment. Second, we analyze how internal capital flows across countries depend on different frictions than flows within domestic business groups (e.g., "Darwinism" internationally versus "Socialism" at home and cross-country differences in credit markets, currencies, geography, and capital controls.)

Third, we highlight that internal capital markets transmit financial shocks strongly and that recovery takes several years, suggesting a quantitatively important channel through which monetary policy, currency crises, and other financial disruptions propagate across countries. Fourth, we show that internal capital markets transmit non-financial shocks more weakly, implying that the presence of capital constraints determines whether internal capital flows and real transmission effects are large. Fifth, while much of the literature shows that access to internal capital markets reduces volatility, we argue that internal capital flows can also cause financial constraints and thereby harm growth.

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<sup>6</sup>For example, internal trade and the allocation of management, human capital, machinery, and other resources may explain the transmission results in Shin and Stulz (1998), Giroud and Mueller (2019), and Bena et al. (2022). Differences in productivity, human capital of workers, and reliance on domestic inputs may explain why affiliates of multinationals outperform other firms (Bloom et al. 2012; Guadalupe et al. 2012; Setzler and Tintelnot 2021).

The paper also contributes to our understanding of how individual firms affect the international economy. The literature suggests that "granular" firms affect aggregate growth in their home country, as studied theoretically (Gabaix 2011; Acemoglu et al. 2012; di Giovanni and Levchenko 2012; Grassi 2017; Magerman et al. 2017; Carvalho and Grassi 2019) and empirically (di Giovanni et al. 2014; Friberg and Sanctuary 2016; Amiti and Weinstein 2018). We highlight a new mechanism: a shock to an individual firm (in our case, Commerzbank) can impact firms all over the world, even if the shocked firm initially only transmits the shock within its home country. This mechanism is novel because it generates international shock transmission without requiring that a firm is directly connected to other countries.<sup>7</sup> Our methodology differs from existing work because we quantify how important an individual firm can be, rather than the joint impact of all firm-level shocks.

Finally, the results of this paper suggest that comovement of connected countries (Frankel and Rose 1998) and firms (Desai and Foley 2006) can reflect causal shock transmission rather than just common shocks across countries (Imbs 2004).<sup>8</sup> The results also support models where multinationals increase cross-country comovement (Contessi 2010; Zlate 2016; Menno 2017; Tintelnot 2017).<sup>9</sup>

## II The Shock to Commerzbank

This paper investigates how a shock to parents was transmitted internationally. In this section, we describe the specific shock that we analyze: the lending cut of Commerzbank, the second-largest German bank before 2008. Commerzbank's business model focused on corporate lending in Germany (with 96 percent of branches located in Germany). Commerzbank's market share in lending to medium-sized (*Mittelstand*) and large firms in Germany was around

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<sup>7</sup>The mechanism is distinct from the finding that firms comove with foreign countries where they have direct trade or production links (di Giovanni et al. 2018; 2020; Hassan et al. 2023). The mechanism also differs from the result that multinational banks with direct operations in several countries transmit crises internationally (Peek and Rosengren 1997; Peek and Rosengren 2000; Acharya and Schnabl 2010; Cetorelli and Goldberg 2012; Popov and Udell 2012; Schnabl 2012; de Haas and van Lelyveld 2014; Ongena et al. 2015; di Giovanni et al. 2021). Hassan et al. (forthcoming) similarly find that risk is transmitted through channels not captured by direct trade links.

<sup>8</sup>Further evidence on comovement of countries is in Clark and van Wincoop (2001), Baxter and Kouparitsas (2005), Calderón et al. (2007), Burstein et al. (2008), Ng (2010), Abiad et al. (2013), and Liao and Santacreu (2015) and of firms in Budd et al. (2005), di Giovanni and Levchenko (2010), di Giovanni et al. (2014), Kleinert et al. (2015), Cravino and Levchenko (2017), and di Giovanni et al. (2018).

<sup>9</sup>In theory, financial connections can lower comovement (Baxter and Crucini 1995; Kalemli-Özcan et al. 2013; Monnet and Puy 2019) or raise comovement (Morgan et al. 2004; Imbs 2006), depending on whether credit demand or supply shocks are the primary source of fluctuations. In our setting, parents are hit by a financial shock, which raises comovement.

13 percent.<sup>10</sup>

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

Overall, Commerzbank's equity capital fell by a total of 68 percent between December 2007 and December 2009. The drop in equity was entirely due to two components: write-downs on financial instruments and income losses (Figure I, panel A). Write-downs on financial instruments were caused by changes in the valuation of derivatives held by the bank, and can therefore be attributed to the trading and investment divisions. The income losses were also driven by the trading and investment divisions (Figure I, panel B). Interest income, on the other hand, which includes Commerzbank's earnings from lending to firms, remained on an upward trend up to 2009. These figures suggest that Commerzbank's losses were not caused by the corporate lending portfolio. Instead, Commerzbank's corporate borrowers were growing steadily right until Commerzbank cut lending.

Following its trading and investment losses, Commerzbank became financially constrained. It struggled to get wholesale funding in 2008 and was close to its equity threshold. As a result, it cut lending to German borrowers. The closest comparison group to Commerzbank is composed of other German commercial banks. They also operated for profit and had a comparable business model and similar types of borrowers. Commerzbank's lending to German borrowers grew in parallel to other commercial banks and all other German banks until 2007, but fell sharply thereafter (Figure II). In contrast, lending by other German banks actually increased slightly from 2007 to 2009. There was no domestic financial crisis that affected all German banks, for example, there was no housing boom and bust. The majority of German banks suffered less from the 2008/09 financial crisis and were therefore able to continue lending.<sup>11</sup>

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<sup>10</sup>None of the information on individual banks is provided by the Deutsche Bundesbank. Main sources are annual reports of Commerzbank and Dresdner Bank and financial analyst reports listed at the end of Appendix A. Throughout the paper, "Commerzbank" refers to all branches that were part of the Commerzbank network in 2009, including its acquisition Dresdner Bank. Commerzbank had already decided to acquire Dresdner Bank before the crisis hit both banks severely. Both banks suffered significant losses in 2008. Dresdner Bank was more exposed to asset-backed securities, while Commerzbank was more exposed to failing public and institutional debt (including the Icelandic crisis and the Lehman Brothers insolvency). The lending cut affected firms that had banked with the old Dresdner Bank to a similar degree as firms that had banked with the old Commerzbank, so we construct the treatment variable based on relationships to either bank. See Appendix C for more details.

<sup>11</sup>We discuss other banks that made losses in Appendix C and Section VII.G. In any case, focusing on Commerzbank's lending cut is a valid empirical strategy even if other German banks cut lending because aggregate

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

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

The fourth lesson is that Commerzbank's managers recognized the severity of the US mortgage crisis too late, so exposure to US mortgage-related securities contributed to the losses (Credit Suisse Europe 2008). Fifth, the bank's managers believed that governments would prevent large-scale institutional failures of Commerzbank's interbank partners, such as Lehman and the Icelandic banks, so they suffered severe losses when these banks failed (ESN 2009). In combination, these exposures depleted Commerzbank's equity and forced it to cut lending. Commerzbank received equity injections by the government, but these were not quick and large enough to prevent a lending cut altogether. The sixth lesson is that it took Commerzbank until 2010 to fully stabilize. Its lending grew roughly in parallel with other commercial banks from 2010 onward.

### **III Data**

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

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lending by other German banks was stable (Figure II).

### III.A Relationship Banks of German Parents

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

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

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

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

The variable parent Commerzbank dependence is highly correlated with Commerzbank's branching expansions after World War II and after German reunification, which suggests that it captures Commerzbank dependence accurately (Huber 2018). Mean parent Commerzbank dependence was 0.23 and about 40 percent of parents had zero Commerzbank dependence (Figure III).<sup>12</sup>

### III.B MiDi

The data underlying MiDi are collected by Deutsche Bundesbank as part of its supervisory duties. German parents have to report an international affiliate to Deutsche Bundesbank if they hold at least 10 percent of an affiliate's equity and if the affiliate's total assets exceed 3 million

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<sup>12</sup>We cannot match data on the bank relationships of international affiliates to the MiDi data. However, we show using several tests that affiliates were not directly exposed to Commerzbank's lending cut in Section VII.G.

Euro. These reporting criteria have been constant since 2002, so we use data from 2002 until 2015, the most recent year at the time of data provision.

A remarkable feature of MiDi is that it contains detailed balance sheet positions on internal capital market positions between affiliates and parents. We can see annual measures of long-term loans from affiliate to parent, equity invested by the parent, total liabilities owed to the parent by the affiliate, and short-term claims by the affiliate on the parent. MiDi also includes annual data on affiliate balance sheets, sales, employment, and industry.<sup>13</sup>

Our estimation sample includes all affiliates that were directly owned by a German parent in 2006, the final year before the US housing market crisis. We remove affiliates in the financial sector from the sample. Using a unique firm identifier, we match parents' relationship banks to MiDi (Schild et al. 2017). We match the relationship banks for 26.4 percent of parents in MiDi. The other parents do not appear in the data on relationship banks. The affiliates of matched parents were responsible for 70.8 percent of total sales by international affiliates in MiDi in 2006.<sup>14</sup> Overall, there are 655 German parents and 2,695 international affiliates in our data. The foreign direct investment of German parents was the third largest in the world in 2006, so the data contain affiliates located all over the world.

### III.C Ustan

Ustan is a dataset of annual balance sheets of non-financial German parents. The data are collected by the Deutsche Bundesbank as byproduct of its lending activity (Becker et al. 2019). Ustan is also available from 2002 to 2015. Some parents that appear in MiDi do not appear in Ustan, so we supplement Ustan with data from Bureau van Dijk Orbis Historical Financials for these parents. Overall, we have balance sheet data on 407 of the 655 German parents in MiDi. The average parent had 3.8 international affiliates in 2006. There was no significant association between parent Commerzbank dependence and parent characteristics, conditional on parent industry (Table A.II). Parents with Commerzbank dependence between 0.26 and 0.5 were on average larger, which arises mechanically because larger parents have more relationship banks (Table A.III).

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<sup>13</sup>We winsorize all outcome variables at the 1st and 99th percentiles of their distribution to mitigate the impact of outliers. However, this step is not essential, as we find similar coefficients without winsorizing. Since some outcome variables are in logs and contain a handful of zeros, we add 1 unit (1,000 Euro) to all log outcome variables throughout the paper. In robustness checks, we use a different transformation of the outcome variable, the inverse hyperbolic sine. Table A.VII and Table A.XXIV show that results remain similar. The inverse hyperbolic sine of  $y$  is defined as  $IHS(y) = \ln(y + (y^2 + 1)^{\frac{1}{2}}) \approx \ln(2) + \ln(y)$ , so that first differences can be interpreted as approximate log changes (Burbidge et al. 1988; MacKinnon and Magee 1990; Chen 2013; Arcand et al. 2015).

<sup>14</sup>We do not find heterogeneity in our estimates with respect to parent size, suggesting that the match with larger parents does not systematically affect the estimates.

### **III.D Financial Statistics of Affiliates**

The average affiliate was medium-sized, with annual sales of 54 million Euro and 196 employees (Table I). It raised substantial financing on its own. For example it borrowed from banks in its host country, as 76 percent of liabilities were owed to external, non-parent lenders. Some affiliates lent funds to their parents, while others did not lend internally. We describe and analyze internal lending positions in detail in Section VI.<sup>15</sup> On average, parents owned 88 percent of an affiliate's equity. They therefore had the ability to influence affiliates' financial decisions and steer internal lending.

There was no significant association between affiliate characteristics (sales, employment, leverage, internal capital positions, and parent ownership share) and parent Commerzbank dependence, conditional on affiliate country and industry (Table A.IV). The only statistically significant coefficient is on total assets, but the point estimate is small, implying that a one percent increase in assets is associated with a 0.00013 increase in parent Commerzbank dependence. Affiliates of parents with positive Commerzbank dependence also operated in similar industries as affiliates with zero parent Commerzbank dependence (Table A.V, top panel).<sup>16</sup> 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.V, bottom panel).

## **IV Empirical Strategy**

In this section, we outline how we trace the effects of Commerzbank's lending cut across countries. In short, we identify effects on multinational parents borrowing from Commerzbank in Germany and then investigate the effects on international affiliates.

### **IV.A Empirical Challenge**

The empirical challenge in identifying the transmission of shocks is that, in general, there are unobserved shocks that simultaneously hit parents and their affiliates. Consider a global

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<sup>15</sup>To gauge how internal lending depends on borrowing costs, we regress net lending by an affiliate to the parent on the interest rate spread in the affiliate host country (difference between lending and deposit rate). A greater spread indicates that the average cost of external borrowing is greater. We find that affiliate net lending falls with the spread (Table A.VI, columns 1 and 2), while funding by the parent rises with the spread (columns 3 and 4).

<sup>16</sup>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.

decrease in demand for a particular car model produced by a German multinational. The parent that produces the less popular model in Germany would produce and sell fewer cars in Germany. At the same time, affiliates that produce the same model in other countries would produce and sell fewer cars in their host countries. Even without a causal transmission channel from parent to affiliates, parent and affiliate growth would comove.

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

Common shocks could also lead to the spurious concurrence of internal capital market flows with shocks to the parent. For instance, if both affiliate and parent experience a shock to the demand for their products, the affiliate may transfer some of the extra revenue to its parent. As a result, an internal capital flow would appear simultaneously with a shock to the parent, although the internal capital flow was not triggered by the shock to the parent and did not contribute to shock transmission from parent to affiliate.

#### **IV.B Commerzbank's Lending Cut and Relationship Banking**

To overcome the challenge of common shocks, we need to identify a shock that affected only parents, but did not directly impact international affiliates. Commerzbank's lending cut during the financial crisis 2008/09 provides such a shock.

A subset of German parents had Commerzbank as relationship bank. A large theoretical literature shows that relationship banks gain an informational advantage from their longstanding dealings with relationship borrowers (Sharpe 1990; Boot 2000). This reduces asymmetric information and improves banks' monitoring capabilities. But the informational advantage creates an adverse selection problem when borrowers want to find new lenders. New potential lenders suspect that firms not getting loans from their existing relationship bank are of low quality. This problem is particularly severe in a recession like the 2008/09 crisis when default rates are high (see also Slovin et al. 1993, Lemmon and Roberts 2010, and Alfaro et al. 2021). At the time, it was not generally known that Commerzbank's losses were caused by external factors and not the performance of German borrowers. As a result, Commerzbank's borrowers struggled to get credit when their bank cut lending.

Commerzbank's corporate lending was concentrated on borrowers in Germany. The bank credit supply of international affiliates of German multinationals was therefore not directly



harmed by Commerzbank's lending cut.<sup>17</sup> In our main analyses, we compare the growth of affiliates, whose German parents were relatively dependent on Commerzbank for financial services, to the growth of other affiliates, whose German parents had lower or zero Commerzbank dependence.<sup>18</sup> Our estimation sample exclusively contains affiliates of German multinationals located outside Germany. We always compare affiliates located in the same country at the same time.

#### **IV.C Commerzbank's Lending Cut Affected German Parents**

Our empirical strategy requires that Commerzbank's lending cut reduced the credit supply of German parents for whom Commerzbank was an important relationship bank. Existing evidence already suggests that multinational parents in Europe depend on the credit supply of their relationship banks, for instance Bentolila et al. (2018) for Spain, Huber (2018), Berg et al. (2021), and Fraccaroli and Pizzigolotto (2022) for the case of Commerzbank, and general media reports on German multinationals (e.g., Reuters 2008; 2018). While these papers already support our empirical approach, it may still be useful to examine the Ustan dataset.

The Ustan data contain 407 German parents, a relatively small number compared to the population of parents that are represented in our main dataset MiDi (which contains affiliate-level data). The small sample naturally implies that the results are less precise than previous papers. Nonetheless, all estimates suggest that parents with higher Commerzbank dependence faced a credit shock after the lending cut.

The main treatment variable is parent Commerzbank dependence in 2006. We find that the total bank debt of parents with greater Commerzbank dependence fell after Commerzbank's lending cut. The estimate is significant at the 10 percent level and implies that bank debt of the average parent with a Commerzbank relationship was 34.7 log points (roughly 29 percent) lower after the lending cut (Table A.VII, column 1).<sup>19</sup> Before the lending cut, there was no

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<sup>17</sup>To support this point, we show in Section VII.G that affiliates with greater parent Commerzbank dependence did not reduce borrowing from banks after Commerzbank's lending cut. Moreover, the results are robust to excluding countries where Commerzbank had an international office or business dealings with local banks.

<sup>18</sup>We estimate the reduced-form impact of the lending cut on affiliates and do not estimate the structural relationship between bank loans and borrower outcomes. The reason is that a lending cut can affect borrowers 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.

<sup>19</sup>Figure A.I implies that the effects on parents' bank debt persisted until 2015, even though Commerzbank recovered by 2011 (Section II). An explanation for the persistence could be that parents voluntarily reduced their bank debt after the lending cut, because managers 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

association between parent Commerzbank dependence and bank debt growth, including during the 2003 recession (Figure A.I). This shows that parents with higher Commerzbank dependence were on parallel growth paths to other parents and not more cyclical. Results using survey data from the Ifo institute confirm this view. During Commerzbank's lending cut, firms with higher Commerzbank reported more restrictive bank loan supply, compared to firms with other relationship banks, but not during the previous years (Table A.VIII).

Parents were unable to compensate for the lost bank debt using non-bank financing. Between 2008 and 2010, parents did not raise more external trade credit (from outside the multinational), bonds and other forms of debt, or equity (Table A.IX, columns 1-3). After 2011, external trade credit increased (Figure A.II, significant at 1 percent). The point estimate implies that parents compensated for around 79 percent of the lost bank debt using external trade credit after 2011, supporting the view that it takes time to raise external credit (Antràs and Foley 2015; Paravisini et al. 2015). Consistent with this timing, parent sales were lower from 2008 to 2010 (significant at 10 percent), but recovered after 2011 (Table A.IX, column 4). Taken together, the results suggest that parents became financially constrained and it took them until roughly 2011 to overcome the constraints.

For the remaining analysis of this paper, we take as the starting point the observation that Commerzbank's lending cut caused an exogenous financial shock to German parents. We then investigate whether the shock to parents was transmitted through internal capital markets and affected international affiliates.

#### **IV.D Support for the Affiliate-Level Identification Assumption**

Our empirical analysis tests whether affiliates with high parent Commerzbank dependence grew more slowly and increased internal lending after Commerzbank's lending cut. The main treatment variable is the Commerzbank dependence of the German parent in 2006. Our analysis identifies the causal effect of parents' exposure to the lending cut under a parallel-trends assumption: affiliates whose parents had high Commerzbank dependence would have evolved in parallel to other affiliates had the parents not been exposed to Commerzbank's lending cut.

Several factors suggest that this assumption holds. First, Commerzbank's lending cut was exogenous to German parents and their international affiliates, as detailed in Section II. Second, affiliates with greater parent Commerzbank dependence were on parallel growth paths right until Commerzbank's lending cut (Figure IV). This suggests that they were facing the same

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alternative means of financing after 2009 because bank loan supply had proven to be risky (Fuchsbriefe 2018). The bank debt point estimate is also relatively large, although at the 90 percent level we cannot reject the possibility that the effect of parent bank debt was just as large as Commerzbank's lending cut.

types of shocks and would have continued to grow in parallel without the lending cut.

A third factor supporting the identification assumption is that we can control for key confounders and determinants of product demand. For example, country-specific shocks have no effects on our estimates because we always include country-time fixed effects. The findings are also robust to several additional control variables, such as country-industry-year fixed effects and affiliate size, financial ratios, and number of banks interacted with time.

In addition, the average characteristics of affiliates were balanced across bins of parent Commerzbank in 2006 (see Section III.D). All our specifications include affiliate fixed effects, so hypothetical differences in affiliate characteristics would be automatically controlled for. Nonetheless, the balanced characteristics are helpful because they imply that affiliates with high parent Commerzbank dependence were not fundamentally different from other affiliates.

## V The Effect on Affiliate Growth

We investigate whether the disruption to parents' credit supply, due to Commerzbank's lending cut, affected the growth of international affiliates.

### V.A Affiliate Sales Over Time

We begin by studying affiliate sales over time. Capital constraints can affect sales in the short run through several channels. First, a shock to the availability of working capital may force affiliates to reduce variable inputs and labor, lowering their sales (Chari et al. 1995). Second, a negative shock to working capital may force firms to halt the transport of products to customers, which immediately harms their sales. Third, firms maintain working capital stocks as liquidity buffers to guard against unexpected shocks (Calomiris et al. 1995). When working capital falls, firms may elect to rebuild their liquidity buffers by halting expenditures that generate sales (e.g., on variable inputs, marketing, and distribution). Finally, working capital may pay for investment into factors of production, like machinery (Fazzari and Petersen 1993). Sales is also an interesting outcome with respect to aggregate growth because aggregate value added equals sales of final-use products.

We use the following specification for sales  $y$  of affiliate  $a$  located in country  $c$  in year  $t$ :

$$\begin{aligned} \ln(y_{act}) = & \sum_{\tau=2002}^{2015} \beta_{\tau} \times \text{Parent CB dep} \times \mathbb{1}(t = \tau) + \gamma_a + \lambda_t + \\ & + \sum_{\tau=2002}^{2015} \phi'_{\tau} \times X_{ac} \times \mathbb{1}(t = \tau) + \varepsilon_{act}. \end{aligned} \tag{2}$$

The treatment variable of interest is parent Commerzbank dependence, measured in 2006, the final year before the US housing market crisis. The coefficients of interest  $\beta_\tau$  measure the effect (in log points) of parent Commerzbank dependence in year  $\tau$  relative to 2006.

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

We plot the relationship between affiliate sales and parent Commerzbank dependence for a parent with average Commerzbank dependence, relative to the pre-crisis baseline year 2006 and conditional on all controls interacted with year fixed effects (Figure IV). The point estimates for the years before 2008 are all close to zero. This shows that affiliates whose parents had higher Commerzbank dependence were on parallel trends to other affiliates, consistent with the identification assumption.

After Commerzbank cut lending to German parents in 2008, sales of affiliates with greater parent Commerzbank dependence fell sharply, relative to other affiliates. Their sales recovered partially in the subsequent year, but still remained below the levels of other affiliates in 2009 and 2010. From 2011 onward, the levels were similar again. Taken together, the dynamic pattern in the graph suggests that sales of affected affiliates were lower from 2008 to 2010, but recovered from 2011 onward.

## V.B Affiliate Sales Fell Temporarily

We test formally whether Commerzbank's 2008 lending cut lowered the sales of international affiliates temporarily by estimating the effect separately for two periods, 2008 to 2010 and 2011 to 2015:

$$\ln(y_{act}) = \beta_1 \times \text{Parent CB dep} \times \mathbb{1}(2008-10)_t + \beta_2 \times \text{Parent CB dep} \times \mathbb{1}(2011-15)_t + \gamma_a + \lambda_t + \phi'_1 \times X_{ac} \times \mathbb{1}(2008-10)_t + \phi'_2 \times X_{ac} \times \mathbb{1}(2011-15)_t + \varepsilon_{act}. \quad (3)$$

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

The point estimate implies that sales of affiliates whose parents had average Commerzbank dependence were on average 9.7 log points (roughly 9 percent) lower between 2008 and 2010 (significant at the 5 percent level), relative to affiliates whose parents had zero Commerzbank dependence (Table II, column 3). Comparing the relative magnitudes of affiliate and parent effects (from Table A.IX, column 4), we find that a shock lowering parent sales by 10 percent reduced affiliate sales by 6.6 percent. The estimate for 2011 to 2015 is small, positive, and statistically insignificant. This confirms that affected affiliates recovered to the level of unaffected affiliates after 2011. The point estimates in the specifications with fewer controls are similar to the baseline effect (columns 1 and 2). This suggests that affiliates with greater parent Commerzbank dependence were not hit by different shocks, in line with the parallel-trends identification assumption. The smaller standard errors in column 3 suggest that the controls soak up a significant amount of noise.

### **V.C Effect on Affiliates Depends on Parents' Alternative Relationship Banks**

Some parents that had Commerzbank as relationship bank also relied on other German relationship banks in 2006. The vast majority of these other banks continued to lend during the crisis (Figure II). We plot the effects on affiliate sales from 2008-10 separately for five quintiles of parent Commerzbank dependence (Figure V). The excluded bin is for affiliates with zero parent Commerzbank dependence (see Appendix D for details).

The point estimates for affiliates with parent Commerzbank dependence in the bins up to 0.25 are small and insignificant. In contrast, point estimates are negative, significant, and of roughly equal magnitude for the two bins between 0.25 and 0.5. Finally, the coefficient for the top quintile of affiliates above 0.5 is the largest and also significant. These results show that multinationals were able to substitute missing credit from Commerzbank in case they had other, preexisting relationship banks. As a result, the effects on affiliates are not driven by all affiliates whose parents had some dependence on Commerzbank, but by affiliates of parents with relatively high dependence.

### **V.D Affiliate Exit and Employment**

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

after 2011.

Similar to the evolution of sales, the employment point estimates imply an employment drop of 4.5 log points (roughly 4 percent) from 2008 to 2010 and a recovery after 2011 (Table A.XI, column 1). The linear coefficient is insignificant but the effect is significant for affiliates between 0.25 and 0.5 (column 2) and for all affiliates above 0.25 (column 3).

### **V.E Affiliates Short-Run Inputs and Production Capital**

Short-term assets include inputs into short-run production and sales, such as holdings of raw materials and other variable inputs; working capital to pay for employees, suppliers, and the distribution of products to points of sales; trade credit issued to external customers; and liquidity buffers against shocks. We find that affiliates reduced their stock of short-term assets from 2008 to 2010 (Table III, column 1). The point estimate implies a decrease of 4.9 log points from 2008 to 2010 (roughly 5 percent, significant at the 5 percent level). Short-term assets fully recovered after 2011 (insignificant point estimate of 0.002).

The reduction in short-term assets is consistent with the view that affiliates became capital constrained after Commerzbank's lending cut, which led them to reduce short-run inputs. Accordingly, the evolution of short-term assets over time mirrored the evolution of sales, with a reduction from 2008 to 2010 and full recovery thereafter.

We show that production capital (including tangible and intangible assets) was 2 log points lower from 2008 to 2010, but the effect is imprecisely estimated (column 2). The slightly weaker point estimate for production capital, relative to short-term assets, may be due to the fact that affiliates do not typically engage in large investment projects and innovation on their own, so that affiliates were starting from a low baseline of potential projects.<sup>20</sup> In general, in response to a temporary shock, firms may find it optimal to reduce short-term assets, which primarily harms short-run sales, by more than production capital, which can harm sales over a longer period of time (see Mezzanotti and Simcoe 2022).

### **V.F Affiliates Did Not Raise External Financing**

We find that affiliates did not reduce external long-term loans to non-parents (Table III, column 3). This would have required early repayment of long-term loans by external borrowers, which is difficult to enforce.

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<sup>20</sup>For instance, Gumpert et al. (2023) find that international affiliates of German multinationals essentially carry out no innovation investments themselves.

There was also no change in affiliates' external liabilities, which includes borrowing from banks, and equity raised from non-parents (columns 4 and 5). Both coefficients are close to zero and insignificant. These estimates suggest that, on average, affiliates were not able to use external funding to overcome their capital constraints. This view is supported by a large literature showing that firms in many countries are borrowing constrained and unable to raise additional external financing in the short term when hit by a shock (for overviews, see Banerjee and Duflo 2014; Catherine et al. 2022), likely due to asymmetric information problems.

## VI The Importance of Internal Capital Markets

This section shows that internal capital markets responded to the shock to parents' credit supply and that real effects were concentrated among affiliates that increased long-term lending to the parent.

### VI.A Affiliates With Greater Long-Term Loans to the Parent

We conduct a heterogeneity analysis. We use preexisting internal capital positions to assign affiliates to two heterogeneity categories. Using preexisting positions is preferable to using actual changes in internal capital flows because actual changes are endogenous to other shocks hitting affiliates.

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

$$\begin{aligned} \ln(y_{act}) = & (\beta_1 + \beta'_1 \times \text{het}_{ac}) \times \text{Parent CB dep} \times \mathbb{1}(2008-10)_t \\ & + \beta_2 \times \text{Parent CB dep} \times \mathbb{1}(2011-15)_t + \gamma_a + \lambda_t \\ & + \phi'_1 \times X_{ac} \times \mathbb{1}(2008-10)_t + \phi'_2 \times X_{ac} \times \mathbb{1}(2011-15)_t + \varepsilon_{act}. \end{aligned} \quad (4)$$

The indicator variable  $\text{het}_{ac}$  identifies whether an affiliate falls into the given heterogeneity category. The coefficient  $\beta_1$  estimates the effect of parent Commerzbank dependence from 2008 to 2010 on affiliates that do not fall into the given heterogeneity category, while  $\beta'_1$  measures the additional effect from 2008 to 2010 on affiliates that fall into the category. We add  $\text{het}_{ac}$  to the control variables, interacted with the indicator for 2008 to 2010. This avoids bias if there were shocks that affected all affiliates in the given heterogeneity category independently

of their parent Commerzbank dependence.

In a specification without the heterogeneity term, we find a positive effect on internal loans by affiliates to the parent. Affiliates with average parent Commerzbank dependence increased long-term loans by 8.7 log points from 2008 to 2010 (roughly 9 percent, significant at the 10 percent level), relative to affiliates with zero parent Commerzbank dependence (Table IV, column 1). Since the average parent owned 88 percent of an affiliate, parents were likely able to direct affiliates to increase internal lending. In column 2, we include the heterogeneity term. We find that the effect on long-term loans was driven by affiliates with previous long-term loans before 2008. The coefficient on the interaction between previous loans and parent Commerzbank dependence is positive, large, and significant at the 5 percent level. Affiliates that had previously lent to their parent increased internal lending to their parent by more from 2008 to 2010.

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

We consider whether other characteristics of affiliates with previous long-term loans can explain this finding. Affiliates with previous loans had similar size and pre-growth to other affiliates (Table A.XII). Parents held a marginally larger ownership share in these affiliates and these affiliates were slightly more levered, although the point estimates are small. This is consistent with the view that parents are able to withdraw internal lending from affiliates over which they have more control and that these affiliates become marginally more levered to lend to the parent. However, the effects on affiliate growth are stable when conditioning on all these characteristics. We also find no evidence that the heterogeneous effects with respect to previous long-term loans are driven by leverage or short-term claims on the parent (relative to affiliate assets).

## **VI.B Affiliates With Greater Short-Term Claims on the Parent**

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



to the parent.<sup>21</sup>

Without testing for heterogeneity, we find that affiliates with average parent Commerzbank dependence reduced short-term claims by 18.8 log points from 2008 to 2010 (roughly 17 percent, significant at the 5 percent level), relative to affiliates with zero parent Commerzbank dependence (Table IV, column 3). A likely explanation is that financially constrained parents demanded fewer production inputs from affiliates. This slowed internal trade and therefore short-term claims by affiliates on their parent. The slowdown in short-term claims was larger for affiliates with previous short-term claims. The interaction between previous short-term claims and parent Commerzbank dependence is negative and significant at the 10 percent level (column 4). This confirms that affiliates with previous short-term claims were more exposed to a slowdown in internal trade with the parent. We also find that the effect on sales was larger for affiliates with previous short-term claims (significant at the 10 percent level), relative to affiliates without short-term claims (Table V, column 2). This suggests that the reduction in internal trade played a role in lowering affiliate sales.

### **VI.C The Importance of Long-Term Loans to the Parent**

To compare the effects of internal lending and internal trade, we include both heterogeneity categories in one specification. The additional effect on affiliates with previous long-term loans remains large and significant at the 1 percent level (Table V, column 3). The additional effect on affiliates with previous short-term claims becomes insignificant, but remains of similar magnitude. These estimates are consistent with the view that greater internal lending contributed to the transmission of the lending cut to affiliates, while internal trade may have also played a role.

For completeness, we also examine the remaining observable internal capital positions. We find that equity invested by the parent into the affiliate and liabilities owed to the parent did not change significantly from 2008 to 2010 (Table A.XIII).<sup>22</sup> A likely reason is that equity divestment is a relatively slow and cumbersome process. Moreover, affiliates where the parent held a larger equity share did not experience faster drops in equity and sales (Table A.XIV). Taken together, the evidence suggests that affiliates primarily transferred capital to their parent by increasing internal lending.

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<sup>21</sup>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.

<sup>22</sup>The Deutsche Bundesbank data do not differentiate between long- and short-term liabilities owed to parents.

## **VII Mechanisms and Frictions Driving Internal Capital Market Flows**

We analyze which mechanisms and frictions determine flows through internal capital markets and their real effects.

### **VII.A "Darwinism" Among International Affiliates**

In standard models where parent managers maximize total profits of the multinational, parent managers are "Darwinist" and allocate a higher level of capital to affiliates with high growth potential (Stein 1997; Inderst and Mueller 2003). In such models, a negative credit shock to the parent has weaker effects on affiliates with high growth potential, as we show theoretically in Appendix B. However, in models where affiliates engage in rent-seeking (Scharfstein and Stein 2000) or power struggles (Rajan et al. 2000), parent managers may be relatively "Socialist" and treat all affiliates equally (Matvos and Seru 2014).

We analyze which model applies to multinationals by testing heterogeneity with respect to affiliates' pre-crisis sales growth from 2006 to 2007. We find that affiliates with higher pre-crisis growth were less affected by their parent's Commerzbank dependence (Table VI, column 1). The interaction effect between pre-crisis growth and parent Commerzbank dependence is positive and significant at the 5 percent level. This suggests that parent managers treat international affiliates in a "Darwinist" manner, so that international affiliates with high growth potential are harmed less.

### **VII.B Home Bias and "Socialism" Among Affiliates Within Germany**

We examine whether German multinationals also transmitted negative effects to their domestic affiliates located within Germany. For this analysis, we construct a dataset of affiliates that were located in Germany and owned by a German multinational parent. Specifically, we use Orbis Historical Financials to measure sales of German firms that were at least 50 percent owned by a German firm with at least one foreign affiliate. We use 2007 to measure ownership, as it is the first year with data in Orbis. We do not have detailed data on internal capital markets within Germany because the Bundesbank data only cover international affiliates.

We find a negative coefficient on parent Commerzbank dependence in a sample of only domestic affiliates (Table VII, column 1). However, the estimate is close to zero and statistically insignificant. This finding suggests that managers of German multinationals have "home bias," so that they disproportionately transmit harmful shocks to international affiliates rather than

domestic affiliates.<sup>23</sup>

We investigate further whether parents transmitted negative effects disproportionately to domestic affiliates with high pre-crisis growth. The interaction effect between pre-crisis growth and parent Commerzbank dependence is also statistically insignificant (Table VII, column 2). If anything, the sign is negative, implying the opposite of Darwinism. This finding implies that there is "Socialism" within the home country of multinationals, so that domestic affiliates are treated equally independent of their growth potential. Using a structural model, Matvos and Seru (2014) find that managers of US conglomerates have a preference for "Socialism," which means that, on average, they allocate more capital to weaker divisions. Our findings enrich this picture. We find that the dynamic response to crises is also "Socialist" in the parent's home country, as parent managers treat domestic affiliates equally in response to a negative shock. In contrast, parent managers are "Darwinist" with respect to international affiliates. A likely explanation for this divergence between domestic and international affiliates is that parent managers are more exposed to power struggles and rent-seeking by domestic affiliates, whereas they can engage in relatively unobstructed "winner picking" among international affiliates.

To buttress the conclusions on domestic versus international affiliates, we analyze whether the differences are statistically significant in Table A.XV. We merge the Orbis data on sales of domestic affiliates to the Bundesbank data on international affiliates. The baseline coefficient in Table A.XV estimates the effect on international affiliates. The interaction coefficient for domestic affiliates implies that the effect on domestic affiliates is significantly weaker than the effect on international affiliates. Similarly, the role of pre-crisis growth is significantly weaker for domestic affiliates, relative to international affiliates.

To complete the analysis of domestic affiliates, we show that the direct Commerzbank dependence of domestic affiliates reduced affiliate sales (Table VII, column 3). This finding is in line with the direct effect on parents and on German firms in general (Huber 2018). The Commerzbank dependence of other domestic affiliates owned by the same parent did not have negative effects, which is not surprising given that the parent's Commerzbank dependence only had weak effects within Germany.

### **VII.C Access to Local Credit Markets Dampened Negative Effects**

We analyze whether frictions on local credit markets shaped the effects on affiliates, as predicted by the theoretical model in Appendix B. We indeed find that the sales effect was stronger for affiliates in countries with underdeveloped credit markets, measured by the ratio of credit

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<sup>23</sup>The finding does not imply that domestic conglomerates never transmit shocks to domestic affiliates because our data only contain affiliates of multinationals and because a weak negative effect is within the confidence band.

to GDP (Table VI, column 2). When affiliates found it harder to borrow locally, they were less able to fund internal lending with external funds and instead had to reduce their sales by more.

However, even in developed credit markets, affiliates still suffered significant sales losses, as indicated by the stable and significant baseline coefficient (column 2). This is consistent with existing work showing that firms are borrowing constrained even in economies with large credit markets, at least in the short run (Lian and Ma 2020). Overall, these results suggest that frictions in the access to capital determine to what extent internal capital market shocks lead to real effects.<sup>24</sup>

#### **VII.D Currency, Geography, Local Business Cycles, and Capital Controls Were Less Important**

We next study whether frictions due to broad regional differences affected shock transmission. On the one hand, we may expect stronger effects for affiliates in EU countries, since it is easier to transfer capital across countries sharing the same currency and regulatory environment. On the other hand, parent managers may display proximity bias for geographically and culturally close countries, which would reduce the effect on EU affiliates. On net, we find no significant difference for affiliates located in Asia, the EU, and the US (Table VI, columns 3-5). In Appendix E, we also report no significant differences by GDP per capita growth, house price growth, or corporate tax rates in the affiliate host country. Overall, variation due to currency, geography, and local business cycles did not strongly shape the effects. Instead, parents were seemingly able to allocate capital relatively freely across the world.

We do not find that capital controls in affiliate host countries had strong impacts (Table A.XVII), using three different capital control measures developed by Fernández et al. (2016). A likely reason is that capital flows within firms are difficult to monitor and prevent, so most countries do not explicitly target internal capital markets with capital control measures.

#### **VII.E The Role of Internal Trade and Reselling**

A large literature in international economics studies internal trade between affiliates and parents (e.g., Alfaro et al. 2007; Boehm et al. 2019). We present several pieces of evidence that internal trade explains part of, but not the entire effect on affiliate sales, suggesting that internal capital markets also played an important role.

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<sup>24</sup>We also find that larger affiliates suffered smaller effects (Table A.XVI), consistent with the view that larger firms can access external finance more easily (Farre-Mensa and Ljungqvist 2016), but the result is not statistically significant.

If only internal trade mattered, we would expect weaker effects for horizontal and service sector affiliates (Cravino and Levchenko 2017). We first analyze horizontal affiliates, which operated in the same industry as their parent and were therefore less likely to internally trade with the parent. We find no significant difference between the effect on horizontal and vertical affiliates (Table A.XVIII, column 1).<sup>25</sup> We also find no significant difference for affiliates in the service sector, which are less likely to trade with their parent (column 2). Finally, the coefficient remains similar when we drop affiliates in wholesale and retail (Table A.XIX), suggesting that the effect is not driven by affiliates that primarily resell their parent's output.<sup>26</sup>

#### **VII.F Affiliates Were Not Directly Borrowing From Commerzbank**

We show that affiliates' direct exposure to Commerzbank branches (in Germany or abroad) cannot explain the effects on affiliate growth. For one, affiliate liabilities toward banks and other non-parents did not change significantly, suggesting that affiliates were not directly exposed to a bank lending cut (Table III, column 4). We cannot match affiliate relationship banks to MiDi, but we can analyze them separately, using data from Bureau van Dijk Orbis. We find that the correlation between parent and affiliate Commerzbank dependence is low at 0.025. Only 3 percent of foreign affiliates had a direct bank relationship to Commerzbank.

Moreover, we exclude from the sample all countries where Commerzbank had a foreign branch and find similar effects (Table A.XX, column 1). Results remain similar when controlling for the fraction of bank lending in the affiliate's host country (relative to total lending provided by the Bank of International Settlements) that came directly from German branches of the three largest German banks in 2006, as recorded in the Deutsche Bundesbank's dataset Austa (Krueger et al. 2017). We separately control for the effect of such lending to non-financial firms (column 2) and to financial firms (column 3) in the affiliate's host country.

#### **VII.G Dependence on Other German Banks**

We study whether parent dependence on other German banks affected affiliates from 2008 to 2010. We study three groups of other banks that suffered losses during the financial crisis 2008/09 (Hüfner 2010): Landesbanken (state-level publicly owned banks) with trading losses,

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<sup>25</sup>We use one-digit industries to define horizontal affiliates, but find similar results using two- or three-digit industries.

<sup>26</sup>More generally, our results are consistent with the view that multinational activity depends on financial frictions (Antràs et al. 2009; Bilir et al. 2019). Alfaro and Charlton (2009) and Ramondo et al. (2016) report that many multinationals do not trade internally, leaving an important role for internal capital markets.

municipal savings banks that partially owned these Landesbanken, and other banks with trading losses.<sup>27</sup>

We find no evidence that affiliates whose parents depended on any of these banks grew more slowly from 2008 to 2010 (Table A.XXI). The results are consistent with narrative evidence in Appendix C suggesting that other German banks did not cut lending during the crisis. In sum, the Landesbanken received quicker and more comprehensive guarantees from the government, relative to Commerzbank. The savings banks did not have to guarantee large losses and actually increased lending during the crisis. And other commercial banks had stronger financial buffers and hedging strategies than Commerzbank.

## **VIII Comparison: The Transmission of a Non-Financial Flooding Shock**

We analyze how internal capital markets and affiliate outcomes respond to a different, non-financial shock that hit parents. This analysis helps us to understand whether internal capital markets operate differently in the case of non-financial shocks, relative to financial shocks like Commerzbank's lending cut.

### **VIII.A The Flood Lowered Parent Assets But Not Credit Supply**

We identify parents that were exposed to the large-scale German floods of June 2013 but whose relationship banks were still able to lend to them. The floods affected regions around the rivers Elbe and Danube and were caused by unexpectedly heavy rainfall. The floods covered the largest geographic area of any flood in Germany since the start of official records in 1950. As argued by Koetter et al. (2020), banks located outside flooded regions provided "recovery lending" to flooded firms, whereas some banks located in flooded regions were harmed directly by flooding. To isolate a non-financial shock, we therefore define a treatment indicator for "flooded parents" with stable credit supply. We include parents with (1) a headquarter in flooded states (where at least 0.24 percent of flood insurance contracts were activated according to the German Association of Insurers) and (2) a relationship bank outside these states (according to the Creditreform data on relationship banks).

We first examine the direct impact of the flood on parents, using an analogous specification as for the analysis of Commerzbank's lending cut. We find that flooded parents experienced

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<sup>27</sup>The affected Landesbanken were BayernLB, HSH Nordbank, Landesbank Baden-Württemberg, Sachsen LB, and WestLB. Other affected banks are Deutsche Bank, DZ Bank, IKB, HypoVereinsbank, and KfW, as listed in Hüfner (2010). Huber (2018, Appendices E and F) also shows that trading losses at other German banks did not have real effects on firms.

an average reduction in assets of approximately 2 log points (roughly 2 percent, Table VIII, column 1) in the years 2013 to 2015, relative to non-flooded parents. The reduction is consistent with the flood destroying production capital and inventory, which takes time to rebuild. However, treated parents were not financially constrained, as their bank debt increased by 20.6 log points (roughly 23 percent, column 2), a magnitude roughly equal to the decline in bank debt following Commerzbank's lending cut. This finding suggests that treated parents experienced a non-financial, asset-destroying shock but were able to receive strong financing from their German relationship banks.

### **VIII.B The Effect of the Flood on International Affiliates and Internal Capital Markets**

We turn to results at the affiliate level. Affiliates with flooded parents did not increase long-term lending to their flooded parents (Table IX, column 1), as parents were able to access capital from their German banks instead. Affiliates slightly increased short-term claims on their parent (column 2), possibly because affiliates delivered more goods to their parent as the parent was rebuilding production capital and inventory. There is no evidence that affiliate sales fell, as the coefficient is small and insignificant (column 3). There is also no significant heterogeneity for affiliates with greater internal capital market links to their parent (column 4).

Taken together, the results suggest that internal capital markets did not transmit the non-financial flood shock from parents to international affiliates. This conclusion stands in sharp contrast to the international transmission of Commerzbank's lending cut through internal capital markets. The difference is that parents were financially constrained following the Commerzbank shock, leading them to withdraw capital from their affiliates and thereby harming affiliates' real growth. In contrast, parents were able to rely on German banks for funding after the floods without gathering capital from affiliates.

The evidence implies that multinationals transmit crises forcefully across the globe when crises have a financial component, that means when directly shocked firms cannot smooth the shock themselves by relying on their own external credit supply. Of course, many crises are both financial and non-financial in nature, including the crises studied in Boehm et al. (2019) and Bena et al. (2022). In this section, we have instead focused on a non-financial flooding shock. This focus may explain why the estimated transmission effects of the flooding shock are small relative to these other crises and relative to Commerzbank's lending cut.

## IX The Magnitude of Shock Transmission Through Multinationals

In the final step of our analysis, we compare the magnitude of the affiliate-level results to aggregate outcomes in different countries. We calculate in which countries the shock to Commerzbank had the largest effects because it was transmitted through multinationals.

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

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

$$\begin{aligned} (\text{Impact on total sales of German affiliates})_c = & \\ & |\hat{\beta}_1| \times (\text{Weighted average of parent CB dep of affiliates of German parents})_c \quad (5) \\ & \times (\text{Total sales of affiliates of German parents in 2006})_c. \end{aligned}$$

Estimate  $\hat{\beta}_1$  is the effect of parent Commerzbank dependence on the sales of an individual affiliate from 2008 to 2010. We use the baseline estimate  $\hat{\beta}_1$  from Table II, column 3 for this calculation. To measure the parent Commerzbank dependence of a representative German affiliate in country  $c$ , we use the sales-weighted average parent Commerzbank dependence of German affiliates. The product of the first two terms is an estimate of the sales loss (in percent) at a representative German affiliate in country  $c$ . Finally, the third term is the total value of sales of non-financial German affiliates in country  $c$  in 2006, calculated using MiDi. By multiplying the effect on a representative affiliate with the third term, we get an estimate of the impact on total sales of German affiliates in country  $c$ , relative to what total sales would have been had all German affiliates grown at the same rate as unaffected affiliates. We are interested in how large the impact was compared to the aggregate economy, so we report the impact as a percentage of aggregate sales.

We present results for the most common locations of German affiliates in Table X.<sup>28</sup> The mean impact relative to aggregate sales was 0.18 percent. It was modest in the United States (0.03 percent), but large in the Czech Republic (0.49 percent), Austria (0.36 percent), and Poland (0.31 percent). The differences across countries were mostly driven by heterogeneity

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<sup>28</sup>We exclude China and Switzerland because data on aggregate sales are not available.



in the size of German affiliates relative to the aggregate economy. German affiliates were responsible for only 0.2 percent of aggregate sales in the US, but for a large part of sales in economies at Germany's Eastern border, up to 4 percent in the Czech Republic.

To illustrate the magnitude of the effects, consider the concrete example of the Czech Republic. If affected German affiliates (with positive Commerzbank dependence) had grown at the same rate as unaffected affiliates, total sales of affected German affiliates in the Czech Republic between 2008 and 2010 would have been 1.8 billion Euros higher (or 0.49 percent of aggregate sales). Hence, Commerzbank's lending cut, even though it initially only hit German firms, was an important determinant of the distribution of firm growth in the Czech Republic.<sup>29</sup>

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

## **IX.B Aggregate Implications**

Our discussion of Table X so far has focused on the impact on affected affiliates (with positive parent Commerzbank dependence), relative to the growth of unaffected affiliates. The impact numbers would be identical to aggregate changes if the growth of unaffected affiliates would have been the same with and without the sales losses at affected affiliates. General equilibrium effects could cause the growth of unaffected affiliates to differ across the two cases. On the one hand, sales of unaffected firms may have increased when affected affiliates became constrained, as product demand shifted from affected to unaffected affiliates. On the other hand, sales of unaffected firms may have fallen because the constraints at affected affiliates lowered aggregate demand and propagated through input-output links (Acemoglu et al. 2016; di Giovanni et al. 2018).

The impact numbers may be informative at least about the order of magnitude of aggregate effects, according to recent work. For instance, Huber (2018) estimates that general equilibrium effects of a credit shock exacerbate losses at the regional level. This suggests that aggregate losses may be even larger than the impact numbers in Table X. Indeed, calibrated models in Chodorow-Reich (2014), Herreño (2020), and Sraer and Thesmar (2022) suggest that general equilibrium effects are likely to harm the growth of unaffected affiliates or have at most a weakly positive effect.<sup>30</sup>

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<sup>29</sup>Of course, all these effects relate only to transmission through multinationals. Other transmission channels may have further depressed economies abroad because of Commerzbank's lending cut, for example, if German customers demanded fewer goods from abroad. We intentionally keep these other channels constant in our research design, so that we can isolate the effect of multinationals.

<sup>30</sup>At most, the results in Chodorow-Reich (2014) suggest that growth improvements of unaffected affiliates

## X Conclusion

This paper highlights that a shock to one bank can have far-reaching effects that extend beyond countries directly borrowing from the shocked bank. We identify a shock to Commerzbank in Germany. This shock had direct effects on Commerzbank's borrowers in Germany because Commerzbank cut their loan supply. However, the shock ultimately also affected affiliates of German multinationals in other countries, even though the affiliates were not directly borrowing from Commerzbank.

The analysis produces new insights on the workings of internal capital markets. We analyze a detailed regulatory dataset that reports internal capital market positions between German multinational parents and each international affiliate. We show that the international affiliates financially supported their constrained parents through internal lending. The affiliates became financially constrained themselves, experienced lower sales and employment growth, and took three years to recover. Real effects primarily affected affiliates that increased internal lending after the shock, implying that internal capital markets contributed to shock transmission.

Managers allocated the harmful effects across international affiliates in a relatively strategic, "Darwinist" manner, without being limited by frictions due to currencies, geographic distance, or capital controls. However, managers were "Socialist" toward domestic affiliates within Germany and displayed home bias favoring German affiliates. Moreover, international affiliates with access to developed credit markets were able to dampen the effects of the internal capital shock. While the literature has suggested that internal capital flows help affiliates in crisis, these findings show that internal capital markets can also have severe negative impacts on real outcomes.

Aggregating the real effects, we calculate that transmission of Commerzbank's lending cut through multinationals had substantial effects in foreign countries, for example, a total impact of roughly 0.4 percent of aggregate sales in Austria and the Czech Republic and 0.1 percent in Spain and the UK. In contrast, we find that internal capital markets did not significantly transmit a non-financial flooding shock to international affiliates. The findings suggest that internal capital markets transmit financial shocks, which harm credit access, particularly strongly.

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would undo 27 percent of the total losses at affected affiliates. Applying this correction to the numbers in Table X, the aggregate impact in the Czech Republic, Austria, and Poland would still be sizable, at 0.36, 0.26, and 0.23 percent, respectively.

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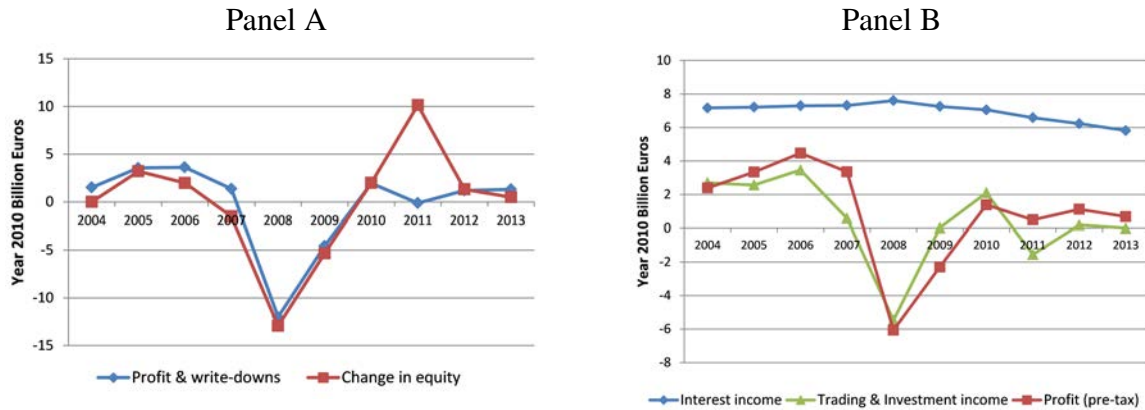
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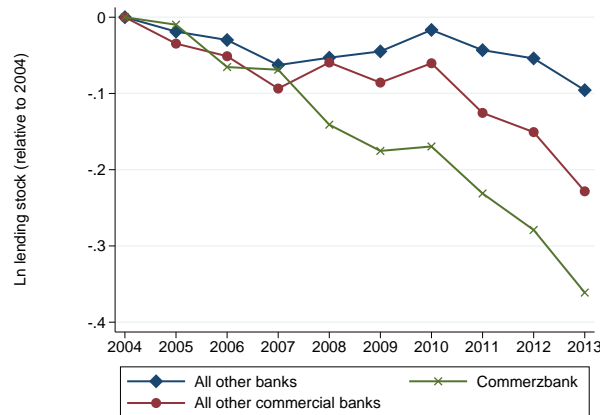
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Figure I: Commerzbank's equity capital, write-downs, and profits



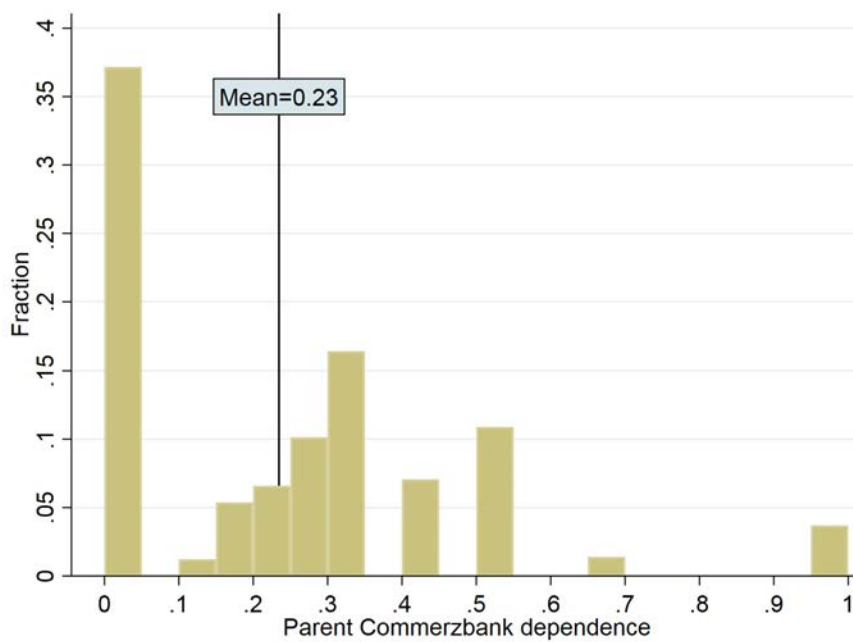
Notes: The left panel shows Commerzbank's profits and write-downs plus equity capital. Write-downs arise from changes in revaluation reserves, cash flow hedges, and currency reserves. Panel B shows the composition of Commerzbank's profits. Interest income is interest received from loans and securities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

Figure II: Lending by German banks



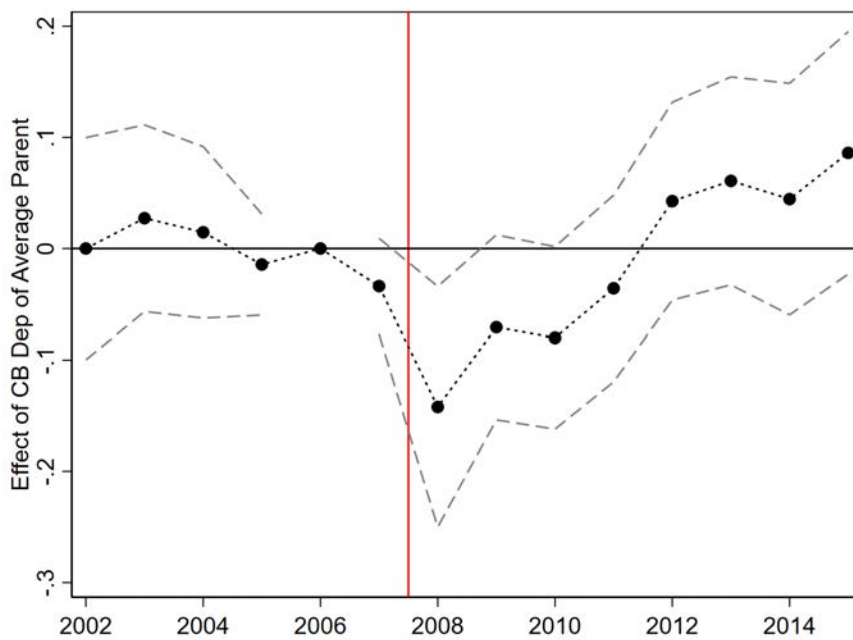
Notes: The figure plots the log lending stock to German non-financial customers for different groups of banks, relative to 2004. The values are in year 2010 billion Euro. We include lending by branches of Commerzbank and Dresdner Bank to calculate lending by Commerzbank (provided in the bank annual reports).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

Figure III: Distribution of parent Commerzbank dependence



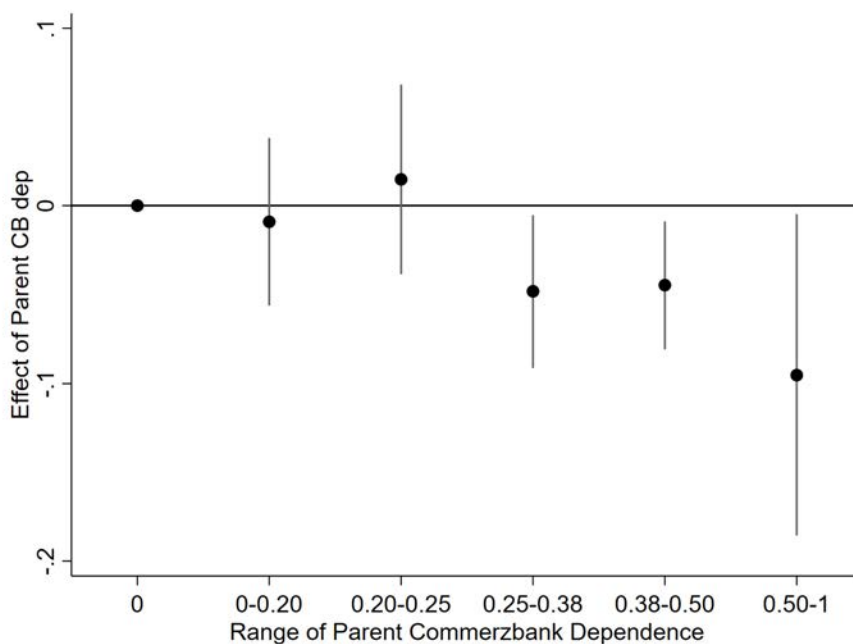
Notes: The figure shows a histogram of Commerzbank dependence for the 655 German parents in our dataset in 2006. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Figure IV: Impact of parent Commerzbank dependence on affiliate sales



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

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



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



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

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

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

Table II: Impact of parent Commerzbank dependence on affiliate sales

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

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

Table III: Impact of parent Commerzbank dependence on affiliate assets, liabilities, and equity

Outcome	(1) Short-term assets	(2) Production capital	(3) External LT loans	(4) External liabilities	(5) External equity
Parent CB dep × 2008-10	-0.0487** (0.0197)	-0.0196 (0.0322)	0.0898 (0.0774)	0.0008 (0.0349)	0.0153 (0.0441)
Parent CB dep × 2011-15	0.0024 (0.0337)	-0.0228 (0.0415)	0.0504 (0.0829)	0.0289 (0.0499)	0.0024 (0.0526)
$R^2$	0.089	0.064	0.047	0.067	0.074
Number of firms	2,695	2,695	2,695	2,695	2,695
Observations	24,941	24,941	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes	Yes	Yes

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

Table IV: Impact of parent Commerzbank dependence on internal capital market flows

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

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

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

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

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

Table VI: Mechanisms and frictions driving internal capital market flows

Outcome	(1)	(2)	(3)	(4)	(5)
	Affiliate sales				
Parent CB dep $\times$ 2008-10	-0.0953* (0.0490)	-0.1080* (0.0596)	-0.1054** (0.0420)	-0.0748 (0.0582)	-0.0913* (0.0539)
Parent CB dep $\times$ 2008-10 $\times$ Affiliate pre-growth	0.0597** (0.0280)				
Parent CB dep $\times$ 2008-10 $\times$ Credit/GDP low		-0.1984*** (0.0620)			
Parent CB dep $\times$ 2008-10 $\times$ Credit/GDP high		0.0276 (0.0550)			
Parent CB dep $\times$ 2008-10 $\times$ Affiliate in Asia			0.0525 (0.1122)		
Parent CB dep $\times$ 2008-10 $\times$ Affiliate in EU				-0.0393 (0.0618)	
Parent CB dep $\times$ 2008-10 $\times$ Affiliate in US					-0.0550 (0.0519)
Parent CB dep $\times$ 2011-15	0.0333 (0.0427)	0.0298 (0.0430)	0.0302 (0.0425)	0.0301 (0.0423)	0.0300 (0.0422)
$R^2$	0.117	0.073	0.092	0.092	0.092
Number of firms	2,244	2,661	2,695	2,695	2,695
Observations	23,143	24,681	24,941	24,941	24,941
Affiliate FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Controls $\times$ Time FE	Yes	Yes	Yes	Yes	Yes
Affiliate pre-growth $\times$ 2008-10	Yes	No	No	No	No

Notes: The table reports estimates from OLS panel regressions. The outcome variable is log affiliate sales. Column 1 tests for heterogeneity by the growth in affiliate sales from 2006 to 2007. Column 2 tests for heterogeneity by whether the affiliate host country was in the top or bottom 10 percent of the distribution of credit to GDP in 2006 (based on World Bank data). Columns 3 to 5 analyze heterogeneity by whether the affiliate was located in Asia, the EU, or the US. The remaining regressors are explained in Table II and the baseline controls include fixed effects for size bin, industry, country, and leverage bin. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23.  $R^2$  is the within-firm  $R^2$ . Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, own calculations.

Table VII: Impact on sales of affiliates within Germany

Outcome	(1)	(2)	(3)
	Affiliate sales		
Parent CB dep $\times$ 2008-10	-0.0118 (0.0355)	-0.0048 (0.0368)	-0.1212 (0.0840)
Parent CB dep $\times$ 2008-10 $\times$ Affiliate pre-growth		-0.0825 (0.0554)	-0.0417 (0.0735)
Affiliate CB dep $\times$ 2008-10			-0.0970** (0.0402)
Affiliate CB dep $\times$ 2008-10 $\times$ Affiliate pre-growth			0.0888 (0.0789)
Other affiliates' CB dep $\times$ 2008-10			0.1235 (0.0781)
Other affiliates' CB dep $\times$ 2008-10 $\times$ Affiliate pre-growth			-0.0123 (0.0618)
Parent CB dep $\times$ 2011-15	-0.0143 (0.0431)	-0.0166 (0.0434)	-0.1991* (0.1033)
Affiliate CB dep $\times$ 2011-15			-0.0269 (0.0375)
Other affiliates' CB dep $\times$ 2011-15			0.1312 (0.0804)
$R^2$	0.230	0.233	0.263
Number of firms	940	940	550
Observations	11,430	11,430	6,473
Affiliate FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Controls $\times$ Time FE	Yes	Yes	Yes
Affiliate pre-growth $\times$ 2008-10	No	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The sample only contains affiliates that were located within Germany, that were owned at least 50 percent by a German parent, and whose parent had at least one foreign affiliate. The outcome is log affiliate sales. The regressors are explained in Table II and the controls include fixed effects for size bin, industry, location, and leverage bin. Other affiliates' CB dep is the average Commerzbank dependence of other affiliates within Germany owned by the same parent. The coefficients are scaled to reflect the effect on a firm with average Commerzbank dependence, which was 0.23.  $R^2$  is the within-firm  $R^2$ . Standard errors are clustered at the level of the parent. Data sources: Orbis Historical Ownership 2007, Orbis Historical Financials 1990-2015, own calculations.

Table VIII: Impact of the 2013 flood on parent bank debt and total assets

Outcome	(1) Total assets	(2) Bank debt
Flooded parent 2013 × 2013-2015	-0.0197* (0.0113)	0.2055** (0.0967)
$R^2$	0.340	0.049
Number of firms	431	325
Observations	5,245	4,133
Parent FE	Yes	Yes
Year FE	Yes	Yes
Size bin FE × Time FE	Yes	Yes
Industry FE × Time FE	Yes	Yes
Affiliate location FE × Time FE	Yes	Yes
Leverage bin FE × Time FE	Yes	Yes

Notes: The table reports estimates from OLS panel regressions. The outcome variable in column 1 is log parent total assets and in column 2 it is log parent bank debt. A flooded parent (1) had its headquarter in states where at least 0.24 percent of flood insurance contracts were activated in 2013 (according to the German Association of Insurers) and (2) a relationship bank located outside these states. The following time-invariant control variables are calculated for parents in the year 2006 and interacted with a fixed effect for the years 2013-15: industry fixed effects, fixed effects for deciles of total sales, fixed effects for deciles of leverage, and fixed effects for whether the parent had an affiliate in Asia, the EU, or the US.  $R^2$  is the within-firm  $R^2$ . Standard errors are clustered at the parent level. Data sources: Research Data and Service Centre of the Deutsche Bundesbank, Ustan 2002-2015, Orbis Historical Financials, German Association of Insurers, own calculations.



Table IX: Impact of the 2013 flood on affiliates

Outcome	(1) LT loans to parent	(2) ST claims on parent	(3) Affiliate sales	(4) Affiliate sales
Flooded parent 2013 × 2013-2015	-0.0079 (0.0142)	0.0856** (0.0372)	0.0033 (0.0264)	-0.0104 (0.0390)
Flooded parent 2013 × 2013-2015 × Previous long-term loans to parent	-0.0570 (0.1293)			0.0370 (0.1598)
Flooded parent 2013 × 2013-2015 × Previous short-term claims on parent		-0.0330 (0.0564)		0.0063 (0.0432)
$R^2$	0.018	0.043	0.046	0.047
Number of firms	1,948	1,948	1,948	1,948
Observations	19,012	19,012	19,012	19,012
Affiliate FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls × Time FE	Yes	Yes	Yes	Yes
Previous long-term loans on parent × Time FE	Yes	No	No	Yes
Previous short-term claims on parent × Time FE	No	Yes	No	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. The outcome in column 2 is log short-term claims on the parent by the affiliate. The outcome variable in columns 3 and 4 is log affiliate sales. Column 1 analyzes heterogeneity by whether the affiliate had issued long-term loans to its parent in any year before 2013. Column 2 analyzes heterogeneity by whether the affiliate held short-term claims on its parent in any year before 2013. The remaining regressors are explained in Table II and the baseline controls include fixed effects for size bin, industry, country, and leverage bin. The coefficients are scaled to reflect the effect on an affiliate whose parent had average Commerzbank dependence, which was 0.23.  $R^2$  is the within-firm  $R^2$ . Standard errors are two-way clustered at the level of the country and the parent. Data source: Research Data and Service Centre of the Deutsche Bundesbank, MiDi 2002-2015, German Association of Insurers, own calculations.

Table X: The impact in different countries

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

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