# Disentangling the Effects of a Banking Crisis: Evidence from German Firms and Counties

Kilian Huber[*]

Revised Version, May 2017

*Lending cuts by banks directly affect the firms borrowing from them, but also indirectly depress economic activity in the regions they operate in. This paper moves beyond firm-level studies by estimating the effects of an exogenous lending cut by a large German bank on firms and counties. I present evidence that the lending cut affected firms independently of their banking relationships, through lower aggregate demand and agglomeration spillovers in counties exposed to the lending cut. GDP and employment remained persistently low even after bank lending had normalized. Innovation and productivity fell, consistent with the persistent effects. (JEL E22, E24, E44, G01, G21)*

During the financial crisis of 2008/09 banks around the globe reduced their loan supply. The subsequent Great Recession followed a common pattern in many developed economies, including the United States: There were two years of negative growth and a slow recovery, during which output and employment failed to return to their pre-crisis trends. This persistence is unusual in the post-war history of developed economies, where downturns were commonly followed by strong recoveries (Friedman 1993). Was the fall in bank lending during the financial crisis a cause of the large output and employment losses during the Great Recession? Can it account for the sluggish recovery in the aftermath of the recession?

Motivated by these questions, this paper delivers causal evidence on the effects of bank lending on the real economy. I analyze a lending cut by Commerzbank, a large German bank. During the financial crisis, Commerzbank suffered significant losses on its international trading book. These losses were unrelated to its domestic loan portfolio, but forced it to reduce its loan supply to German borrowers. I study the effects of the lending cut using variation across German counties and firms in their dependence on Commerzbank.[1]

By focusing on an imported lending cut, I address the key identification challenge that plagues the literature on financial frictions: the reverse causality between the health of the banking sector and economic growth. Unlike most developed economies, Germany experienced no house price boom or decline (Mian and Sufi 2014), no endogenous banking panic (Ivashina and Scharfstein 2010), relatively little uncertainty (Baker et al. 2013), and no sovereign debt crisis before or during the Great Recession. Therefore, the lending cut by Commerzbank provides a suitable natural experiment to disentangle the causal effects of bank lending. To verify my empirical strategy, I show that firms with a pre-crisis relationship to Commerzbank held less bank debt after the lending cut. In a survey, these firms reported restrictive bank loan supply in 2009 and 2010, but not in any year before or after Commerzbank's lending cut.

A second identification challenge arises from the possibility that unobserved shocks affected counties dependent on Commerzbank at the same time as Commerzbank's lending cut. To address this possibility, I construct an instrumental variable (IV) for county Commerzbank dependence. The instrument is based on the enforced breakup of Commerzbank by the Allies after World War II, which led Commerzbank to set up three separate, temporary head offices, in Düsseldorf,

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[1]Commerzbank refers to all branches that were part of the Commerzbank network in 2009, including Dresdner Bank.

Frankfurt, and Hamburg. The data show that Commerzbank expanded its branch network around its temporary head offices while it was broken up. The association between distance to these cities and Commerzbank dependence has survived until today. I can thus use a county's distance to the closest post-war head office as an instrument for Commerzbank dependence before the lending cut.

The first set of results shows that the lending cut had real effects on firms. Following the lending cut, firms dependent on Commerzbank reduced their capital stock and employment, relative to similar firms located in the same county, but with no pre-crisis Commerzbank relationship. I call these firm-level responses the *direct* effects of the lending cut, because they were driven by firms' immediate financial connections to Commerzbank. They are a partial equilibrium response, keeping constant other aggregate factors that affected firms independently of their banking relationships. The findings on the direct effects confirm the results of Almeida et al. (2012) and Chodorow-Reich (2014).[2] I estimate effects of similar magnitude to the existing literature, which suggests that Commerzbank's lending cut has external relevance to the United States and other countries.

An important question is whether banking shocks affect growth at higher levels of economic aggregation. I test the effect on counties. I construct a measure of county Commerzbank dependence based on the average exposure to Commerzbank of firms in the county. The results show that GDP and employment in counties dependent on Commerzbank fell after the lending cut. The IV point estimates, based on the distance instrument, imply larger effects than the OLS estimates, but are not statistically different. This suggest that unobserved, negative shocks cannot explain the OLS results. The IV results are robust to controlling for the linear distances to the post-war head offices, which ensures that shocks particular to one city do not bias the estimates.

Having established there are real effects on firms and counties, I discuss two aspects of the results in more detail: indirect effects and persistence. The first aspect relates to the difference in magnitude between the firm and county effects. Two types of firm-level effect determine the response of county aggregates. One is the *direct*, partial equilibrium effect. In addition, there is an *indirect* effect of the lending cut. This impacts firms independently of their direct financial connections to Commerzbank. It arises when the aggregate economic environment of a

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[2]Gan (2007); Khwaja and Mian (2008); Amiti and Weinstein (2011); Garicano and Steinwender (2013); Bentolila et al. (2015); Paravisini et al. (2015); Cingano et al. (2016) present further evidence.

county responds to the lending cut. For example, if directly affected firms reduce employment, the consumption of households falls, lowering aggregate demand in the county. Furthermore, a fall in the innovation activities of directly affected firms reduces agglomeration spillovers to neighboring firms.

I investigate whether significant indirect effects of the lending cut affected the county response. Specifically, I estimate the effect on firms of increasing the Commerzbank dependence of other firms in the county, while keeping constant the firms' direct exposure. The results show negative and sizable indirect effects on producers of non-tradables and firms with high innovation activities. The data reject the hypothesis that in a county fully dependent on Commerzbank these indirect effects were smaller than the direct effect on a firm that borrowed only from Commerzbank. There is no evidence for an indirect effect on tradables producers with low innovation activities. This pattern of heterogeneity suggests that reduced county aggregate demand and lower agglomeration spillovers in high-innovation industries generated the indirect effects. Migration and household debt were not affected, so they cannot explain the indirect effects.

The second aspect I discuss is that the effects on both firms and counties were persistent. The causal effects resemble the growth pattern of developed economies during and after the Great Recession. During the years of the lending cut, growth was significantly lower. In the subsequent two years, affected firms and counties remained on a lower parallel trend, without any sign of convergence to the level of unaffected firms and counties. This implies that a temporary bank lending cut can persistently keep output and employment low even after bank loan supply has normalized. The dynamics of the estimated effects suggest that the bank lending cuts during the financial crisis of 2008/09 may have contributed to the sluggish recovery from the Great Recession, even though the banking sector had stabilized by 2010 (Hall 2010).

Persistent effects are not generally a response to shocks. For example, I show that firms and counties exposed to lower export demand during the Great Recession recovered to the level of unaffected firms and counties in under two years. Neoclassical growth theory similarly implies that once credit markets have stabilized, the economy should converge back to its pre-crisis trend (Fernald and Jones 2014). A decrease in innovation and productivity, however, could explain the persistent effects. Indeed, firms reduced innovation activities, proxied by patenting, when they were directly affected by Commerzbank's lending cut. A back-of-the envelope growth accounting exercise suggests that county total factor productiv-

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ity fell, implying that productivity losses may have played a role in generating the persistence.

Influential contributions by Bernanke (1983) and Bernanke and Blinder (1992) argue that banking shocks affect the real economy. A number of more recent empirical studies document that banking crises have been correlated with deep and persistent recessions (Reinhart and Rogoff 2009; Schularick and Taylor 2012; Giesecke et al. 2014; Krishnamurthy and Muir 2015). But there is ambiguous causal evidence on the effects at levels of aggregation higher than the firm-level. Peek and Rosengren (2000), Calomiris and Mason (2003), Ashcraft (2005), Benmelech et al. (2011), and Mondragon (2015) find that banking shocks in the United States strongly reduce local economic activity. On the other hand, Driscoll (2004), Ashcraft (2006), and Greenstone et al. (2014) report no or only small effects. Mian and Sufi (2014) argue that business financing was not an important problem in the United States during the Great Recession. In contrast, Christiano et al. (2015) and Beraja et al. (2015) calibrate models that show supply-side shocks, such as financial frictions, best account for the growth pattern. In the German setting, Dwenger et al. (2015), Hochfellner et al. (2015), and Popov and Rocholl (2015) argue that banking shocks have real effects.

Ashcraft (2005) speculates that a reason for the different findings may be that small, regional differences in exposure to bank shocks are not informative about the consequences of a large, systemic lending cut. An advantage of studying Commerzbank's lending cut is that the variation across counties in exposure to Commerzbank is large and uncorrelated with other contemporaneous shocks.

I contribute to the literature by clearly differentiating between the contemporaneous effects of a lending cut and the effects after lending has stabilized. I present evidence that productivity is affected. Furthermore, the existing literature has had to rely on strong assumptions about the indirect effects. The findings of large indirect effects are of interest to researchers studying the aggregate implications of a range of shocks, not just banking crises. It is a general problem in empirical work that well-identified, partial equilibrium effects may not be informative about the aggregate implications of a given shock (Acemoglu 2010).

This paper also adds to the literature on the importance of a single firm, in this case a bank, in shaping macroeconomic outcomes. Models by Gabaix (2011) and Acemoglu et al. (2012) illustrate how idiosyncratic firm-level shocks may translate into large aggregate fluctuations. I show empirically that lending by a single financial institution can persistently affect regional output and employment. In line with

Romer and Romer (2015), the results show that going beyond binary measures of financial distress helps to identify the real effects of financial shocks.

The paper proceeds in the following section by explaining the identification strategy and the institutional background. I describe the data in Section II, including a new dataset on the relationship banks of German firms. Section III verifies my identification strategy, by showing that firms dependent on Commerzbank reported restricted loan supply and held less bank debt after Commerzbank's lending cut. Section IV reports the firm-level results on the direct effect and Section V performs the county analysis. Section VI discusses the evidence for the indirect effects and the persistent losses. Section VII concludes.

## I   Identification and Institutional Background

### I.A   Identification Strategy

This paper aims to estimate the causal effects of exposure to a bank lending cut. There are two well-known identification challenges. The first is reverse causality. A negative, exogenous shock to firms harms their lenders, for example because some firms default on loans. Therefore, banks may experience financial distress and cut lending because of the performance of their borrowers. The second identification challenge is that an omitted variable may simultaneously affect both the outcome and bank loan supply. For example, an expected reduction in regional growth would induce local firms to reduce employment and banks to cut lending to that region. Both these endogeneity concerns would lead to spurious correlations between lending cut exposure and firm growth, even if the true causal effect of a lending cut was zero.

I overcome the identification challenges by using the Commerzbank dependence of German firms and counties as proxy for their exposure to Commerzbank's lending cut. Frictions on credit markets mean that firms depend on the loan supply of their relationship banks (Sharpe 1990). Firms and counties, for which Commerzbank was an important relationship bank, were therefore more exposed to the lending cut.

A lending cut can affect firms through multiple channels. It can reduce access to bank loans, affect the interest rate on loans and deposits, reduce the length of loans, and increase uncertainty regarding future credit access. Using just one of these variables as regressor would overestimate the effect of this particular vari-

able. Identifying the causal impact of each channel would require one separate instrument per channel (Chodorow-Reich 2014). I do not pursue such approaches here. Instead, I estimate the reduced-form impact, where Commerzbank dependence serves as proxy for exposure to a lending cut. This strategy overcomes the problem of reverse causality because Commerzbank's lending cut was exogenous to the performance of its German loan portfolio, as shown in the next Section I.B. To address possible bias due to omitted unobservable variables at the regional level, I propose an instrument for county Commerzbank dependence in the subsequent Section I.C.

## I.B The Origin of Commerzbank's Lending Cut

This section argues that Commerzbank's lending cut during the financial crisis of 2008/09 was an exogenous shock to its German borrowers. Commerzbank was responsible for around 9 percent of total bank lending to German non-financial customers in 2006. Its lending stock developed in parallel to that of the other banks until 2007, as shown in Figure I. In 2008 and 2009, lending by Commerzbank fell sharply. Subsequently, it returned to a parallel trend relative to its peergroup of other commercial banks.[3]

Why did lending decrease? Commerzbank is a universal bank, which means it earns both interest income from lending and non-interest income from trading and investing in international financial markets. During the financial crisis, Commerzbank suffered significant losses and write-downs on its trading portfolio. The trading losses led to a fall in Commerzbank's equity capital in every year between 2007 and 2009, decreasing it by 68 percent during this period. Commerzbank responded by cutting its loan supply to the German economy for two reasons. First, the Basel II regulations require a bank to hold at least 4 percent of its risk-weighted assets in equity. When equity falls, banks have to reduce assets (and start raising new equity). Second, the equity losses raised Commerzbank's cost of external funds, so it needed to lower risk exposure to be able to access funding markets.

The changes in Commerzbank's equity capital were entirely driven by write-downs on financial instruments and profits, as shown in the left panel of Figure II.

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[3]There are three types of banks in Germany: commercial banks, cooperative credit unions, and public banks (Landesbanken and savings banks). The cooperatives and public banks have a political and social mandate to upkeep lending, unlike the commercial banks. Appendix E and Appendix F explain why trading losses at other German banks did not have real economic consequences, discussing papers by Dwenger et al. (2015) and Popov and Rocholl (2015).

Write-downs on financial instruments included, for example, changes in the valuation of derivatives the bank held, and were unconnected to the firm and household loan portfolio. The change in profits was also unrelated to firms and households. The right panel of Figure II illustrates that trading and investment income was entirely responsible for the negative profits. Interest income, on the other hand, which includes what Commerzbank earns from lending to firms and households, remained on an upward trend up to 2009.

Research by financial analysts confirms that Commerzbank's firm and household loan portfolio was not riskier than other German banks' and that it did not affect its financial health. The trading losses were due to its investments in asset-backed securities related to the United States subprime mortgage market and its exposure to the insolvencies of Lehman Brothers and the large Icelandic banks. The evidence suggests that in 2008 Commerzbank had wrongly forecast the duration of the financial crisis and the likelihood of institutional failures. Commerzbank head Martin Blessing admitted that his bank had reduced its exposure to asset-backed securities investments too late and had believed that the United States government would not let Lehman Brothers fail. In comparison, Deutsche Bank avoided damage by hedging against a persistent drop in the United States housing market early on. Appendix B presents a narrative of Commerzbank's trading losses, including a description of analyst reports, the developments at other German banks, and Commerzbank's 2009 acquisition of Dresdner Bank. Overall, the evidence in this section shows that reverse causality is not a concern when I analyze the effects of Commerzbank's lending cut.

### I.C An Instrument for County Commerzbank Dependence

The second identification concern is that unobserved shocks affected counties dependent on Commerzbank at the same time as the lending cut. To investigate this possibility, I propose an instrument for county Commerzbank dependence. The instrument isolates the effect of Commerzbank dependence from other unobservable determinants of county growth. It is the county's distance to the closest of three temporary, post-World War II head offices of Commerzbank. After World War II, the Americans were convinced that the Nazi government's ability to wage war effectively stemmed from the Third Reich's economic centralization. From 1948 to 1957, they forced three large German banks to break up into separate entities in three mandated banking zones. During this period, Commerzbank and (and

its 2009 acquisition Dresdner Bank) had three separate head offices in Düsseldorf, Frankfurt, and Hamburg.

These cities were chosen due to a combination of historic accident and power struggles among the Allies, rather than the bank's business considerations. In the first banking zone, North-Rhine Westphalia, the British declared Düsseldorf as the state capital, because it was the only city with a large building that had survived the war (Düwell 2006). The banks followed the political power and settled there. In the second, Northern zone, the British ordered the surviving and non-imprisoned bank board members to set up a central head office in Hamburg. Frankfurt was chosen as head office for the Southern zone because the Americans had placed the new central bank there. At the time, Frankfurt was far from its current role as Germany's financial center, but it was chosen for its central location (Horstmann 1991).

The literature has established that banks prefer to form relationships with geographically close customers (Guiso et al. 2004; Degryse and Ongena 2005). Indeed, in the years after the breakup, Commerzbank was significantly more likely to establish a new branch in counties close to its temporary head offices, as shown in Appendix Table A.I. The association between county Commerzbank dependence and distance to a post-war head office has survived until today, allowing me to construct a distance instrument based on how far a county is located from the post-war head offices. This distance instrument is calculated as the minimum of the linear (geodesic) distances to Düsseldorf, Frankfurt, and Hamburg. None of the three linear distances is perfectly correlated with the distance instrument. That means I can control for each of the linear distances to Düsseldorf, Frankfurt, and Hamburg in the IV specifications. In addition, I control for the linear distances to Berlin and Dresden, because historic, pre-war head offices of Commerzbank were located there.

Controlling for the linear distances is a crucial aspect of my IV strategy. It addresses the concern that the instrument may simply pick up spurious factors that are correlated with proximity to one of the post-war head offices. For example, the shipping industry is highly cyclical and concentrated around Hamburg. At the same time, due to the post-war breakup of Commerzbank, the counties around Hamburg are more dependent on Commerzbank. One may worry that the shock to the shipping industry during the Great Recession, rather than Commerzbank's lending cut, drives the results. By controlling for the linear distance to Hamburg, I statistically remove the correlation between industry concentration around Hamburg and

growth after the lending cut. The identification is solely driven by the distance to the closest post-war Commerzbank head office, rather than the factors associated with proximity to one of the cities.

## II  Data

This paper uses five datasets: a firm panel, a firm employment cross-section, a firm survey, a county panel, and a household panel. The firm panel is based on balance sheet data from the database Dafne by Bureau van Dijk. It contains firms with non-missing data from 2007 to 2012 for the following variables: employment, wage bill, bank loans, value added, production capital (fixed tangible assets), and capital depreciation. Dafne reports the firms' industry, foundation year, the export share (fraction of exports out of total revenue), and the import share (fraction of imports out of total costs). From the database Orbis, I match information on the firms' patents. To construct the firm employment cross-section, I extract data from Dafne for all firms, for which I can calculate the employment change from 2008 to 2012.

The firm survey is the Business Expectations Panel of the ifo Institute. The sample includes all firms that responded to the following two questions in 2006 and 2009: "How do you evaluate the current willingness of banks to grant loans to businesses: cooperative, normal, or restrictive?" and "Are your business activities constrained by low demand or too few orders: yes or no?"

I obtain proprietary data from the year 2006 on the names of the relationship banks (Hausbanken) of 112,344 German firms, recorded by the credit rating agency Creditreform. The agency collects information on the relationship banks from firm surveys and financial statements. In all three firm datasets, I link firms to their banks in 2006 using a unique firm identifier (Crefonummer). The pre-crisis timing avoids endogeneity from weak banks getting matched with weak firms during the Great Recession. I drop firms in the financial and public sectors. This leaves 2,011 matched firms in the panel, 48,101 in the employment cross-section, and 1,032 in the survey. I construct a variable to measure a firm's dependence on Commerzbank in 2006, called $CB\,dep_{fc}$ for firm $f$ in county $c$. It equals the fraction of the firm's relationship banks that were Commerzbank branches out of the firm's total number of relationship banks:

$$CB\,dep_{fc} = \frac{number\ of\ relationship\ banks\ that\ are\ Commerzbank\ branches_{fc}}{total\ number\ of\ relationship\ banks_{fc}}.$$

$$(1)$$

I additionally construct a county panel dataset from 2000 to 2012. It contains data on GDP, employment, and migration from the German Statistical Federal Office. A variable called county Commerzbank dependence ($\overline{CB\,dep}_c$ for county $c$) measures the average value of firm Commerzbank dependence for firms with their head office in the county, using all 112,344 firms in the dataset of relationship banks. For each firm, I additionally construct a variable $\overline{CB\,dep}_{fc}$ that measures the average Commerzbank dependence of all the other firms in the county, from the point of view of an individual firm (leave-out mean). I calculate the distance measures for the IV specifications using the average geodesic distance between firms in the county and the location of the former Commerzbank head offices.

The household panel I analyze is the nationally representative German Socio-Economic Panel (GSOEP). In 2002, 2007, and 2012 individuals reported the value of their outstanding debt. Every year they also reported a binary variable for whether they had any outstanding debt. In some specifications, the outcome variable is the symmetric growth rate, a second-order approximation to the ln growth rate. This measure is bounded in the interval [-2,2]. It has become standard in the establishment-level literature because it naturally accommodates zeros in the outcome variable, for example due to zero household debt or firm exit (Davis et al. 1998).[4]

Table I summarizes the firm panel. Firms have an average of 3 relationship banks. German firms traditionally form close and durable ties to their relationship banks. Dwenger et al. (2015) report that only 1.7 percent of firms find a new relationship bank per year. There is no information in my data on what services exactly a firm receives from a particular bank. In a separate survey, Elsas (2005) finds that relationship banks mostly finance bank loans, both long- and short-term, and provide payment transactions. A histogram of firm Commerzbank dependence is in the left panel of Figure III. Just under half of firms have a Commerzbank branch among their relationship banks. The average value of firm Commerzbank dependence is 0.16.

To test whether firms borrowing from Commerzbank differ from other firms, I regress firm Commerzbank dependence on observables from the year 2006 using the firm panel. There is no evidence for an economically significant correlation

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[4]The formal definition of the symmetric growth of $y$ between t-1 and t is: $g^y = 2 \cdot \frac{(y_t - y_{t-1})}{(y_t + y_{t-1})}$. The firm panel contains some insolvencies, but no cases of zero employment, because the German insolvency process takes long. The employment cross-section contains some cases of zero employment in 2012, because it includes more small firms, which have faster insolvency processes.

between Commerzbank dependence and any of the firm characteristics, controlling for county and industry. More details are in Appendix A. In general, my firm datasets underweight small firms and the service sector relative to the population. For example, 72 percent of firms in the employment cross-section dataset have fewer than 50 employees and 16 percent are in the service sector. In the population, 98 percent of firms have under fifty employees and 20 percent are in the service sector.

County summary statistics are in Table II. The mean population of a county in 2000 was 203,280 and mean county Commerzbank dependence is 0.12. There is significant variation in county Commerzbank dependence, as shown in the right panel of Figure III and in the map in Appendix Figure A.I.

## III   The Effect of the Lending Cut on Bank Debt

This section contains the first step of the empirical analysis. It verifies my empirical strategy by showing that Commerzbank's lending cut reduced the bank loan supply of firms. Hence, Commerzbank dependence is a valid proxy for firms' exposure to a lending cut. I find no effect on household debt and explain why.

### III.A   Firm Survey Evidence on Commerzbank's Lending Cut

I examine whether firms dependent on Commerzbank perceived their banks to lend more restrictively. The results are in Table III. The outcome variable is the answer to the question: "How do you evaluate the current willingness of banks to grant loans to businesses: cooperative, normal, or restrictive?" All the specifications control for firm industry, federal state, size, and age. A lagged dependent variable from 2006 accounts for pre-existing, time-invariant differences in bank loan supply.

The coefficient on firm Commerzbank dependence in column (3) has the interpretation that in 2009 a firm fully dependent on Commerzbank perceived its banks to be 0.47 standard deviations less willing to grant loans, compared to a firm with no Commerzbank relationship. The estimate is statistically significant at the 1 percent level. The effect remained significant in 2010, as Commerzbank continued its lending cut. There was no association between Commerzbank dependence and perceived bank loan supply in 2007 and 2008, indicating the absence of a pretrend. Commerzbank repaid most of the government equity in 2011 and refocused

its operations on the core business of lending. Accordingly, the negative effect of Commerzbank dependence disappeared in 2011 and turned positive in 2012. This is in line with Figure I, which shows Commerzbank's lending stock returning to the same trend as the other commercial banks from 2011 onward. The lending cut only led to temporary credit constraints.

There was no difference in the perceived level of demand between firms dependent on Commerzbank and other firms in any year (Appendix C). This shows worse demand shocks cannot explain the reduction in loan supply.

### III.B The Effect of Commerzbank's Lending Cut on Firms' Bank Debt

Having established that firms dependent on Commerzbank reported reduced loan supply, I test whether the lending cut actually reduced bank debt. The outcome is the natural logarithm of firm bank loans. I run specifications using the firm panel dataset, including year and firm fixed effects. Table IV presents the results. The first regressor of interest is the average Commerzbank dependence of firms in the county interacted with d, a dummy for the years following the lending cut, 2009 to 2012. The point estimate in column (1) implies that firm bank debt in a county fully dependent on Commerzbank was 17 percent lower in the years following the lending cut. This is identical to the decline in Commerzbank's lending stock by 17 percent, compared to the other German banks (Figure I).

The coefficients are stable and statistically significant when I add controls for firm age, size, industry, and the export and import shares in columns (2) and (3). A remaining concern is that unobserved shocks to counties may drive the effect, rather than Commerzbank's lending cut. In column (4), I add county fixed effects to the specification and use firm Commerzbank dependence as the regressor. The identification now relies on within-county variation in firm Commerzbank dependence. Despite the change in the specification, the coefficient remains of a similar magnitude and significant. These results suggest that firms dependent on Commerzbank were unable to turn to other lenders after Commerzbank's lending cut. Commerzbank dependence is a valid proxy for exposure to Commerzbank's lending cut.[5]

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[5]There was no heterogeneity in the size of the lending cut by firm characteristics, such as productivity, size, or county economic growth (Appendix Figure A.II). This suggests that Commerzbank did not cut lending disproportionately to firms with weaker growth prospects. Heterogeneity in the lending cut would not affect my identification strategy, since I use predetermined Commerzbank dependence as proxy for lending cut exposure.

### III.C The Effect of Commerzbank's Lending Cut on Household Debt

I investigate whether Commerzbank's lending cut also affected households' access to bank loans. 32 percent of Commerzbank's interest income in 2006 stemmed from households. Table V analyzes the household panel GSOEP. The outcome in the first three columns is the symmetric growth rate of debt. The effect of county Commerzbank dependence is small and statistically insignificant in all specifications. The estimate in column (2) controls for county characteristics and predetermined individual debt holdings. It implies that households in a county entirely dependent on Commerzbank experienced an increase in their growth rate of debt between 2007 and 2012 by 0.7 percentage points. Adding individual control variables in column (3) raises the coefficient, but it remains insignificant. The outcomes in columns (4) to (8) are dummies for whether an individual has any outstanding debt in the given year. There is no significant effect of county Commerzbank dependence in any year between 2008 and 2012.

These results can be explained by features of the German financial system that facilitate bank-switching for households. For example, the government-owned development bank KfW co-finances nationally standardized mortgage contracts in cooperation with private and public banks. This is important because mortgage debt comprised 91 percent of German household debt. Households can apply for these mortgages through any bank, regardless of whether they have a pre-existing relationship bank or not. KfW raised its mortgage commitments to households by 26.5 percent during the crisis. Aggregate lending to private customers by commercial banks actually rose slightly between 2007 and 2010, which suggests that other commercial banks were able to compensate households for Commerzbank's lending cut. In contrast, aggregate lending to corporate borrowers by commercial banks fell, which implies firms were not able to turn to other lenders. Consistent with these findings, a recent paper by Jensen and Johannesen (2016) shows that when bank-switching costs are low, there is no effect of lending cuts by individual banks on household debt.

## IV The Direct Effect on Firms

Having established that Commerzbank dependence is a valid proxy for firm exposure to Commerzbank's lending cut, I proceed to estimating the real effects of the lending cut on firms. This section focuses on the *direct* effect, which is driven by

firm's immediate financial connections to banks that cut lending. The effect operates independently of the economic environment the firm faces. That means it is a partial equilibrium response, identified by comparing two similar firms affected by the same aggregate shocks. The direct effect has been the focus of the firm-level literature, for example Almeida et al. (2012) and Chodorow-Reich (2014).

## IV.A Firm Specification

I use the firm panel to estimate equation 2, for firm $f$ in county $c$ at time $t$:

$$y_{fct} = \zeta + \beta \, CB \, dep_{fc} * d_t + \kappa_c * d_t + \Gamma' X_{fc} * d_t + \gamma_{fc} + \lambda_t + \varepsilon_{fct}. \qquad (2)$$

$\beta$ is the direct effect. $d_t$ is a dummy for the years following the lending cut, 2009 to 2012. The specification includes county fixed effects interacted with the post-lending cut dummy, $\kappa_c * d_t$. This is an important step in isolating the direct effect. It keeps constant any county-specific shocks associated with the Commerzbank dependence of other firms in the county. Firm fixed effects $\gamma_{fc}$ account for time-invariant, firm-specific differences in the outcome. Year fixed effects $\lambda_t$ control for changes in the outcome that are common to all firms in a year, for example due to macroeconomic fluctuations. $X_{fc}$ is a vector of further control variables, listed in Table VI. The standard errors are two-way clustered at the level of the county and the industry.

The identifying assumption in this section is that there were no unobservable shocks within counties correlated with firm Commerzbank dependence. The evidence supports this assumption. Figure IV shows that firms with and without a relationship to Commerzbank followed parallel employment trends before the lending cut. The firm panel shows no strong correlation between Commerzbank dependence and firm observables in 2006 (Appendix A). There was no effect of Commerzbank dependence on perceived product demand in any year before the lending cut, and an effect on perceived credit constraints only during the lending cut (Appendix C).

## IV.B Firm Results

Table VI reports the main result of this section in column (3). The point estimate implies that, following the lending cut, employment at a firm fully dependent on Commerzbank was on average 5.3 percent lower than at a firm with no Com-

merzbank relationship. The modest impact of the control variables across the first three columns of Table VI strengthens the argument that Commerzbank dependence was not significantly correlated with other determinants of firm growth. The existing literature estimates direct effects of a similar magnitude, suggesting that Commerzbank's lending cut has external relevance. For instance, Chodorow-Reich (2014) for the United States and Bentolila et al. (2015) for Spain find that firms connected to distressed banks reduced employment growth by 4 to 5 percentage points.

The remaining results in Table VI support the view that reduced bank loan supply was responsible for the effect of Commerzbank dependence, rather than unobserved shocks hitting all firms dependent on Commerzbank. Column (4) reports no statistically significant effect on firms with a low share of bank loans out of total debt. The effect for bank-dependent firms is strong. Column (5) shows there is no effect on firms with Commerzbank dependence greater than 0, but less than 0.26. These firms had a relatively large number of other relationship banks that could step in after Commerzbank cut lending. The effect is strongest for firms with Commerzbank dependence over 0.5, which had few alternative options to access bank loans.[6]

Table VII analyzes other outcomes and thereby sheds light on how firms adjust to a lending cut. The capital stock decreased by an average of 13 percent. Therefore, the capital-labor ratio fell, which suggests firms primarily use bank loans to finance capital investment. Firms dependent on Commerzbank were capital-constrained, which increased their average product of capital, measured as value added per capital in column (3). On the contrary, the lending cut did not affect the average product of labor and the average wage, relative to other firms in the same county, as shown in columns (4) and (5) respectively. This is consistent with a competitive county labor market. Column (6) reports no effect on the interest rate, in line with evidence from the United States credit card market (Ausubel 1991).

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[6]In unreported results, I find no heterogeneity in the effect on capital-intensive industries (consistent with Paravisini et al. (2015)), on large firms (consistent with Bentolila et al. (2015)), or on firms dependent on Dresdner Bank before the 2009 acquisition. Appendix D shows firms dependent on Commerzbank did not suffer higher losses on the value of their financial assets during the financial crisis.

## V  The Effect on Counties

The previous section has established that there were significant direct effects of the lending cut on firms. In this section, I test whether the lending cut also had effects at a higher level of aggregation, on counties.

### V.A  County Specification

I estimate equation 3 for county $c$ at time $t$:

$$y_{ct} = \zeta + \rho \, \overline{CB\,dep_c} * d_t + \Gamma' X_c * d_t + \gamma_c + \lambda_t + \varepsilon_{ct}. \qquad (3)$$

The coefficient on $\overline{CB\,dep_c} * d_t$, scaled by 100, measures the average percentage change in the outcome following the lending cut in a county fully dependent on Commerzbank. $\gamma_c$ is a county fixed effect and $\lambda_t$ a year fixed effect. $X_c$ is a vector of time-invariant control variables, described in the notes of Table V. The standard errors are clustered at the level of 42 quantiles of the county's industrial production share (GDP share of mining, manufacturing, utilities, recycling, construction). This is a more general method than clustering at the level of the county. It allows for arbitrary correlations of the errors across counties of similar industrial structure.

### V.B  County OLS Results

The left panel of Figure V plots the growth rate of county GDP from 2007 to 2012 against Commerzbank dependence. The line of best fit shows a statistically significant negative relationship, suggesting that the lending cut lowered GDP growth.

Table VIII reports the results of the corresponding OLS specifications. The key result of this section is in column (2). The point estimate implies that a standard deviation increase in Commerzbank dependence (6 percentage points) lowered county GDP by an average of 1 percent after Commerzbank's lending cut. This specification controls for the two main identification concerns. The first concern is that idiosyncratic shocks to certain industries and exposure to the trade collapse during the Great Recession may be correlated with Commerzbank dependence. I control for the share of 17 industries among the county's firms in 2006 as well as the average export and import shares of firms in the county. The second main concern is that some regions fared worse because they were in the former GDR or because their Landesbank suffered losses in the financial crisis (Puri et

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al. 2011). I add dummies for counties in these regions to the specification. Column (3) tests the robustness of the result further, by controlling for population density, ln population, ln GDP per capita, and household leverage. The coefficient remains stable, suggesting that the results are not driven by pre-existing differences in county characteristics.

The specification in column (4) estimates that a standard deviation increase in Commerzbank dependence lowered county employment by an average of 0.83 percent, conditional on the main controls.[7] Following Blanchard and Katz (1992), I investigate whether the effects can be explained by migration across counties in column (5). The outcome is county net migration divided by 2006 employment. The coefficient is insignificant and small, implying there was no migratory response. Mertens and Haas (2013) similarly report no association between county unemployment rates and migration in Germany.

### V.C   County IV Results

I use the distance instrument to test whether there is any evidence for bias in the OLS estimates. The right panel of Figure V plots the growth rate of GDP from 2007 to 2012 against the distance instrument. There is a negative and statistically significant reduced-form relationship. Figure VI confirms that the growth rate of GDP was lower only during the years of Commerzbank's lending cut. In the figures and in all IV specifications, I add five separate linear distance control variables, measuring the distances to five former head offices in Düsseldorf, Frankfurt, Hamburg, Berlin, and Dresden. This ensures that the effect is identified only through the distance to the closest of Commerzbank's post-war head offices. I also include a dummy for the former GDR to account for the post-war breakup of Germany.

Table IX reports the regression results. Columns (1) and (2) show a strong first-stage relationship between the distance instrument and Commerzbank dependence. The IV second-stage coefficients in columns (3) to (7) report negative and significant effects on county GDP and employment and no effect on migration, consistent with the OLS results. Adding the list of control variables hardly affects the point estimates, strengthening the argument that the distance instrument is exogenous to

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[7]Burda and Hunt (2011) show that the German government's well-known short-time work scheme did not have a strong effect on the labor market. Firms could only claim subsidies for a maximum of 2 years. The level of short-time workers was back down to its pre-crisis value in 2011, suggesting if anything only a transitory impact (Fujita and Gartner 2014).

county growth.[8]

In general, the IV point estimates imply larger effects than the OLS estimates. The coefficient in column (4) implies a GDP loss of 2.2 percent from a standard deviation increase in Commerzbank dependence, conditional on the main controls. There could be a number of reasons for the difference. First, county Commerzbank dependence may be measured with error, since it is based on the Creditreform sample of firms, which covers roughly half of total employment in Germany. Measurement error would attenuate the OLS, but not the IV estimates. Second, there is some evidence that Commerzbank's expansion across German counties was driven by economic considerations. For example, Klein (1993) describes that Commerzbank followed a unique branch expansion strategy in the former GDR after German reunification in 1990. The other German banks simply took over the pre-existing branch networks of the former GDR state banks, while Commerzbank built up its own. Commerzbank may have selectively expanded into counties that are less affected in recessions. In unreported results, I find no general association between county Commerzbank dependence and the average annual growth rate before 2009. Only in the sole recessionary year 2003, counties dependent on Commerzbank grew faster. If this indicates a systematic positive correlation between county Commerzbank dependence and growth in recessions, OLS estimators of the effect of Commerzbank's lending cut on county growth would be biased upwards.

It is important to recognize, however, that the OLS and IV coefficients are not statistically different. This suggests the difference between the point estimates could also be driven by estimation error. The most important insight from this section is that the IV analysis confirms the negative effect of Commerzbank's lending cut on county growth.

## VI Discussion of the Results

With the firm and county estimates in hand, I turn to discussing two aspects of how the lending cut affected firms and counties. First, I examine how the direct, firm-level effects translated into county outcomes. Specifically, I test whether there

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[8]Appendix Table A.III reports that the linear distance to a post-war Commerzbank head office or any other major city is uncorrelated with growth after Commerzbank's lending cut, conditional on the distance instrument. A placebo experiment for Deutsche Bank, using the distance to post-war Deutsche Bank head offices, finds no effect of Deutsche Bank dependence on county growth. Hence, there is no generic effect from dependence on large banks. I confirm the effects of Commerzbank's lending cut using a county-level proxy for the change in bank loans in Appendix G.

is evidence for an *indirect* effect on all firms in counties with high county Commerzbank dependence, independent of the firms' individual banking relationships. Second, I show that the temporary lending cut had *persistent* effects on firms and counties.

## VI.A The Indirect Effect

The response of county aggregates depends on two types of firm-level effects. The first are the direct effects on firms borrowing from Commerzbank. In addition, there may also be indirect effects on all firms in a county. Such indirect effects arise through changes in the county's aggregate economic conditions due to the direct responses of firms borrowing from Commerzbank. This section explores whether indirect effects played a role in shaping the effect of the lending cut on counties.

I use the employment cross-section dataset to estimate equation 4. The larger sample size of 48,101 firms enables me to estimate the direct effect $\beta$ and the indirect effect $\sigma$ in the same specification. The outcome is the symmetric growth rate of firm employment between 2008 and 2012:

$$employment\ growth_{fc} = \zeta + \beta\,CB\,dep_{fc} + \sigma\,\overline{CB\,dep_{fc}} + \Gamma' X_{fc} + \xi_{fc}. \quad (4)$$

Table X presents the results. The main object of interest in this section is the indirect effect, that is the coefficient on the average Commerzbank dependence of other firms in the county. I include firm control variables in column (1). The point estimate is negative and statistically significant at the 5 percent level. Adding the county controls in column (2) hardly affects the estimate. To illustrate the size of the indirect effect implied by the point estimates, consider a firm fully dependent on Commerzbank, operating in a county where no other firm had Commerzbank among their relationship banks. This firm reduced employment growth between 2008 and 2012 by 3.6 percentage points, the direct effect.[9] If the same firm had operated in a county where the Commerzbank dependence of the other firms had been one standard deviation (6 percentage points) greater, employment growth would have fallen by 4.6 percentage points. In this latter county, firms with no direct relationship to Commerzbank would have reduced employment growth by 1 per-

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[9]This point estimate of the direct effect is slightly smaller than in Table VI, because I use a different outcome, the symmetric growth rate. Using the ln difference as outcome renders the point estimates almost identical.

centage point, solely due to the indirect effect.

Table XI gives an overview of the county employment change implied by the different estimates in the paper. The estimate in row 1, based solely on the direct effect, underestimates the county employment loss, because it ignores the indirect effect. The average county Commerzbank dependence is 0.12, so the direct effects harm only a relatively small fraction of firms. It is the indirect effect that amplifies the effects of the lending cut throughout the county economy. The estimates of the sum of direct and indirect effects are larger than the estimate in row 1, whether I use the county data (rows 2 and 3) or the firm data (row 4). The IV estimate based on the county dataset is close to the OLS estimate based on the firm employment cross-section dataset, supporting the view that there is no significant bias in the OLS estimates.

I turn to investigating which economic mechanisms underlie the indirect effect, by testing two theoretical channels. The first argues that the direct effects reduced local agglomeration spillovers. These can exist in the form of knowledge spillovers, transport costs of inputs and outputs, or the quality of the local labor market (Ellison et al. 2010, Greenstone et al. 2010, Bloom et al. 2013). There is evidence that high-innovation industries are particularly dependent on such spillovers (Jaffe et al. 1993, Audretsch and Feldman 1996, Henderson 2003). This leads me to hypothesize that the indirect effect should increase with the innovation intensity of an industry. I classify industries with R&D spending in excess of 2.5 percent of revenue (the OECD cut-off) as high innovators, using data on German industries from Gehrke et al. (2010). For low-innovation industries, I rely on Gehrke et al. (2013), who identify a group of industries with the lowest score on all innovation indicators in the Mannheim Innovation Panel. The lists of high- and low-innovation industries are in Appendix Tables A.IV and A.V.

The second theoretical channel argues that household consumption fell due to employment losses at firms dependent on Commerzbank, reducing aggregate demand in the county. Producers of non-tradables rely strongly on local demand. Producers of tradables, on the other hand, mainly depend on national and global demand. Following the methodology of Mian and Sufi (2014), I classify an industry as tradable if the sum of its exports is at least USD 10,000 per worker or USD 500 million in total (using industry data from the United States). The retail and restaurant sector are classified as non-tradable. In addition, firms with a Herfindahl index in the top quartile produce tradables and firms in the bottom quartile non-tradables. This uses the fact that non-tradable industries are highly

dispersed, because they need to produce locally in the markets they serve, while tradable industries tend to be concentrated. If industries remain unclassified, I call them producers of part-tradables.

The interaction of innovation and tradability leaves me with seven industry types.[10] I estimate a separate indirect effect for each industry type, by interacting the variable $\overline{CB\,dep_{fc}}$ in equation 4 with a full set of industry type dummies. The specification controls for the direct effect, by including the variable $CB\,dep_{fc}$. In addition to the full set of firm and county control variables, the specification also includes fixed effects for the categories of tradability and innovation, to ensure that the coefficients are not biased by common shocks to firms in these categories.

Figure VII plots estimates of the indirect effect by industry type. There is a statistically significant indirect effect for high-innovation producers of tradables and producers of non-tradables.[11] The effect on high-innovation firms is consistent with agglomeration spillovers particular to these industries. In unreported results, I find that the Commerzbank dependence of other high-innovation firms in the county drives the indirect effect on high-innovation firms. There is no significant indirect effect from the Commerzbank dependence of low- and medium-innovation firms. Furthermore, the indirect effect is larger in counties with a high, above-median density of high-innovation firms. This suggests agglomeration spillovers are more important in innovation clusters.

The significant indirect effect on producers of non-tradables is consistent with the second theory on demand. After directly affected firms in their county reduced employment, producers of non-tradables experienced the largest reduction in demand relative to the other industry types and cut employment.[12] Moretti (2010) studies the local employment multiplier in the US, finding that for each additional job in the tradable sector, 1.6 jobs are created in the non-tradable sector. The corresponding figure based on my estimate is 1.7.

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[10]The industry shares in my sample are: producers of tradables with low innovation activities: 2 percent; tradables, medium: 29; tradables, high: 8; part-tradables, low: 11; part-tradables, medium: 25; non-tradables, low: 5; non-tradables, medium: 20. Few firms are high-innovation part-tradables and non-tradables producers, so I add them to the medium-innovation industry types.

[11]I find no significant heterogeneity by industry type in the direct effect, so this cannot explain the results. In a robustness check, I find similar results when I do not follow the Mian and Sufi (2014) methodology, but instead classify firms with a strictly positive export share as tradable producers.

[12]Changes in household debt cannot explain the non-tradable indirect effect. Di Maggio and Kermani (2017) estimate an elasticity of non-tradable employment with respect to household debt of 0.2. Using their estimate, the lower bound of the 90 percent confidence interval of the household debt effect from column (1) of Table V can only explain 15 percent of the indirect effect on non-tradable, low-innovation firms' employment.

The two theories predict no indirect effect on producers of tradables with low innovation activities. Indeed, the coefficient on these firms in Figure VII is positive and statistically insignificant. In an unreported test, I also find no indirect effect for low- and medium-innovation tradables producers located in an industrial cluster, unlike for high-innovation firms.

## VI.B    The Persistence of the Effects

Firms dependent on Commerzbank reported restrictive bank loan supply in 2009 and 2010, but not in any year before or after (Section III.A). Figure IV shows that employment at firms with Commerzbank among their relationship banks developed in parallel to other firms before the lending cut. In 2009 and 2010, firms dependent on Commerzbank grew more slowly. Afterwards they remained on a lower, parallel trend for two years. Figure VI illustrates the same pattern for counties. Counties close to the post-war head offices, with greater Commerzbank dependence, grew more slowly during the years of the lending cut and did not recover afterwards.

Such persistent losses do not occur in response to all economic shocks. For example, firms and counties exposed to the drop in export demand during the Great Recession converged to the level of unaffected firms and counties in under two years, as shown in Appendix H. A standard neoclassical production function implies that temporary shocks to the capital stock do not lead to persistent output losses. But there is no such mechanism that facilitates convergence after productivity losses. I investigate whether there is evidence that the lending cut lowered innovation and productivity.

Table XII examines the effect of the lending cut on firms' innovation activities, proxied by patents. The outcome in column (1) is the symmetric growth rate of the number of patents between the periods before (2005-08) and after Commerzbank's lending cut (2009-12). If a firm produced no patents in either period, the growth rate is set to zero. If a firm produced at least one patent from 1990 to 2004, I call it a patenting firm. The effect on these patenting firms is large. The growth rate of the number of patents was approximately 55 percentage points lower at patenting firms entirely dependent on Commerzbank. There is no effect on non-patenting firms. It is possible that many non-patenting firms are structurally unsuited to ever issue patents, independent of credit supply, or that in a period of low global growth, few firms choose to commence patenting. Negative binomial count models in columns (2) and (3) confirm that after the lending cut, patenting firms dependent on Com-

merzbank issued significantly fewer patents. There was no significant difference before the lending cut.[13]

At the county level, I use an IV specification to estimate that a standard deviation increase in Commerzbank dependence lowered output per worker by 1.2 percent. There are no data on county capital. Using back-of-the-envelope growth accounting, I calculate that to explain the result while keeping TFP constant, capital would have had to fall by 4.1 percent. This equals 1.9 times the output loss, which is implausibly large. Alternatively, I estimate using the firm panel that the capital-labor ratio at firms fully dependent on Commerzbank fell by 7.7 percent. Under the assumption that for all the other firms the capital-labor ratio grew at an identical rate, a standard deviation increase in Commerzbank dependence reduced county TFP by 1 percent. Therefore, the firm and county data suggest innovation and productivity fell after the lending cut, which could explain the persistent losses.

## VII    Conclusion

This paper presents new evidence on the causal effects of bank lending on economic activity. It analyzes a lending cut by Commerzbank, a large German bank. The lending cut was not caused by domestic factors, but it was imported to Germany through Commerzbank's trading losses on international financial markets during the financial crisis of 2008/09. The results show that the lending cut lowered the output and employment of firms and counties dependent on Commerzbank.

Two key findings stand out. First, there were indirect effects of the lending cut that affected firms independently of their immediate bank loan supply. The results suggest that these indirect effects operated through lower aggregate demand and reduced agglomeration spillovers among high-innovation firms. Second, a bank lending cut causes an extended hangover. Both firms and counties dependent on Commerzbank experienced lower growth rates during the years of the lending cut. Thereafter, they returned to the growth rates of unaffected firms and counties, but did not converge to the unaffected levels. This pattern resembles the growth experience of the United States and other developed economies following the financial crisis of 2008/09.

The findings in this paper contribute to the academic discussion about the Great Recession and its aftermath. Reifschneider et al. (2015) and Anzoategui et al.

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[13]The average patenting process takes around two years. In unreported results, I find the effect on patents is entirely driven by the years after 2011, with no significant difference for the years before.

(2017) interpret the productivity slowdown following the Great Recession as an endogenous response to weak aggregate demand. This paper's finding of an indirect demand effect suggests that bank lending cuts during the financial crisis can partially account for the aggregate demand shortfall. In addition, the evidence in this paper shows a direct, causal link from bank lending cuts to lower innovation and productivity. Since economies are unable to make up productivity shortfalls in only a few years, recoveries from banking crises are slow. This pattern can be seen in the slow recovery from the Great Recession and the lengthy recessions associated with banking crises in the cross-country literature.

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# Tables

## Table I: Summary statistics for the firm panel

|  | mean | sd | p5 | p50 | p95 |
|---|---|---|---|---|---|
| Firm CB dep | 0.16 | 0.23 | 0.00 | 0.00 | 0.50 |
| No of relationship banks | 3.00 | 1.54 | 1.00 | 3.00 | 6.00 |
| Employment | 913.71 | 11,592.54 | 19.00 | 132.00 | 2,030.00 |
| Wage | 32.04 | 47.15 | 15.51 | 29.46 | 46.37 |
| Capital | 57,711.61 | 544,582.57 | 225.75 | 5,467.81 | 196,539.06 |
| Liabilities | 152,628.46 | 3,657,557.10 | 1,552.79 | 8,848.93 | 213,144.20 |
| Export share | 11.02 | 21.31 | 0.00 | 0.00 | 64.00 |
| Import share | 5.24 | 16.73 | 0.00 | 0.00 | 40.00 |
| Age | 47.60 | 45.90 | 13.00 | 31.00 | 126.00 |
| Bank debt/liabilities | 0.48 | 0.26 | 0.05 | 0.49 | 0.90 |
| Liabilities/assets | 0.66 | 0.21 | 0.26 | 0.68 | 0.98 |
| Firms | 2,011 | | | | |

Notes: The data are from the firm panel for the year 2006. Monetary values are in year 2000 thousands of Euro. Capital is the book value of fixed tangible assets. The wage is the total wage bill divided by the number of employees. The export share is the percentage of exports out of total revenue, and the import share is the percentage of imports out of total costs.

## Table II: Summary statistics for the county dataset

|  | mean | sd | p5 | p50 | p95 |
|---|---|---|---|---|---|
| County CB dep | 0.12 | 0.06 | 0.04 | 0.11 | 0.23 |
| 2000 GDP (in year 2010 bn Euro) | 6.01 | 9.12 | 1.46 | 3.63 | 14.31 |
| 2000 Population (in 1000s) | 203.28 | 229.39 | 52.68 | 147.12 | 487.13 |
| 2000 Employment (in 1000s) | 98.27 | 126.49 | 29.90 | 64.50 | 220.40 |
| Former GDR | 0.16 | 0.37 | 0 | 0 | 1 |
| Landesbank in crisis | 0.67 | 0.47 | 0 | 1 | 1 |
| CB dist instrument | 1.63 | 0.97 | 0.28 | 1.51 | 3.43 |
| GDP Growth 2008-12 | 2.66 | 6.18 | -7.25 | 2.73 | 11.76 |
| Employment Growth 2008-12 | 2.79 | 3.22 | -1.98 | 2.77 | 7.21 |
| Observations | 385 | | | | |

Notes: The data are from the Federal Statistical Office of Germany. CB dist instrument is the county's distance to the closest post-war Commerzbank head office, in 100 kilometers. Landesbank in crisis is a dummy for whether the county's Landesbank suffered losses in the financial crisis (Puri et al. 2011). Growth rates are in percent.

## Table III: Firm survey on banks' willingness to grant loans

| YEAR | (1) 2007 | (2) 2008 | (3) 2009 | (4) 2010 | (5) 2011 | (6) 2012 |
|---|---|---|---|---|---|---|
| Firm CB dep | -0.111 | -0.095 | -0.473 | -0.316 | 0.059 | 0.379 |
| | (0.157) | (0.140) | (0.190) | (0.182) | (0.197) | (0.184) |
| Dep var from 2006 | 0.631 | 0.522 | 0.380 | 0.365 | 0.335 | 0.206 |
| | (0.041) | (0.047) | (0.051) | (0.055) | (0.055) | (0.050) |
| | | | | | | |
| Observations | 856 | 988 | 1,032 | 946 | 898 | 503 |
| $R^2$ | 0.460 | 0.371 | 0.204 | 0.213 | 0.207 | 0.199 |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Size Bin FE | Yes | Yes | Yes | Yes | Yes | Yes |
| ln age | Yes | Yes | Yes | Yes | Yes | Yes |

Notes: This table reports estimates from cross-sectional firm regressions for different years. The outcome variable is the answer to the question: "How do you evaluate the current willingness of banks to grant loans to businesses: cooperative (coded as 1), normal (0), or restrictive (-1)?" It is standardized to have zero mean and unit variance. The coefficients are interpreted as the standard deviation increase in banks' willingness to grant loans from increasing Commerzbank dependence by one. The control variables include fixed effects for 36 industries, 16 federal states, 4 size bins (1-49, 50-249, 250-999, and over 1000 employees in the year 2006), and the ln of firm age. Standard errors are clustered at the level of the county.

## Table IV: Firm bank loans and Commerzbank dependence

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| County CB dep*d | -0.170 | -0.237 | -0.186 | |
| | (0.137) | (0.127) | (0.040) | |
| Firm CB dep*d | | | | -0.205 |
| | | | | (0.078) |
| | | | | |
| Observations | 11,382 | 11,382 | 11,382 | 12,066 |
| $R^2$ | 0.009 | 0.010 | 0.032 | 0.094 |
| Number of firms | 1,897 | 1,897 | 1,897 | 2,011 |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| ln age*d | No | Yes | Yes | Yes |
| Size Bin FE*d | No | Yes | Yes | Yes |
| Industry FE*d | No | No | Yes | Yes |
| Import and Export Share*d | No | No | Yes | Yes |
| County FE*d | No | No | No | Yes |

Notes: This table reports estimates from firm OLS panel regressions. The outcome in all columns is firm ln bank loans. Firm CB dep is the fraction of the firm's relationship banks that were Commerzbank branches in 2006. County CB dep is the average of firm CB dep over firms in the county. d is a dummy for the years following the lending cut, 2009 to 2012. The sample size is smaller in columns (1) to (3) because county Commerzbank dependence is missing for counties that underwent border reforms in the years after the lending cut. The following time-invariant control variables are calculated for the year 2006 and interacted with d: fixed effects for 70 industries, 357 counties, and 4 firm size bins (1-49, 50-249, 250-999, and over 1000 employees); the ln of firm age; the export share is the fraction of exports out of total revenue; and the import share is the fraction of imports out of total costs. The data include the years 2007 to 2012. $R^2$ is the within-firm $R^2$. Standard errors are two-way clustered at the level of the county and the industry.

Table V: Household debt and county Commerzbank dependence

| OUTCOME | (1) Total debt growth 2007-12 | (2) Total debt growth 2007-12 | (3) Total debt growth 2007-12 | (4) Debtor 2008 | (5) Debtor 2009 | (6) Debtor 2010 | (7) Debtor 2011 | (8) Debtor 2012 |
|---|---|---|---|---|---|---|---|---|
| County CB dep | 0.107 | 0.007 | 0.112 | 0.027 | 0.080 | -0.052 | 0.050 | 0.104 |
|  | (0.234) | (0.272) | (0.300) | (0.126) | (0.124) | (0.114) | (0.131) | (0.165) |
| Ln mortgage debt 2002 | -0.042 | -0.042 | -0.036 | 0.018 | 0.018 | 0.015 | 0.015 | 0.011 |
|  | (0.003) | (0.005) | (0.004) | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) |
| Ln other debt 2002 | -0.006 | -0.006 | -0.005 | 0.008 | 0.008 | 0.008 | 0.009 | 0.010 |
|  | (0.006) | (0.006) | (0.006) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| Debtor in 2002 FE | -0.028 | -0.028 | -0.088 | 0.278 | 0.253 | 0.231 | 0.208 | 0.202 |
|  | (0.039) | (0.039) | (0.040) | (0.015) | (0.015) | (0.017) | (0.016) | (0.018) |
| Observations | 6,423 | 6,423 | 6,423 | 10,829 | 9,992 | 9,206 | 8,520 | 7,409 |
| $R^2$ | 0.048 | 0.053 | 0.069 | 0.395 | 0.399 | 0.404 | 0.289 | 0.288 |
| County controls | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Individual controls | No | No | Yes | Yes | Yes | Yes | Yes | Yes |

Notes: This table reports estimates from cross-sectional OLS regressions using data on individuals over 16 years of age from the GSOEP. The outcome in columns (1) to (3) is the symmetric growth rate of total debt from 2007 to 2012. If an individual has no debt in either year, the growth rate is set to zero. The outcomes in columns (4) to (8) are dummy variables for any outstanding debt in the given year. The mean value of the outcome in 2007 is 0.4. To avoid dropping observations with zero debt in 2002 from the sample, I add one Euro to the 2002 debt levels before transforming them into the ln control variables. The county controls include 17 industry shares, population density, population (in ln), GDP per capita (in ln), and the Schufa 2003 debt index, as described in Table VIII. The individual controls are all measured in 2007. They include dummies for sex, the individual's employment status (unemployed, full-time, part-time, not in labor force), the employment status of household members (at least one full-time employed, at least one part-time employed, none employed), the former GDR, the number of children in the household, the number of adults in the household, the number of years in education of the most-educated household member (<10, 10, 11, 12, 13, >13), ten dummies for the deciles in the age distribution, and ten dummies for the deciles in the household income distribution. Standard errors are clustered at the level of the county.

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## Table VI: Firm employment and Commerzbank dependence

|  | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Firm CB dep*d | -0.044 | -0.047 | -0.053 |  |  |
|  | (0.021) | (0.016) | (0.015) |  |  |
| Low bank debt dep*Firm CB dep*d |  |  |  | -0.035 |  |
|  |  |  |  | (0.032) |  |
| High bank debt dep*Firm CB dep*d |  |  |  | -0.071 |  |
|  |  |  |  | (0.020) |  |
| $(0 < \text{Firm CB dep} \leq 0.25)*d$ |  |  |  |  | 0.007 |
|  |  |  |  |  | (0.016) |
| $(0.25 < \text{Firm CB dep} \leq 0.5)*d$ |  |  |  |  | -0.017 |
|  |  |  |  |  | (0.008) |
| $(0.5 < \text{Firm CB dep} \leq 1)*d$ |  |  |  |  | -0.065 |
|  |  |  |  |  | (0.018) |
| Observations | 12,066 | 12,066 | 12,066 | 12,066 | 12,066 |
| $R^2$ | 0.026 | 0.098 | 0.124 | 0.125 | 0.125 |
| Number of firms | 2,011 | 2,011 | 2,011 | 2,011 | 2,011 |
| Firm FE | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| County FE*d | No | Yes | Yes | Yes | Yes |
| Size Bin FE*d | No | Yes | Yes | Yes | Yes |
| ln age*d | No | Yes | Yes | Yes | Yes |
| Industry FE*d | No | No | Yes | Yes | Yes |
| Import and Export Share*d | No | No | Yes | Yes | Yes |

Notes: This table reports estimates from firm OLS panel regressions. The outcome in all columns is firm ln employment. Firms with low (high) bank debt dependence have up to (over) 50 percent of their liabilities with banks. The control variables, the standard error calculations, the years covered by the data, and the definition of $R^2$ are explained in Table IV.

## Table VII: Further firm outcomes and Commerzbank dependence

| OUTCOME | (1) Capital | (2) Val add | (3) Val add/capital | (4) Val add/empl | (5) Wage | (6) Int rate |
|---|---|---|---|---|---|---|
| Firm CB dep*d | -0.130 | -0.061 | 0.069 | -0.008 | 0.001 | -0.003 |
|  | (0.038) | (0.028) | (0.038) | (0.024) | (0.011) | (0.003) |
| Observations | 12,066 | 12,066 | 12,066 | 12,066 | 12,066 | 12,024 |
| $R^2$ | 0.131 | 0.116 | 0.116 | 0.091 | 0.069 | 0.073 |
| Number of firms | 2,011 | 2,011 | 2,011 | 2,011 | 2,011 | 2,004 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm Controls*d | Yes | Yes | Yes | Yes | Yes | Yes |

Notes: This table reports estimates from firm OLS panel regressions. The respective outcome is given in the column title. Capital is the ln book value of fixed tangible assets. Value added (val add) is the ln of revenue minus expenditure on intermediates. Value added per worker is ln(val add/empl) and per unit of capital is ln(val add/cap). The wage is the ln of the wage bill divided by the number of employees. The interest rate is the interest paid over total liabilities. The control variables, the standard error calculations, the years covered by the data, and the definition of $R^2$ are explained in Table IV.

Table VIII: County outcomes and Commerzbank dependence (OLS)

|  | (1)<br>GDP | (2)<br>GDP | (3)<br>GDP | (4)<br>Empl | (5)<br>Net migr |
|---|---|---|---|---|---|
| OUTCOME |  |  |  |  |  |
| County CB dep*d | -0.132 | -0.165 | -0.141 | -0.138 | 0.003 |
|  | (0.063) | (0.066) | (0.077) | (0.042) | (0.006) |
| Observations | 5,005 | 5,005 | 5,005 | 5,005 | 1,925 |
| $R^2$ | 0.301 | 0.341 | 0.350 | 0.494 | 0.592 |
| Number of counties | 385 | 385 | 385 | 385 | 385 |
| County FE | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Former GDR FE*d | No | Yes | Yes | Yes | Yes |
| Industry Shares*d | No | Yes | Yes | Yes | Yes |
| Export and Import Shares*d | No | Yes | Yes | Yes | Yes |
| Landesbank in crisis*d | No | Yes | Yes | Yes | Yes |
| Population*d | No | No | Yes | No | No |
| Pop density*d | No | No | Yes | No | No |
| GDP per capita*d | No | No | Yes | No | No |
| Debt Index*d | No | No | Yes | No | No |
| Estimator | OLS | OLS | OLS | OLS | OLS |

Notes: This table reports estimates from county OLS panel regressions of county outcomes on Commerzbank dependence (CB dep) interacted with d, a dummy for the years following the lending cut, 2009 to 2012. The outcome in columns (1) to (3) is ln GDP, in column (4) ln employment, and in column (5) net migration (immigration - out-migration) normalized by 2006 employment. Migration data for all counties are only available for the years 2008 to 2012. The industry shares are 17 variables, giving the fraction of firms in each of the 17 industries in 2006 (agriculture, mining, manufacturing, utilities, recycling, construction, retail trade and vehicle repairs, transportation and storage, hospitality, information, finance, real estate, business services, other services, public sector, education, health). The export share is the fraction of exports out of total revenue and the import share is the fraction of imports out of total costs, both averaged across firms in the county for 2006. Landesbank in crisis is a dummy for whether the county's Landesbank suffered losses in the financial crisis. Population density, total population (in ln) and GDP per capita (in ln) are from 2000. Debt index is a 2003 measure of county household leverage, calculated by credit rating agency Schufa (Privatverschuldungsindex). The regressions are weighted by year 2000 population. Standard errors are clustered at the level of 42 quantiles of the county's industrial production share (GDP share of mining, manufacturing, utilities, recycling, construction). The data include the years 2000 to 2012. $R^2$ is the within-county $R^2$.

## Table IX: County outcomes and Commerzbank dependence (IV)

| OUTCOME | (1) CB dep | (2) CB dep | (3) GDP | (4) GDP | (5) GDP | (6) Empl | (7) Net migr |
|---|---|---|---|---|---|---|---|
| Dist instr*d | 0.028 | 0.042 | | | | | |
| | (0.005) | (0.006) | | | | | |
| County CB dep*d | | | -0.335 | -0.367 | -0.345 | -0.208 | 0.026 |
| | | | (0.118) | (0.182) | (0.173) | (0.113) | (0.020) |
| | | | | | | | |
| Observations | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 1,925 |
| $R^2$ | 0.876 | 0.941 | 0.322 | 0.348 | 0.355 | 0.504 | 0.590 |
| Number of counties | 385 | 385 | 385 | 385 | 385 | 385 | 385 |
| County FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Former GDR FE*d | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Linear Distances*d | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Shares*d | No | Yes | No | Yes | Yes | Yes | Yes |
| Export and Import Shares*d | No | Yes | No | Yes | Yes | Yes | Yes |
| Landesbank in crisis*d | No | Yes | No | Yes | Yes | Yes | Yes |
| Population*d | No | Yes | No | No | Yes | No | No |
| Pop density*d | No | Yes | No | No | Yes | No | No |
| GDP per capita*d | No | Yes | No | No | Yes | No | No |
| Debt Index*d | No | Yes | No | No | Yes | No | No |
| Estimator | OLS | OLS | IV | IV | IV | IV | IV |

Notes: This table reports estimates from county panel regressions. Columns (1) and (2) report the first stage and columns (3) to (7) the IV regressions. The distance instrument is the negative of the county's distance to the closest post-war Commerzbank head office, in 100 kilometers. The linear distances include the county's distances to Düsseldorf, Frankfurt, Hamburg, Berlin, and Dresden. The outcomes, other control variables, weights, standard error calculations, the years covered by the data, and the definition of $R^2$ are explained in Table VIII.

## Table X: The direct and indirect effect on firm employment growth

| | (1) | (2) |
|---|---|---|
| Firm CB dep | -0.030 | -0.036 |
| | (0.009) | (0.009) |
| CB dep of other firms in county | -0.166 | -0.170 |
| | (0.076) | (0.082) |
| | | |
| Observations | 48,101 | 48,101 |
| $R^2$ | 0.012 | 0.017 |
| Firm Controls | Yes | Yes |
| County Controls | No | Yes |

Notes: This table reports estimates from cross-sectional firm OLS regressions. The outcome is the symmetric growth rate of firm employment from 2008 to 2012. CB dep of other firms in county is the average firm Commerzbank dependence of all the other firms in the county. The firm control variables are the same as in Table IV, except there are no county fixed effects. The county controls and the standard error calculations are the same as in Table VIII.

## Table XI: The implied county employment change based on different estimates

| Row | Estimate from section | Estimator | Dataset | Estimated effect | Point estimate | 95 percent CI Lower | Upper |
|---|---|---|---|---|---|---|---|
| 1 | IV.B | OLS | Firm Panel | Only Direct | -0.32 | -0.49 | -0.14 |
| 2 | V.B | OLS | County Panel | Direct & Indirect | -0.83 | -1.31 | -0.34 |
| 3 | V.C | IV | County Panel | Direct & Indirect | -1.25 | -2.58 | -0.09 |
| 4 | VI.A | OLS | Firm Cross-section | Direct & Indirect | -1.24 | -2.17 | -0.29 |

Notes: This table reports different estimates of the county employment loss from increasing county Commerzbank dependence by a standard deviation (6 percentage points). Row 1 uses the estimate of the direct effect from column (3) of Table VI. Row 2 uses the county OLS estimate from Table VIII, column (4). Row 3 uses the county IV estimate from Table IX, column (6). Row 4 uses the sum of direct and indirect effect from column (2) of Table X.

## Table XII: Firm patents and Commerzbank dependence

| OUTCOME | (1) Growth rate of patents | (2) Patents post lending cut | (3) Patents pre lending cut |
|---|---|---|---|
| Patenting*Firm CB dep | -0.548 | -0.770 | 0.206 |
| | (0.245) | (0.409) | (0.409) |
| Non-patenting*Firm CB dep | 0.037 | | |
| | (0.065) | | |
| Ln Patents 1990-2004 | | 0.671 | 0.687 |
| | | (0.088) | (0.116) |
| | | | |
| Observations | 2,011 | 382 | 382 |
| $R^2$ | 0.251 | | |
| ln age | Yes | Yes | Yes |
| Size Bin FE | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes |
| County FE | Yes | No | No |
| State FE | No | Yes | Yes |
| Import and Export Share | Yes | Yes | Yes |
| Only patenting firms in sample | No | Yes | Yes |
| Estimator | OLS | Neg bin | Neg bin |

Notes: A patenting firm is defined as a firm that has produced at least one patent from 1990 to 2004. The outcome in column (1) is the symmetric growth rate of the number of patents between the periods before (2005-08) and after Commerzbank's lending cut (2009-12). If a firm produces no patents in either period, the growth rate is set to zero. The control variables and the standard error calculations in column (1) are the same as in Table IV. Standard errors in columns (2) and (3) are clustered at the level of the industry.

**Figures**

Figure I: The lending stock of German banks
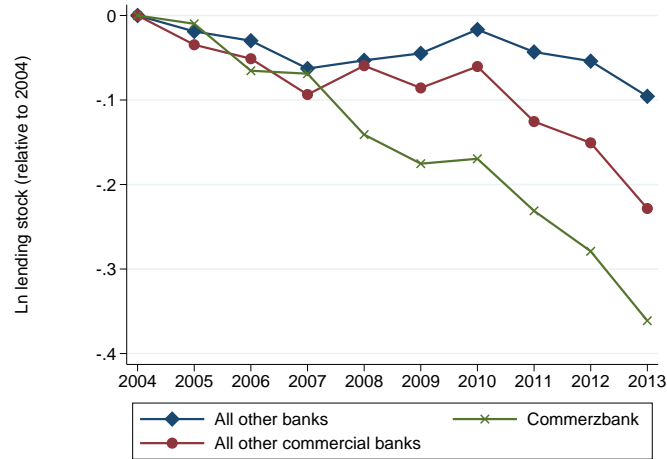


Notes: This figure plots the ln lending stock to German non-financial customers, relative to the year 2004, in 2010 billion Euro. The data for Commerzbank include lending by branches of Commerzbank and Dresdner Bank. I sum their lending stock for the years before the 2009 take-over, using data from the annual reports. For "all other banks", I use aggregated data from the Deutsche Bundesbank on German banks and subtract lending by Commerzbank. For "all other commercial banks", I subtract lending by Commerzbank, the savings banks, the Landesbanken, and the cooperative banks.

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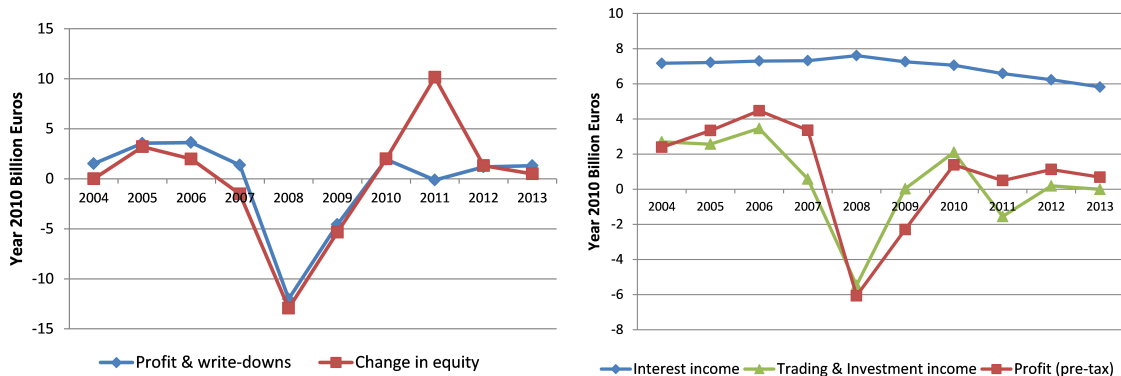


Notes: The left panel shows Commerzbank's profits & write-downs and equity capital. Write-downs arise from changes in revaluation reserves, cash flow hedges and currency reserves. The right panel shows the composition of Commerzbank's profits. Interest income is interest received from loans and securities minus interest paid on deposits. Trading & 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 & investment income minus costs. The values are in year 2010 billion Euro. I aggregate the positions of Commerzbank and Dresdner Bank for the years before the 2009 take-over. The data are from the annual bank reports.

Figure III: Firm and county Commerzbank dependence
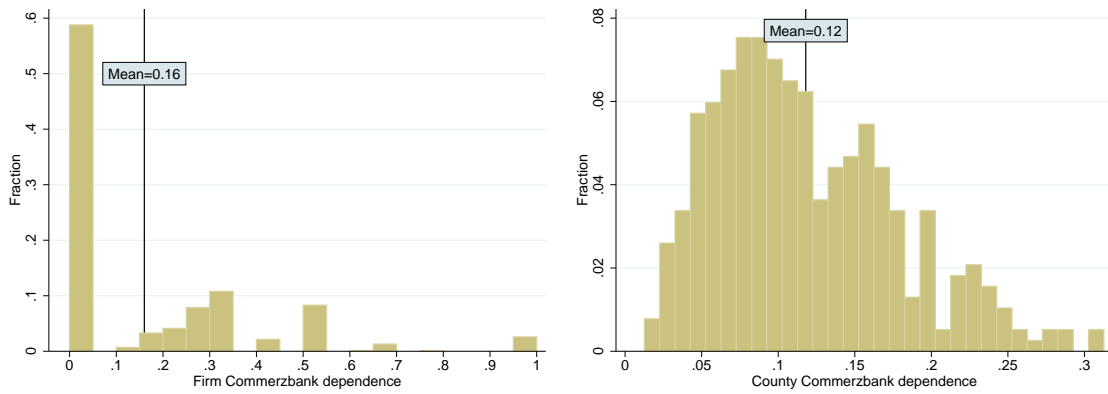


Notes: The figure shows histograms of firm Commerzbank dependence for the 2,011 firms in the firm panel (on the left) and of county Commerzbank dependence for the 385 counties in the dataset (on the right).

Figure IV: Firm employment effects
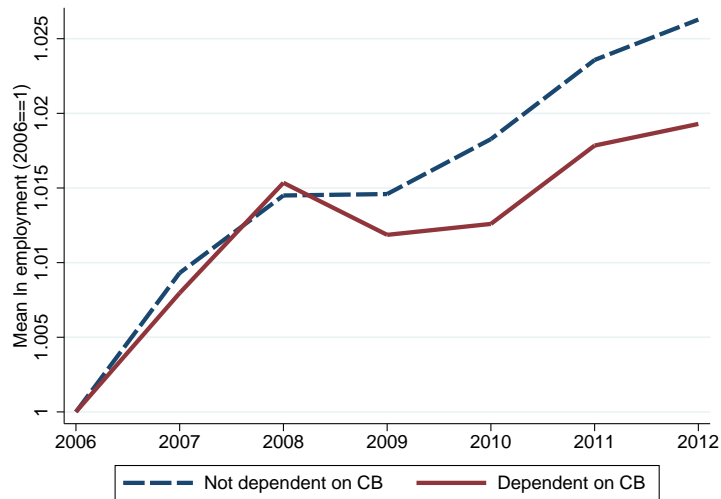


Notes: This figure plots the time series of the mean ln employment of firms with and without Commerzbank as one of their relationship banks. The time series are divided by their 2006 value. The data are from the firm panel.

Figure V: County GDP growth, Commerzbank dependence, and the distance instrument
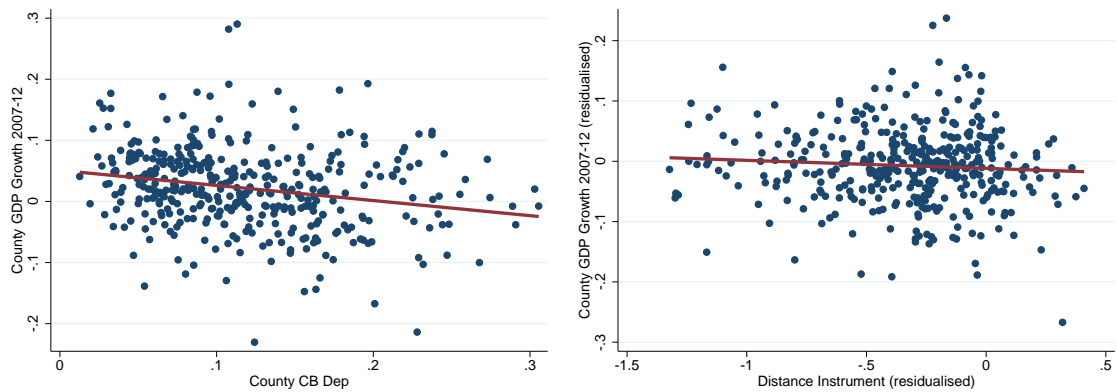


Notes: The left figure plots county GDP growth from 2007 to 2012 against county Commerzbank depen-dence. The right figure plots county GDP growth against the distance instrument, where both variables are residualized of the linear distances to Düsseldorf, Frankfurt, Hamburg, Berlin, and Dresden, and of a dummy for the former GDR. Both linear slope coefficients are negative and significant at the 1 percent level.

Figure VI: Reduced-form impact of the instrument on the county GDP growth rate
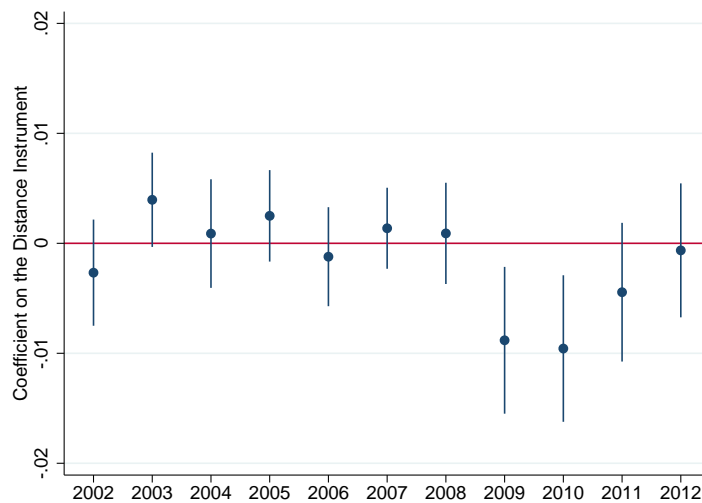


Notes: This figure is based on a single regression, in which the dependent variable is the county's annual GDP growth rate. The plotted point estimates are the coefficients on the instrument, interacted with annual dummy variables. The vertical lines are 90 percent confidence intervals. The regression includes year and county fixed effects and the full set of control variables from Table IX, including the linear distances. The standard errors are calculated as in Table VIII.

Figure VII: The size of the indirect effect by industry type
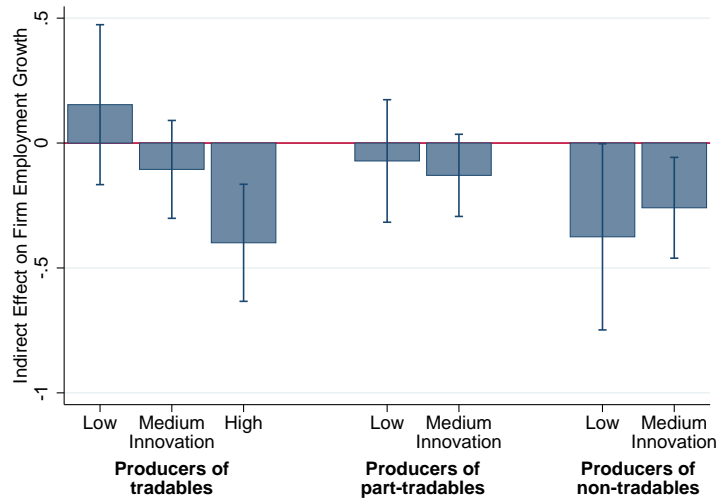


Notes: This figure illustrates heterogeneity in the indirect effect by industry type. The plotted point estimates are the effect of the Commerzbank dependence of all other firms in the county on the symmetric growth rate of firm employment between 2008 and 2012. The estimates are from a single regression that controls for the firm's direct Commerzbank dependence and the other control variables from Table X. The vertical lines are 90 percent confidence intervals.

## Appendix A  Firm Summary Statistics

I present summary statistics for the firm panel by six bins of Commerzbank dependence in Appendix Table A.VI. In general, the table shows no linear relationship between Commerzbank dependence and firm characteristics. For instance, mean employment is less than 800 in the top two bins, for firms with Commerzbank dependence over 0.4. Employment is largest for firms in the mid-category, while the bins with low Commerzbank dependence have mean employment between 800 and 1,000. The average wage is fairly stable across the bins. The mean of total liabilities behaves similarly to employment. Firms with no Commerzbank dependence are somewhat of an outlier as they hold a large stock of liabilities given their employment and capital stock. The standard errors are large, however, indicating that the differences between the bins are not statistically significant. To conduct a test with greater statistical power, I pool all firms with a Commerzbank relationship and compare them to firms with zero Commerzbank dependence. I find no statistically significant difference between the two groups (t-statistic: 0.31). Bank loans over total liabilities are similar across bins. This suggests that the degree of Commerzbank dependence is not correlated with firms' dependence on banks.

Appendix Table A.II carries out a regression-based test of whether Commerzbank dependence is correlated with firm observables before the lending cut. I regress firm Commerzbank dependence ($CB\ dep_f$) on a cross-section of firm observables from 2006. The coefficients have the interpretation of the approximate change in Commerzbank dependence following a 100 percent increase in the regressor. Only the coefficient on ln capital has a coefficient that is statistically significantly different from zero. The estimate implies that a 100 percent increase in the capital stock is associated with a 0.014 decrease in Commerzbank dependence. There is no difference in the value of financial assets or the amount of bank loans. I therefore conclude that while there are slight differences between firms dependent on Commerzbank and other firms in the firm panel, they are not large.

## Appendix B  Commerzbank's Trading Losses

This section provides more institutional detail on the trading losses that forced Commerzbank to cut lending.

**Appendix B.A  Interpreting Financial Analyst Research Reports**

Understanding the details of Commerzbank's trading losses is not trivial, because almost no bank publishes its detailed financial asset holdings. A more promising resource are research reports by financial analysts. I use the investment database Thomson Reuters Investext to extract relevant research reports on Commerzbank before and during the financial crisis. I focus on the period from 2008 to 2009, as these were the loss-making years, extracting all the available reports from Thomson Reuters Investext for this period. I also consider the most relevant reports from the years before and after, to understand the build-up of Commerzbank's trading portfolio and the years after the lending cut. Overall, I analyze the 110 research reports listed at the end of the references section of the Appendix.

I formulate nine questions in Table A.VII that relate to the origin and nature of Commerzbank's trading losses. For each question, I begin by counting the number of reports that can provide any relevant information to a question. I then categorize the reports into three categories. Either they offer a clear conclusion (Answer yes/no) or they give information without committing either way (Answer unclear).

To illustrate my method, consider question 1 of Table A.VII. This questions asks whether trading income was more volatile at Commerzbank than at other German banks. One report mentions that Commerzbank's trading portfolio remained "resilient when even the large investment banks were struggling", so it gets classified as answering no to question 1 (Kepler Cheuvreux 6/11/2006). Many reports analyze movements in trading income, describing strengths and weaknesses, but do not make an explicit judgment on the relative volatility of the trading portfolio. These get classified as providing an unclear answer to question 1.

Questions 2, 8, and 9 are categorized in the same manner as question 1. Questions 3 to 7 are of a different style, asking whether a certain factor is mentioned explicitly as cause of Commerzbank's losses during the financial crisis of 2008/09. There are no unclear answers for these questions.

Commerzbank announced its acquisition of Dresdner Bank in 2008 and completed it in January 2009. From mid-2008 onward, there are few reports that analyze Dresdner Bank separately, so I report results combining the information for the new, enlarged Commerzbank for the period after 2008. When I generally refer to Commerzbank, this includes Dresdner Bank.

In what follows, I describe the narrative of Commerzbank's trading losses, drawing on the reports of Table A.VII, financial statements, and additional sec-

ondary sources.

**Appendix B.B    The Expansion Into Trading During the Early 2000s**

From the early 2000s onward, German banks began increasing their international activities. The main actors were the large commercial banks, Commerzbank, Deutsche Bank, and Dresdner Bank (which was acquired by Commerzbank in January 2009), as well as the publicly owned Landesbanken. Unlike their competitors from France, Spain, and Italy, this internationalization was not driven by retail branching into foreign countries. Instead, German banks focused on trading on international financial markets (Hardie and Howarth 2013).

There was political support for this expansion, as Germany was suffering from anemic growth and a recession in 2003. Politicians hoped trading profits would allow banks to raise credit supply. For example, the federal 2003 *Kleinunternehmerförderungsgesetz* (law for the promotion of small businesses) introduced tax benefits for financial institutions involved in secularization, and the 2005 coalition agreement mentioned the development of secularization markets as a policy goal. The secularization of German assets had only been legalized in 1997, so these markets were small and unimportant before and during the financial crisis of 2008/09.

Commerzbank took part in this trading expansion, but not to an extraordinary degree relative to the other banks. The share of trading assets out of total assets at Commerzbank rose from 12 percent in 1999 to 22 percent in 2005, the eve of the United States subprime mortgage crisis. The other two large commercial banks had a bigger trading division than Commerzbank already in the 1990s, because Commerzbank's historic focus had been corporate credit. Dresdner Bank's share of trading assets out of total assets was 35 percent in 2005 (1999 data unavailable), and Deutsche Bank went from 27 percent in 1999 to 45 percent in 2005 (source: bank annual reports). For the Landesbanken, there was a similar range, with HSH Nordbank at 13.4 percent in 2006 and WestLB at 32.5 in 2007 ( Hardie and Howarth 2013).

Commerzbank's and Dresdner Bank's increased trading activities coincided with two developments on financial markets. First, the rise of subprime mortgage lending in the United States, which peaked in 2006. German banks invested heavily in investment-grade-rated asset-backed securities based on the United States mortgage market and sold by American investment banks. Second, the expansion of the Icelandic banking sector. The total assets of Icelandic banks increased more

than sixfold (in real terms) between 2003 and 2007 and their total assets grew to 10 times the value of Icelandic GDP. The Icelandic banks relied on financing from European bond markets, interbank credit lines, and wholesale market funding (Flannery 2009). By lending to the Icelandic banks, Commerzbank became more exposed to Iceland than the other German banks. However, this was not considered a risky strategy by the analysts at the time.

For the period 2004 to 2007, the research reports relevant to question 1 of Table A.VII do not suggest that Commerzbank's and Dresdner Bank's trading income was more volatile or riskier than trading income of Deutsche Bank or the Landesbanken. Nine reports describe the year-by-year changes in trading income at different banks without identifying which banks were more volatile. I classify reports of this kind as giving no clear answer. If indeed there was excess volatility in trading incomes or if analysts believed that the trading portfolio was riskier, one would have expected the analysts to mention this in the reports. The lack of a clear statement can therefore be interpreted as evidence against higher volatility at Commerzbank and Dresdner Bank. Two of the reports mention that Commerzbank's trading income was stable relative to the other banks ("normal trading profit" Deutsche Bank Equity Research 7/02/2006; "trading result continued its remarkable stability" Kepler Cheuvreux 6/11/2006).

The capital ratios of German banks strengthen the impression that Commerzbank did not take on more risk than other German banks before the crisis. In 2005, the tier 1 capital ratio at Commerzbank was at 8 percent, Dresdner Bank at 10 percent, Deutsche Bank at 8.7 percent, and the aggregate of German banks at 7.8 percent.

**Appendix B.C    The Relation Between Trading and Loan Portfolios**

Question 2 of Table A.VII asks whether the loan portfolios of Commerzbank and Dresdner Bank were riskier or more cyclical than other banks'. The answer is no. The research reports considered the loan portfolios of Commerzbank and Dresdner Bank a source of income stability and strength. The reports argue that the banks' long-term banking relationships to firms and households were reliable sources of income, because the German market is based on relationship lending and because the German economy is relatively stable. (For example: "We like Commerzbank, which benefits from relatively high exposure to German corporate lending." Deutsche Bank Equity Research 16/01/2004; Commerzbank's "strong

progression in Mittelstand" JPMorgan 10/08/2007; Dresdner Bank's "retail client base is an important lever for revenues" Natixis 22/11/2006). In particular, Commerzbank was known for its strong position in the Mittelstand, the German group of small and medium-sized firms ("firmly established relationships with this client group, which is not easily penetrated by the large international banks, but has demand for a broad range of lucrative products." Bear Stearns & Co. Inc. 5/09/2005). Figure II confirms the remarkable stability of interest income before the lending cut.

There is no evidence in any of the reports that Commerzbank's or Dresdner Bank's trading portfolios were supposed to hedge the loan portfolio (question 3 of Table A.VII). The reports analyze the income streams for the lending division entirely separately from the trading and investment banking divisions ("conceptually separate Commerzbank into three banks" CA Cheuvreux 13/11/2008). One would have expected the bank management to point out cross-hedges between the lending and the trading portfolios in their communication to the analysts, in order to convince them that overall income was relatively stable. The fact that they did not suggests there were no such hedges.

Figure II shows that trading income varied in every year between 2004 to 2008, while net interest income remained on a gentle upward trend throughout the period. Following the trading losses in 2008, we would have expected the performance of firms dependent on Commerzbank and net interest income to improve, if there had been a hedging relationship. Instead, there was initially no change in 2008, followed by the firms underperforming and net interest income slowly declining in the following years. Thus the behavior of trading and net interest income confirms that there was no hedging relationship.

## Appendix B.D    The Trading Losses 2007-09

Why did Commerzbank suffer severe losses during the financial crisis? None of the 83 relevant reports I examined blame the losses on the German loan portfolio (question 4 in Table A.VII). Given the discussion in the previous subsection on the nature of the loan portfolio and the stability of net interest income, this is not surprising. Several reports praise the income generated by the corporate loan and retail divisions from 2007 until the final quarter of 2008, even as trading losses were unfolding. (For example: "Mittelstand once again with a strong performance" ESN/equinet Bank 4/11/2008; Dresdner's "retail business continues to generate

healthy returns" Deutsche Bank Equity Research 28/02/2008).

87 percent of reports explicitly mention losses and write-downs in asset-backed securities (ABS) related to the United States subprime mortgage crisis as loss drivers at Commerzbank and Dresdner Bank. These ABS include collateralized debt obligations, residential mortgage-backed securities, and credit default swaps. As the price of the ABS fell, the banks had to write down their values and sell at a loss. The research reports cite figures released by the banks to financial analysts to underscore the influence of the ABS on the banks. Dresdner Bank lost 1.3 billion Euro on its ABS trading portfolio in 2007, which on its own can explain around 75 percent of the difference in its trading income to the previous year. The remainder is accounted for by spill-over effects from the subprime mortgage crisis to other financial markets, as liquidity and confidence in trading markets declined (breakdown of figures in CA Cheuvreux 24/04/2008). The story for Commerzbank is similar, as around 84 percent of its 2007 trading losses are due to losses in subprime ABS (Credit Suisse - Europe 25/03/2008).

By mid-2008, Commerzbank and Dresdner Bank were severely weakened, but there were no acute fears of bankruptcy. They were in a similar position to the other German banks (Commerzbank "handled the financial crisis relatively well" Kepler Cheuvreux 7/08/2008; "Dresdner has not done worse than other banks" Deutsche Bank Equity Research 28/02/2008). This changed when Lehman Brothers declared insolvency on 15 September 2008. As wholesale funding markets froze, the three large Icelandic banks were taken into government custody in October 2008, and their international creditors lost their deposits. Figures released to analysts by Commerzbank and Dresdner Bank confirm that the bulk of the losses in 2008 and 2009 can be explained by losses on the ABS trading portfolios and items that had to be written down because of Lehman Brothers' and the Icelandic banks' insolvency (see, for instance, ESN 1/12/2009 and Credit Suisse - Europe 26/02/2009). These were the main factors behind the equity capital shortages at Commerzbank and Dresdner Bank (questions 5 to 7 in Table A.VII).

The importance of the insolvency of Lehman Brothers and the Icelandic banks can be seen in the timing of the 2008 quarterly results. Both Commerzbank and Dresdner Bank achieved positive earnings in the first and second quarters. The significant 2008 losses that we see in Figure II are entirely driven by third and fourth quarter trading losses and write-downs. Losses related to ABS write-downs continued throughout 2009.

The German bond markets did not deteriorate in this period, so Commerzbank's

and Dresdner Bank's ABS losses were unrelated to the German economy. Germany saw a low default rate of around 0.3 percent for securitized transactions issued between 2005 and 2007, while in the United States subprime mortgage market the default rate was around 20 percent (International Monetary Fund 2011). The index for German mortgage covered bonds (iBoxx Euro Hypothekenpfandbriefe) rose by 18 percent between the end of 2006 and 2009. The index for German corporate bonds (RDAX) gained 17 percent in the same period. In comparison, the index for US AAA-rated subprime ABS (ABX.HE-AAA 07-1) fell by around 65 percent and the index for A-rated subprime ABS (ABX.HE-A 07-1) by over 95 percent.

The reason for the trading losses was the failure of the management of Commerzbank and Dresdner Bank to recognize the institutional instability that the financial crisis had caused in other institutions. Commerzbank wrote in its 2008 annual report: "We were encouraged by the US Treasury Department's rescue of Bear Stearns and for too long shared the market's mistaken belief that Lehman was too big to fail." Similarly, it had been too tentative in reducing its exposure to the Icelandic banks.

This is what differentiated it from Deutsche Bank, which profited from consequently hedging its ABS portfolio and shorting the subprime mortgage market, after the first signs of distress became apparent in 2007 (Fox-Pitt Kelton Cochran Caronia Waller 2/01/2008; O'Donnell and Nann 2008; Landler 2008). A number of Landesbanken followed a similar trading strategy as Commerzbank, for example Bayern LB, Sachsen LB, and West LB. However, they were publicly owned, and could rely on quick government funding at all stages of the crisis, preventing equity capital shortages and hence a lending cut (see Appendix E for details on the Landesbanken).

## Appendix B.E    Commerzbank's 2009 Acquisition of Dresdner Bank

The insurance company Allianz had acquired Dresdner Bank in 2001. The aim was to exploit economies of scale and build a nationwide branch network offering "bankassurance", the combined retail of banking and insurance products. By 2007, it became clear that the plan had failed. The research reports and the media blamed management errors and the complexity of the task of merging the world's largest insurer with Germany's third-largest bank (CA Cheuvreux 24/04/2008). In late 2007 Allianz decided to give up the plan of "bankassurance", sell Dresdner, and refocus on its core business of insurance.

Commerzbank's management had first expressed interest in expanding in 2007. Commerzbank wanted to enlarge its German retail banking customer base and it was worried about being a takeover target itself (Schultz 2008). Dresdner Bank, with its solid and traditional retail banking division, was a natural option. The proposed acquisition got much political support, as German politicians were fond of the idea of a second "national banking champion", next to Deutsche Bank. German finance minister Steinbrück and Commerzbank head Blessing appeared on national television together to explain the deal.

Commerzbank and Dresdner Bank had got relatively well through the first two quarters of 2008. The acquisition plan was announced on 31 August 2008 and to be completed on 12 January of 2009. The analyst reports welcomed the deal. Out of eleven reports released around the time of the announcement, nine were explicitly positive (question 8 in Table A.VII). Morgan Stanley, for instance, welcomed the deal as "making perfect strategic sense" (Morgan Stanley 1/09/2008). One report delivered no clear judgment, and one argued the purchase price Commerzbank had to pay was too high.

The unexpected Lehman Brothers bankruptcy threw both banks into severe financial distress. Given their similar trading strategy discussed in the previous subsection, it is not surprising that the Commerzbank and Dresdner Bank contributed approximately evenly to the 12 billion Euro in negative profits and write-downs of the combined, enlarged Commerzbank in 2008 (based on my own calculations using the banks' annual reports). 48 percent of the12 billion Euro were due to operations at the "old" Commerzbank and 52 percent due to the "old" Dresdner Bank. It is thus likely that both banks would have had to cut lending even if it had not been for the acquisition. Testing for heterogeneity, I find that the lending cut affected firms and counties similarly, independent of whether they were initially served by Commerzbank or Dresdner Bank.

**Appendix B.F    Recovery by 2011**

The German government fund Soffin supported Commerzbank twice, on 3 November 2008 and on 8 January 2009, but was unable to entirely prevent a lending cut. Overall, Soffin provided Commerzbank with 18.2 billion Euro in equity and bought a 25 percent stake in the bank, around two-thirds of Soffin's total engagement. Commerzbank was the only large lender in Germany to be subsidized by Soffin. Only three other, specialized banks received capital from Soffin (two smaller real

estate banks, Aareal Bank and Hypo Real Estate Group, and the former Landes-
bank West LB/Portigon), which shows that Commerzbank was uniquely affected.

The equity capital losses had forced Commerzbank to shrink its assets, in or-
der to improve the tier 1 capital ratio, reduce risk exposure, and gain the trust of
investors. This resulted in a lending cut to its customers in 2009 and 2010. The
Commerzbank management subsequently refocused the bank on its core business
of lending to German firms and households, whilst downsizing the trading and in-
vestment banking division. The research reports generally comment favorably on
the success of the new strategy (question 9 in Table A.VII). Losses due to the sub-
prime mortgage crisis are not mentioned anymore from 2011. One key piece of
evidence for Commerzbank's recovery is that around 14.3 billion of the 18.2 bil-
lion in equity had been repaid by Commerzbank to the government by mid-2011.
From 2010 onward, lending by Commerzbank moved in parallel to other private
banks once again (Figure I).

## Appendix C  Further Firm Survey Results

Appendix Table A.VIII reports robustness checks on the survey results of Section
III.A. Column (1) shows that the effect in 2009 is not driven by the inclusion of
the lagged dependent variable from 2006. The effect also remains stable and sta-
tistically significant at the 10 percent level when including county fixed effects in
column (2). The year 2003 is an interesting comparison to 2009, because it was
also a recessionary year. It is the first year, in which the question on bank loans was
asked in the survey. The results in columns (3) to (6) of Appendix Table A.VIII
show no association between Commerzbank dependence and bank loan supply or
firms' product demand conditions in 2003. This implies that Commerzbank's loan
supply was not more cyclical than other banks'. It also suggests that firms depen-
dent on Commerzbank did not face different demand conditions in recessions.

I examine three survey questions on demand conditions, to test whether dif-
ferences in product demand might affect the performance of firms dependent on
Commerzbank. Appendix Table A.IX analyzes responses to the question "Are your
business activities constrained by low demand or too few orders: yes or no?", Table
A.X to "Currently we perceive our backlog of orders to be: comparatively large,
sufficient / typical for the season, or too small?", and Table A.XI to "Tendencies in
the previous month - The demand situation has: improved, remained unchanged, or
deteriorated?". Firms are asked these questions at multiple times during the year,

so I use the annual average of responses as outcome variable in the regressions. For these demand questions, none of the coefficients on Commerzbank dependence are statistically significant in any year, and most are of small magnitude. This indicates that neither before, during, or after Commerzbank's lending cut were there differences in the product demand for firms dependent on Commerzbank.

## Appendix D   Firm Financial Assets

The bulk of Commerzbank's trading losses occurred between 2007 and 2009. I test whether firms dependent on Commerzbank experienced a decrease in the value of their financial assets at the same time. If Commerzbank gave firms investment advice correlated with the strategy of its own trading division, one would expect such an effect.

Appendix Table A.XII presents the results. The outcome is the symmetric growth rate of the value of the firm's financial assets in the given period. If a firm begins and ends the period with no financial assets, the growth rate is set to zero. There is no association between Commerzbank dependence and the change in financial assets from 2007 to 2009. The insignificant point estimate in column (2) implies that the growth of financial assets from 2007 to 2009 at a firm fully dependent on Commerzbank was 3.6 percentage points higher than at a firm with no Commerzbank relationship. This result makes sense, given that the analyst reports presented in Appendix B suggest there was little coordination across the trading and corporate lending divisions at Commerzbank. Columns (1) analyzes the year before 2007, column (3) the year after 2009, column (4) a bivariate specification without controls, and column (5) adds county fixed effects. There is no significant effect in any specification.

## Appendix E   An Identification Strategy Based on Savings Banks' Support to the Landesbanken

### Appendix E.A   The Literature Analyzing Affected Savings Banks

Germany has eleven Landesbanken. Each operates in a restricted region, either one federal state or a group of states. The Landesbanken are jointly owned by the federal states and the savings banks of their region. During the financial crisis, five Landesbanken announced significant losses in their trading portfolios: Sachsen LB, HSH Nordbank, WestLB, Bayern LB, and Landesbank Baden-Württemberg.

Following Popov and Rocholl (2015), I define a savings bank to be "affected" if it owns one of the five Landesbanken with trading losses during the crisis.

Puri et al. (2011), Hochfellner et al. (2015), and Popov and Rocholl (2015) argue that the affected savings banks financially supported the Landesbanken they owned, and that this led the savings banks to cut lending. Below, I add further evidence to their analysis. First, I find little evidence that affected savings banks contributed significantly to the support measures to the Landesbanken, lost equity capital, or reduced lending following losses at their Landesbanken.[14] Second, I replicate the findings in Popov and Rocholl (2015) (henceforth PR). I show that the correlation between firm performance and affected savings banks disappears once I add the firm-level controls I use in my paper. There is also no association between firm growth and having an affected Landesbank as relationship bank, and there is no effect on counties.

### Appendix E.B    The Public Support Measures to the Landesbanken

### Appendix E.B.1    Support to Sachsen LB

A detailed narrative for the case of Sachsen LB, the first Landesbank to announce losses, is available from the European Commission investigation report on whether the public support given to Sachsen LB constituted illegal state aid (Kroes 2008). In the middle of August 2007, financial markets became suspicious that Sachsen LB was heavily affected by the subprime mortgage crisis. The bank was unable to finance itself on wholesale markets as a result.

On 17 August, the funding problems were publicly announced. On the same day, German banking regulators, the state government of Saxony, and representatives of the savings banks and other Landesbanken agreed that the other Landesbanken and DekaBank (jointly owned by all the German Landesbanken and all German savings banks) would purchase a set of subprime assets from Sachsen LB. On 26 August, the Landesbank Baden-Württemberg agreed to take over Sachsen LB and immediately injected capital. When further unexpected losses arose in late 2007, the state government of Saxony provided a guarantee for losses from Sachsen LB's securities portfolio of 2.75 billion Euro to Landesbank Baden-Württemberg, in addition to financing a separate investment vehicle that contained troubled assets with 8.75 billion. Sachsen LB and Landesbank Baden-Württemberg were not

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[14]A research report by Fitch confirms this: "Sparkassen-Finanzgruppe Vollständiger Ratingbericht", 15 July 2014, page 16

required to pay back the public funding. Because Sachsen LB was publicly owned, the public support measures were decided within days after it ran into difficulties. There was only a very short period of distress, during which Sachsen LB and the associated savings would have had time to cut lending.

The European Commission does not mention any capital injections or guarantees by the regional savings banks of Saxony to Sachsen LB. The annual report of the savings banks that partially owned Sachsen LB (Sachsen Finanzgruppe Geschäftsbericht 2007, page 4) reports "the sale of Sachsen LB produced no financial burden for the savings banks." The average equity capital of the savings banks that partially owned Sachsen LB grew by 8 percent in 2007, the year of Sachsen LB's distress and subsequent sale. As comparison, Commerzbank lost 68 percent of its equity capital from 2007 to 2009. The aggregate equity capital of German banks except Commerzbank rose by seven percent from 2007 to 2009. Overall, there is little evidence to suggests that the savings banks were strongly affected by the losses at Sachsen LB.

### Appendix E.B.2 Support to HSH Nordbank

In 2008, the owners of HSH Nordbank provided 2 billion Euro of equity capital to the bank (Almunia 2011a). The savings bank association of Schleswig-Holstein contributed 78 million Euro of this in the form of silent participation and 170 million Euro in the form of a convertible bond. Following further losses, a second rescue package in 2009 included 3 billion Euro in equity capital and liquidity guarantees totaling 27 billion. The savings banks did not participate in this second package. The contribution of the savings banks to the support measures to HSH Nordbank amounted to less than one percent of the total package and to 0.7 percent of the savings banks' 2008 total assets. Lending to businesses by the savings banks of Schleswig-Holstein rose by 3.8 percent and new mortgage issuance rose by 17 percent in 2008 (data from the annual reports).

### Appendix E.B.3 Support to West LB

The European Commission (Almunia 2011b) reports two support measures for WestLB from 2007 to 2010. The first measure in January 2008 was a guarantee to secure toxic assets held in WestLB's subsidiary Phoenix Light. The savings banks association of North-Rhine Westphalia guaranteed 1 billion Euro. The federal state and municipal governments guaranteed 4 billion Euro.

The second measure in November 2009 involved a 3 billion Euro capital injection by Soffin, the German government fund. In addition, it was agreed that the savings banks would only be responsible for 4.5 billion Euro of losses, independent of what the actual requirements of WestLB would be. These 4.5 billion Euro would have to be paid only after 25 years. In the meantime, the government would guarantee for the amount. Under standard financial regulations, the savings banks would have been responsible for 50 percent of losses immediately, as they held a 50 percent stake in WestLB. The combined equity capital of savings banks in 2008 was 14.4 billion Euro. This capital buffer and the possibility to accrue earnings over 25 years before paying for losses ensured the savings banks would not become insolvent due to their involvement with WestLB. The support measures for WestLB occurred in 2008 and 2009. Between the end of 2007 and 2009, the aggregate equity capital of savings banks in North-Rhine Westphalia rose by 11 percent.

### Appendix E.B.4    Support to Bayern LB

Bayern LB reported losses from its exposure to asset-backed securities starting in February 2008. In December 2008, Bayern LB received 10 billion Euro in equity capital and a guarantee for losses of 4.8 billion from the federal state government of Bavaria. The savings bank association of Bavaria did not contribute to these measures (Almunia 2013). The losses at Bayern LB led to write-downs of a moderate size at the Bavarian savings banks, a total of 0.5 billion Euro in the year 2008, relative to total assets of 160 billion Euro (Krämer 2009). All Bavarian savings banks recorded a positive profit for 2008. The annual reports of Bayern LB state that aggregate loans by the savings banks in Bavaria rose by 4 percent between the end of 2007 and 2009.

### Appendix E.B.5    Support to Landesbank Baden-Württemberg

Until late 2008, Landesbank Baden-Württemberg had not recorded serious losses. It was perceived strong enough by its management to take over Sachsen LB in 2007 (Kroes 2009). But after the Lehman Brothers insolvency, Landesbank Baden-Württemberg urgently required funding due to write-downs and trading losses on securities. On 21 November, Landesbank Baden-Württemberg announced that it would receive 5 billion Euro in equity capital from its owners. The contribution was in proportion to the ownership share (Gubitz 2013). The state's savings banks

association owned 35.6 percent of Landesbank Baden-Württemberg and therefore contributed 1.8 billion Euro. This is not a negligible amount, considering the aggregate equity capital of the savings banks in Baden-Württemberg was 7.1 billion Euro at the end of 2007. Nevertheless, between the end of 2007 and 2009, the aggregate equity capital of savings banks in Baden-Württemberg rose by 6 percent. Lending to non-banks increased by 5 percent (data from the annual reports).

**Appendix E.B.6    Lending by the Affected Savings Banks**

I analyze the Bureau van Dijk database Bankscope, which reports the lending stock for over 90 percent of the German savings banks.[15] I find that the affected savings banks, on average, increased their lending to non-financial customers by 2 percent between 2006 and 2008, and by 7 percent from 2006 and 2010. This suggests they did not cut lending. To test this conclusion further, I run bank-level regressions of the growth of lending on a dummy for affected savings banks. I use the change in lending between 2006 and 2010 as outcome.

The results are in Appendix Table A.XIII. Column (1) includes a dummy for savings banks, which means this regression compares the affected to unaffected savings banks. Savings banks across Germany are similar in structure, scope, and customer type, so this is a natural comparison. Affected savings banks grew their lending by 8 percent more relative to the unaffected.[16] Column (2) compares the affected savings banks to all similar banks, by adding dummies for bank size, federal state, cooperative banks, real estate banks, and commercial banks. Controlling for the pre-trend in column (3) does not change this conclusion. In column (4), I use the change in lending between 2006 and 2008 as outcome. Column (5) uses the symmetric growth of lending between 2006 and 2010 as outcome to limit the influence of outliers. There is no evidence in any specification that affected savings banks reduced their lending relative to other banks.

The savings banks that owned WestLB and Landesbank Baden-Württemberg contributed more to the rescue of their respective Landesbanken than the other affected savings banks, as I describe above. I add a dummy for affected savings banks in these two regions in column (6). The point estimate is positive, small, and insignificant, which indicates no difference in loan growth.

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[15]Bankscope also includes information on the history of the banks, including bank mergers. I hand-code all mergers since 2006 based on this information. For the years before a merger, I sum the lending stock of the merging banks, and keep one observation per institution, as of 2012.

[16]The results are unchanged when I weight regressions by the banks' lending stock in 2006.

## Appendix E.C   The Relationship Between Affected Savings Banks and Firm Employment

The results on equity capital and lending in the previous subsection raise the question whether the correlation between relationship to an affected savings bank and firm employment losses in PR can be interpreted as a causal effect. I extend the analysis in PR to examine this question. I replicate the sample in PR using the description in their paper. I use my Creditreform dataset to identify firms' relationship banks in the year 2006. The treatment variable is a dummy for whether a firm has an affected savings bank among its relationship banks, interacted with a dummy for the treatment period in PR, the years 2009 to 2012.

PR present their main results in Table 3 of their paper. They find that firms with an affected savings bank among their relationship banks reduced employment by an average of 1.1 percent in the period 2009 to 2012. The results of my replication exercise are in Appendix Table A.XIV. In all the regressions, standard errors are clustered at the level of the firm. Columns (3) to (7) estimate panel specifications identical to PR. The point estimate in column (3) implies an employment loss of 0.5 percent at firms with an affected savings bank among their relationship banks. Columns (1) to (2) of Table A.XIV estimate cross-sectional specifications, using my large employment cross-section dataset. The outcome is the ln employment difference between 2008 and 2012, which corresponds to the ln outcome variable in PR. The estimate in column (1) implies that firms with an affected savings bank among their relationship banks experienced an employment loss of 1.5 percent. The coefficient is statistically significant at the 1 percent level. Hence, I can replicate their findings.

I propose two additional control variables. These are the age and industry of the firm, measured in the year 2006. Firm age is important because the literature has frequently found correlations between age and growth (Haltiwanger et al. 2013). In my data, dependence on an affected savings bank is positively and significantly correlated with age, even when conditioning on firm size. The reason is that savings banks traditionally have a public mandate to lend to business startups. I control for industry at the two-digit level of the German classification scheme WZ2008. Since savings banks only operate in their municipality, differences in the industrial composition of the municipal economy will lead to differences in the exposure of banks to industries. Controlling for ln age and industry shrinks the estimate in column (2) towards zero, and it becomes statistically insignificant. Similarly,

the point estimate in column (4) switches sign to positive, is of small magnitude, and insignificant. The 95 percent confidence interval in column (4) excludes employment losses greater than 0.5 percent. The coefficient on age has the expected negative sign and is significant.

Column (5) uses fixed effects for age bins, rather than ln age, to control for age-related differences in employment growth. The three age bins are for firms founded before 1990, from 1990 to 2000, and after 2000. The coefficient on savings banks remains small, positive, and statistically insignificant. Column (6) adds a number of controls that PR propose: the natural logarithm of firm assets, the capital-to-assets ratio, the profit-to-assets ratio, and the cash flow-to-assets ratio. To measure profits, I use the German balance sheet item Betriebsergebnis and to measure cashflow I use Jahresüberschuss. PR control for the annual, time-varying value of these variables. This could be problematic, because assets, capital, profit, and cashflow are likely to be outcomes of a credit shock. The coefficient on the affected savings banks in column (6) remains positive, but becomes statistically significant, suggesting the estimates are biased.

In column (7), I add a dummy to the specification that indicates whether the firm has a Commerzbank branch among its relationship banks, interacted with a post-treatment dummy. This measures a firm's relationship to Commerzbank the same way that PR measure a firm's relationship to an affected savings bank. The coefficient is significant at the 1 percent level. It implies that firms with Commerzbank as one of their relationship banks reduced employment by 1.9 percent. I also test whether firms that had one of the affected Landesbanken as relationship bank reduced employment. The coefficient is close to zero and statistically insignificant.

### Appendix E.D    The Relationship Between Affected Savings Banks, Regional Growth, and Household Debt

I call a county "affected" if it is served by one of the affected savings banks. I test if affected counties grew more slowly using a county panel specification, such as the one in Table VIII, column (1). The coefficient on the dummy for affected counties is 0.009 (standard error: 0.008). Thus, there is no effect of dependence on affected savings banks on county growth.

I examine the relationship between household debt and affected savings banks by using the nationally representative GSOEP. Around one-third of total bank loans

to German households are issued by the savings banks and Landesbanken, so changes in their household loan supply may have significant consequences. The regressions I run are equivalent to the ones I report in Table V of my paper. The outcome is the symmetric growth rate of private debt from 2007 to 2012. 97 percent of GSOEP respondents entered the information before August 2007, so the observation for 2007 represents the state before the losses at the Landesbanken were announced. The regressor of interest is a dummy for individuals in affected counties. The coefficient on the dummy is small and insignificant at -0.01 (standard error: 0.03). Controlling for ln mortgage debt in 2002, ln other debt in 2002, and a dummy for any debt in 2002, the coefficient on the dummy becomes positive, but remains insignificant and small (point estimate: 0.01, standard error: 0.03). This suggests that household debt in the affected counties did not change.

## Appendix F  An Identification Strategy Based on Other Banks' Trading Losses

### Appendix F.A  The Literature on Other Banks with Trading Losses

A recent paper by Dwenger et al. (2015) (henceforth DFS) uses two instruments to identify exogenous variation in German firms' bank loan supply in the recent crisis. The first is a firm's dependence on an affected savings bank, which is the same variation PR use. I discuss this in detail in Appendix E. The second instrument in DFS is the average of the trading losses of the firm's relationship banks. In their Table 1, DFS list the main German banks affected by trading losses. The table includes a number of Landesbanken, IKB, Deutsche Bank, HypoVereinsbank, DZ Bank, KfW, and Commerzbank (including Dresdner Bank).

Below, I extend the analysis in DFS by showing that their results are entirely driven by Commerzbank's lending cut. I find no evidence for a lending cut by any other bank. I then explain why the trading losses did not force other banks to cut lending. A number of institutional details played a role, such as a banks' hedging strategies, ownership structures, and pre-crisis capital buffers.

### Appendix F.B  Replicating the Dataset of DFS

I follow Section 3 and Footnote 27 of DFS to replicate their dataset. Their sample spans the years 2006 to 2010. As first regressor, I calculate the firm's fraction of relationship banks that had trading losses, out of all the firm's relationship banks.

I call this the firm's dependence on banks with trading losses. I define banks with trading losses as the banks listed in Table 1 of DFS. As an example: If a firm has two relationship banks, one being IKB and the other Commerzbank, the dependence on banks with trading losses would be 1. I also calculate the firm's dependence on all the other banks with trading losses, except Commerzbank. The firm from the previous example would have a value of 0.5 for this measure. DFS use two outcome variables, the ln annual growth rates of employment and fixed assets.

### Appendix F.C   The Relationship Between Banks with Trading Losses and Firm Employment

Appendix Table A.XV presents results for the type of specification used by DFS. Column (1) shows a negative and statistically significant effect on employment of dependence on a bank with trading losses. It implies that the annual growth rate of employment at a firm fully dependent on banks with trading losses was 1.2 percentage points lower in the years 2006 to 2010. This is the reduced-form effect that DFS capture in their IV specification of their Table 5. Column (2) tests the robustness of the coefficient by adding the firm controls from my paper. These controls are not in DFS. The coefficient falls to one-third of its value and becomes statistically insignificant.

In column (3), I split the regressor into two. I include my measure of firm Commerzbank dependence and the measure of dependence on all the other banks with trading losses, except Commerzbank. The coefficient on Commerzbank is negative and statistically significant. It implies a reduction in the annual employment growth of firms entirely dependent on Commerzbank by 1.1 percentage points.[17] The point estimate on the measure of dependence on the other banks with trading losses is positive, small, and insignificant. Columns (4) and (5) replace the interaction dummy $d$ with a dummy for the years 2008 to 2010 and a dummy for 2007 to 2010, respectively. This tests whether the other banks had an effect in the early years of the financial crisis. I find no effect. In column (6), I add the lagged growth rate of sales to the specification, as suggested by DFS. I also add county fixed effects interacted with $d$. This is controls for cross-regional differences, for example due to regional demand shocks or differences in business regulation. The

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[17]The coefficients in Table VI refer to the employment loss over four years, while this point estimate refers to the annual loss. Therefore, both types of regression estimate an employment loss between 4 to 5 percent from Commerzbank's lending cut, despite the considerable differences in sampling design and specification.

coefficients remain similar.

I investigate whether the zero coefficient on the other banks with trading losses masks heterogeneous effects across the individual banks. I have already examined the affected Landesbanken in Appendix E, so here I focus on the other banks mentioned in Table 1 of DFS. I add measures of dependence on each of these banks to the regression in column (7). None of the point estimates are statistically significant and they are all smaller than the coefficient on Commerzbank dependence. In column (8), I use the annual growth rate of fixed assets as the outcome variable and run the same specification. The results confirm that there was no significant effect of dependence on these banks on firm growth.

The first three columns of Appendix Table A.XVI re-examine the employment effect of dependence on banks with trading losses using the sample and specification of my large employment cross-section. The results are similar to what I find when I use the sample and specification of DFS.

As a final check, I run county-level regressions analogous to the ones reported in Table VIII. The outcome is ln county GDP. The regressor of interest is the average dependence of firms in the county on other banks with trading losses, except Commerzbank, interacted with a dummy for the years 2009 to 2012. I find a small and insignificant coefficient on the county dependence on these other banks with trading losses, in unreported results. The effect of county Commerzbank dependence in the same regression remains robust.

## Appendix F.D    Institutional Details on the Other Banks With Trading Losses

I briefly explain why trading losses at these other banks did not have effects on firms. The case of KfW is similar to the Landesbanken discussed in Appendix E. It is the national development bank, jointly owned by the government of Germany and the federal states. When trading losses at KfW became apparent, the government immediately stepped in. In fact, KfW was charged with several public credit extension programs to help households during the financial crisis. For example, KfW raised its mortgage commitments to households by 26.5 percent during the crisis.

IKB does not play an important role in the loan supply of German firms. In my Creditreform sample of relationship banks, only 0.1 percent of firms list IKB as one of their relationship banks. For the firms that do have an IKB relationship, over 90 percent have at least two other relationship banks. Therefore, when IKB

became financially affected, firms were able to switch to their other relationship lenders. Similarly, in Table VI I find that firms with positive, but low Commerzbank dependent did not cut employment following Commerzbank's lending cut.

DZ Bank and HypoVereinsbank had large equity capital buffers, so they were able to absorb trading losses relatively well. The tier 1 capital ratio at DZ Bank was 14 percent in 2006. DZ Bank is the central bank of the cooperative sector and owned by the cooperative banks, which were not generally affected by the crisis and would have been able to provide support in the hypothetical scenario of a capital shortage. Similarly, the tier 1 capital ratio of HypoVereinsbank was 15.7 percent in 2006. HypoVereinsbank is part of the international UniCredit Group, which eased its access to funding.

Deutsche Bank profited from consequently hedging its ABS portfolio and shorting the subprime mortgage market, after the first signs of distress became apparent in 2007 (see the research report by Fox-Pitt Kelton Cochran Caronia Waller, "European Banks: Credit Crisis - Stock Impact", 2 January 2008). While it made losses on the ABS trading portfolio, these were evened out by its hedging strategy. This enabled Deutsche Bank to expand its lending in Germany during the financial crisis. For example, mortgage lending in its private customer division rose by 21.7 percent between 2007 and 2010.[18]

## Appendix G   A Proxy for the Change in Bank Loans

Data on county-level loans are not available in Germany. This section proposes a proxy to measure by how much county-level bank loans fell due to Commerzbank's lending cut.

### Appendix G.A   Constructing a Proxy for the Change in Bank Loans due to Commerzbank's Lending Cut

The proxy for county-level bank loans is based on two quantities. First, the aggregate reduction in bank loans by Commerzbank. I calculate this as the difference between Commerzbank's lending stock to German customers in 2007 and a counterfactual value for 2010. To calculate the counterfactual value, I assume that in the

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[18]The point estimates on Deutsche Bank dependence in columns (7) and (8) Appendix Table A.XV are both negative and statistically insignificant. In column (4) of Appendix Table A.XVI, I show that this is not a general pattern. The sample is the large employment cross-section and the outcome is the ln employment growth rate. The coefficient on Deutsche Bank dependence is small, statistically insignificant, and positive.

absence of the trading losses, Commerzbank's lending stock would have developed in parallel to the other banks from 2007 to 2010.

The second quantity aims to measure the share that loans to each county took in Commerzbank's loan portfolio before the lending cut. I use the Creditreform dataset of relationship banks to measure this. For each firm, I calculate how many Commerzbank branches are among its relationship banks. I sum the number of Commerzbank relationships in each county. Similarly, I sum the number of Commerzbank relationship in the whole dataset. The second quantity is then the number of Commerzbank relationships in each county divided of Commerzbank relationships in the whole dataset. I call this second quantity the "Commerzbank loan share of the county."

The product of the two quantities is a proxy for how much bank loans fell in a county because of Commerzbank's lending cut. The accuracy of this proxy relies on two assumptions. The first assumption is that the Commerzbank loan share of the county (the second quantity) can be accurately measured using the method described above. This requires that the number of Commerzbank relationships in the Creditreform dataset is proportional to the true number of relationship for each county. To gauge how likely this assumption is to hold, I use the German Business Register as benchmark. There are some differences between the Creditreform dataset and the Business Register. For example, in the Business Register, 13.9 percent of firms are located in the former GDR (excluding Berlin). In the Creditreform dataset, it is 17.2 percent. If this represents a consistent bias towards the former GDR, the proxy would overestimate the lending cut to counties in the former GDR.

The second assumption states that Commerzbank reduced its lending to a county in proportion to the Commerzbank loan share of the county (the second quantity). Figure A.II shows that the effect of Commerzbank dependence on bank loans is stable across different dimensions of firm heterogeneity, which supports this assumption.

## Appendix G.B Result Using the Proxy

I turn to estimating the effects of changes in bank loans on GDP growth, using the proxy calculated above. The outcome is county GDP growth between 2008 and 2012, normalized by the level of county GDP in 2007. The regressor of interest is the proxy, also normalized by county GDP in 2007. This eases the interpretation of the coefficient as the effect of a one Euro increase in bank loans on the level of

GDP. The control variables, weights, and standard error calculations are identical to Table VIII. The (unreported) results imply a one Euro decrease in bank loans leads to a 1.58 Euro fall in GDP, with a standard error of 0.53. In comparison, Peek and Rosengren (2000) find that a one USD drop in bank loans corresponds to a loss of USD 1.11 in construction activity. The regression using the proxy therefore confirms that the lending cut lowered county growth. It is important to recall that the estimate is likely to overstate the causal effect of bank loans, because there are multiple other channels through which a lending cut affects firm and county growth (see Section I.A).

## Appendix H    The Effect of Export Dependence on Counties and Firms

Section VI.B shows that the effects of Commerzbank's temporary lending cut persisted beyond the duration of the lending cut. Are such persistent effects a general response to economic shocks? In this section, I use the fall in export demand during the Great Recession to investigate whether the effects of export demand shocks persist (Eaton et al. 2011; Behrens et al. 2013).

I exploit heterogeneity across firms and counties in export dependence. Aggregate trade statistics show that German real exports fell by 14.3 percent from 2008 to 2009. By 2011, exports had recovered, as they grew by 24 percent from 2009 to 2011. If export demand shocks only have transitory effects, then counties and firms with high export dependence should have experienced lower growth during the years of the export demand shock, but by 2011 they should have recovered.

For both firms and counties, I construct a dummy variable for being in the top quartile of the distribution of the export share. Appendix Table A.XVII reports that GDP in export-dependent counties was on average 1.1 percent lower in 2009 and 2010. The point estimate for 2011, however, is of the opposite sign, larger in absolute terms, and statistically different. This means that export-dependent counties entirely made up the output shortfall in under two years. The dynamics are similar for firms, as shown in Appendix Table A.XVIII. Employment at export-dependent firms was on average 1.8 percent lower in 2009 and 2010. But by 2011, they had recovered to the level of the other firms, outgrowing them by 2 percent in 2011. Hence, export-dependent firms and counties converged to the growth path of unaffected firms and counties in under two years.

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| 2009 | 11 | 5 | Macquarie (formerly Oppenheim Research) – Historical | Quality Of Results Matters |
| 2009 | 11 | 5 | Natixis | Commerzbank - Earnings Boosted By A €435M Provision Release On Toxic Assets |
| 2009 | 11 | 6 | Natixis | Commerzbank - Too Many Balance Sheet Risks |
| 2009 | 11 | 27 | Deutsche Bank Equity Research | Commerzbank : Roadmap 2012 In Spotlight |
| 2009 | 11 | 30 | Warburg Research GmbH | Commerzbank |
| 2010 | 2 | 23 | JPMorgan | Q409 Results Snapshot Before The Call - Alert |
| 2010 | 2 | 23 | Macquarie (formerly Oppenheim Research) – Historical | Negative Earnings Surprise Driven By Trading |
| 2010 | 2 | 23 | Raymond James Europe RJEE/RJFI | Commerzbank: Worrying Q4 Figures But Upbeat Guidance |
| 2010 | 2 | 24 | Credit Suisse - Europe | CBKG.F: Commerzbank - Still Under Water |
| 2010 | 2 | 24 | Deutsche Bank Equity Research | Commerzbank : 2010 - Transition To Operating Profitability |

| 2010 | 2 | 24 | Societe Generale | Commerzbank - 12M Target Downgrade - Tangible Book Takes Another Hit In Q4. Soffin Repayment Still Unresolved |
|------|---|----|------------------|------------------|
| 2010 | 2 | 24 | UBS Equities | Commerzbank "Tough Quarter And Subdued 2010 Outlook" (Sell) Zieschang |
| 2010 | 2 | 25 | ESN/ equinet Bank | Commerzbank - Review Q4 Results (Reduce, Tp Eur 4.60) |
| 2011 | 2 | 23 | CA Cheuvreux | Commerzbank - 2/Outperform - Q4-10 Results Well Above Estimates |
| 2011 | 2 | 23 | JPMorgan | Commerzbank : Q4 Earnings Above Consensus, Focus On Soffin Repayment And Rwa Reduction - Alert |
| 2012 | 2 | 23 | Deutsche Bank Equity Research | Commerzbank : Cinderellabank Has Not Arrived At The Ball (Yet) |
| 2012 | 2 | 23 | JPMorgan | Commerzbank : Q411 Results: Better Than Expected Adj. Pbt But All Eyes Remain On Capital - Alert |
| 2012 | 2 | 24 | Morgan Stanley | Commerzbank: Capital Ok, Eps Still At Risk |
| 2012 | 2 | 24 | Societe Generale | Commerzbank - Full-Year Results - Capital Shortfall Reduced – Poor Organic Capital Generation And Too Many Risks |
| 2012 | 2 | 27 | ESN/ equinet Bank | Commerzbank Q4 Results All In All In Line With Exp., Capital Increase Should Ease Investors' Concerns About CBK'S Capital Position - Company Update |
| 2012 | 2 | 28 | UBS Equities | Commerzbank "Sell Rating Reiterated" (Sell) Zieschang |

# Appendix Tables

Table A.I: Establishment of Commerzbank branches in West Germany

|  | (1)<br>1948-1970 | (2)<br>1948-1970 | (3)<br>1948-1970 | (4)<br>1925-1948 | (5)<br>Pre-1925 |
|---|---|---|---|---|---|
| Distance instrument | 0.094 | 0.090 | 0.077 | 0.021 | 0.010 |
|  | (0.031) | (0.032) | (0.033) | (0.020) | (0.017) |
|  |  |  |  |  |  |
| Observations | 324 | 324 | 324 | 324 | 324 |
| $R^2$ | 0.122 | 0.122 | 0.136 | 0.088 | 0.359 |
| Zonal FE | Yes | Yes | Yes | Yes | Yes |
| Urban FE | No | Yes | Yes | Yes | Yes |
| Ln population | No | No | Yes | Yes | Yes |
| Population density | No | No | Yes | Yes | Yes |
| Estimator | OLS | OLS | OLS | OLS | OLS |

Notes: This table examines the effect of Commerzbank's post-war break-up on its branch network. It reports regressions using a cross-section of West German counties. The data are hand-collected from the historic annual reports of Commerzbank. The outcome variable is a dummy for whether Commerzbank established a branch in the county during the respective period given in the column title. The regressor of interest is the distance instrument, the negative of the county's distance to the closest post-war Commerzbank head office, in 100 kilometers. The zonal fixed effects are dummies for the three post-war banking zones of North Rhine-Westphalia, Northern, and Southern Germany. The urban fixed effect is a dummy for counties with a year 2000 population density greater than 1,000 inhabitants per square kilometer. The ln population and population density are continuous variables from the year 2000. Standard errors are robust. Columns (1) to (3) show that from 1948 to 1970, Commerzbank was more likely to establish a new branch in counties close to its temporary, post-war head offices. Columns (4) and (5) report no significant association in the period before or after.

Table A.II: Commerzbank dependence and firm variables in 2006

|  | (1) | (2) |
|---|---|---|
| ln age | -0.015 | -0.011 |
|  | (0.009) | (0.010) |
| ln value added | 0.018 | 0.022 |
|  | (0.015) | (0.020) |
| ln capital | -0.014 | -0.024 |
|  | (0.006) | (0.008) |
| Investment rate | 0.009 | -0.009 |
|  | (0.016) | (0.020) |
| ln employment | 0.011 | 0.010 |
|  | (0.012) | (0.016) |
| ln liabilites | 0.008 | 0.009 |
|  | (0.012) | (0.012) |
| ln bank loans | 0.002 | 0.000 |
|  | (0.007) | (0.007) |
| ln financial assets |  | 0.001 |
|  |  | (0.002) |
| Observations | 2,011 | 1,618 |
| $R^2$ | 0.307 | 0.340 |
| Industry FE | Yes | Yes |
| County FE | Yes | Yes |
| Estimator | OLS | OLS |

Notes: This table reports estimates from cross-sectional firm regressions of CB dep on firm variables. The data are from the firm panel for the year 2006. The variables are defined as in Table I. The regression includes fixed effects for 70 industries and 357 counties. Standard errors are two-way clustered at the level of the industry and the county.

Table A.III: County GDP and the distance to cities

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distance instrument*d | 18.309 | 14.493 | 18.165 | 17.279 | 17.950 | 17.420 | 16.857 | 19.595 | 19.310 | 17.328 | 19.294 | 18.167 | 17.298 |
| | (3.253) | (4.205) | (4.050) | (3.850) | (3.635) | (3.932) | (3.605) | (3.017) | (2.916) | (3.839) | (3.826) | (3.795) | (3.856) |
| Dist to Düsseldorf*d | -0.845 | | | | | | | | | | | | |
| | (2.618) | | | | | | | | | | | | |
| Dist to Frankfurt*d | | 4.218 | | | | | | | | | | | |
| | | (3.111) | | | | | | | | | | | |
| Dist to Hamburg*d | | | -1.166 | | | | | | | | | | |
| | | | (1.821) | | | | | | | | | | |
| Dist to Berlin*d | | | | -3.016 | | | | | | | | | |
| | | | | (2.510) | | | | | | | | | |
| Dist to Dresden*d | | | | | 2.071 | | | | | | | | |
| | | | | | (2.795) | | | | | | | | |
| Dist to Munich*d | | | | | | 0.146 | | | | | | | |
| | | | | | | (1.858) | | | | | | | |
| Dist to Cologne*d | | | | | | | 0.385 | | | | | | |
| | | | | | | | (2.789) | | | | | | |
| Dist to Essen*d | | | | | | | | -1.945 | | | | | |
| | | | | | | | | (2.458) | | | | | |
| Dist to Dortmund*d | | | | | | | | | -1.806 | | | | |
| | | | | | | | | | (2.364) | | | | |
| Dist to Stuttgart*d | | | | | | | | | | 1.864 | | | |
| | | | | | | | | | | (1.872) | | | |
| Dist to Bremen*d | | | | | | | | | | | -2.371 | | |
| | | | | | | | | | | | (1.940) | | |
| Dist to Hannover*d | | | | | | | | | | | | -1.322 | |
| | | | | | | | | | | | | (2.670) | |
| Dist to Leipzig*d | | | | | | | | | | | | | 0.580 |
| | | | | | | | | | | | | | (3.320) |
| Observations | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 | 5,005 |
| $R^2$ | 0.361 | 0.362 | 0.361 | 0.362 | 0.361 | 0.361 | 0.361 | 0.361 | 0.361 | 0.362 | 0.362 | 0.361 | 0.361 |
| Number of counties | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 |
| County FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Controls*d | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Estimator | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS |

Notes: This table reports the effect of the distance instrument and the linear distances to other cities on county GDP. All regressions include the full set of control variables from Table VIII, but not the linear distances. The data include the years 2000 to 2012. The regressions are weighted by year 2000 population, and the standard errors are calculated as in Table VIII.

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## Table A.IV: High-innovation industries

| WZ2008 Code | Industry |
|---|---|
| 20.2 | Manufacture of pesticides and other agrochemical products |
| 21 | Manufacture of basic pharmaceutical products and preparations |
| 25.4 | Manufacture of weapons and ammunition |
| 26 | Manufacture of computer, electronic and optical products |
| 30.3 | Manufacture of air and spacecraft and related machinery |
| 30.4 | Manufacture of military fighting vehicles |
| 20.1 | Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms |
| 20.4 | Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations |
| 20.5 | Manufacture of other chemical products (explosives, glues, essential oils, man-made fibres) |
| 27 | Manufacture of electrical equipment (electric motors, generators, transformers and electricity distribution and control apparatus) |
| 28 | Manufacture of machinery and equipment (e.g. engines, turbines, fluid power equipment, gears, furnaces, solar heat collectors, lifting and handling equipment, power-driven hand tools, non-domestic cooling and ventilation equipment, machinery for mining, quarrying and construction) |
| 29.1 | Manufacture of motor vehicles |
| 29.3 | Manufacture of parts and accessories for motor vehicles |
| 30.2 | Manufacture of railway locomotives and rolling stock |
| 33.2 | Installation of industrial machinery and equipment |

Notes: This table reports the industries with an internal share of R&D spending over revenue above 2.5 percent (OECD cut-off), classified by Gehrke et al. (2010).

Table A.V: Low-innovation industries

| WZ2008 Code | Industry |
|---|---|
| 8.1 | Quarrying of stone, sand and clay |
| 9 | Mining support service activities (for petroleum, natural gas and other mining and quarrying) |
| 16.1 | Sawmilling and planing of wood |
| 23.7 | Cutting, shaping and finishing of stone |
| 25.1 | Manufacture of structural metal products |
| 35.3 | Steam and air conditioning supply |
| 36 | Water collection, treatment and supply |
| 37 | Sewerage |
| 38.2 | Waste treatment and disposal |
| 39 | Remediation activities and other waste management services |
| 41.1 | Development of building projects |
| 43.9 | Other specialised construction activities |
| 45.1 | Sale of motor vehicles |
| 46.5 | Wholesale of information and communication equipment |
| 46.9 | Non-specialised wholesale trade |
| 47.3 | Retail sale of automotive fuel in specialised stores |
| 49.3 | Other passenger land transport |
| 49.4 | Freight transport by road and removal services |
| 50 | Water transport (passenger and freight) |
| 52.1 | Warehousing and storage |
| 53.2 | Other postal and courier activities |
| 56.1 | Restaurants and mobile food service activities |
| 59.2 | Sound recording and music publishing activities |
| 68.1 | Buying and selling of own real estate |
| 70.1 | Activities of head offices |
| 74.1 | Specialised design activities |
| 74.2 | Photographic activities |
| 78 | Employment activities (employment placement and agency) |
| 80 | Security and investigation activities |
| 81.1 | Combined facilities support activities |
| 81.3 | Landscape service activities |
| 82 | Office administration, office support, and other business support |

Notes: This table reports the industries with the lowest innovation activities, classified by Gehrke et al. (2013) using data from the Mannheim Innovation Panel.

Table A.VI: Summary statistics by bins of Commerzbank dependence

| | | | Range of Commerzbank dependence | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 0.01-0.24 | 0.25-0.32 | 0.33-0.4 | 0.41-0.75 | 0.75-1 | Total |
| Commerzbank dep | 0 | 0.182 | 0.250 | 0.332 | 0.502 | 1 | 0.156 |
| | (0) | (0.0199) | (0) | (0.00830) | (0.0720) | (0) | (0.228) |
| No of relationship banks | 2.433 | 5.577 | 4 | 3.768 | 3.059 | 1.192 | 2.997 |
| | (1.311) | (0.647) | (0) | (1.359) | (1.222) | (0.398) | (1.544) |
| Employment | 831.9 | 982.8 | 840.8 | 1,567.4 | 729.3 | 799.9 | 913.7 |
| | (14,674.6) | (2,587.4) | (4,502.6) | (6,603.1) | (2,699.2) | (1,411.5) | (11,592.5) |
| Wage | 32.50 | 32.08 | 30.81 | 31.72 | 30.57 | 33.11 | 32.04 |
| | (60.92) | (7.777) | (9.429) | (9.484) | (10.98) | (15.54) | (47.15) |
| Capital | 44,699.8 | 86,334.2 | 29,697.3 | 145,522.9 | 36,887.9 | 62,554.4 | 57,711.6 |
| | (258,037.3) | (255,992.6) | (108,208.6) | (1,496,140.7) | (106,876.7) | (134,632.3) | (544,582.6) |
| Investment rate | 0.258 | 0.205 | 0.280 | 0.298 | 0.328 | 0.368 | 0.271 |
| | (0.366) | (0.220) | (0.317) | (0.378) | (0.410) | (0.415) | (0.363) |
| Liabilities | 172,542.4 | 84,362.6 | 93,348.5 | 217,748.4 | 93,014.3 | 79,574.5 | 152,628.5 |
| | (4,653,805.1) | (278,210.9) | (788,451.4) | (2,254,805.0) | (528,174.0) | (169,250.5) | (3,657,557.1) |
| Bank debt/liabilities | 0.501 | 0.483 | 0.477 | 0.434 | 0.448 | 0.449 | 0.483 |
| | (0.266) | (0.246) | (0.241) | (0.242) | (0.262) | (0.281) | (0.261) |
| Firms | 1,182 | 163 | 151 | 224 | 238 | 53 | 2,011 |

Notes: The range of Commerzbank dependence in the relevant bin is given in the top row. The data are from the firm panel for the year 2006. The variables are defined as in Table I.

Table A.VII: Insights from the research reports

| Question | Number of relevant reports | Answer yes | Answer no | Answer unclear |
|---|---|---|---|---|
| 1) Was the trading income more volatile than at other German banks from 2004 to 2007? | | | | |
| - at Commerzbank | 11 | 0 | 2 | 9 |
| - at Dresdner Bank | 4 | 0 | 0 | 4 |
| 2) Was the loan portfolio to German firms and households riskier than at other German banks from 2004 to 2007? | | | | |
| - at Commerzbank | 11 | 0 | 11 | 0 |
| - at Dresdner Bank | 5 | 0 | 5 | 0 |
| 3) Does the report mention that the trading and lending divisions cross-hedged risk from 2004 to 2009? | | | | |
| - at Commerzbank | 85 | 0 | 85 | 0 |
| - at Dresdner Bank | 42 | 0 | 42 | 0 |
| 4) Does the report mention that the German loan portfolio contributed to Commerzbank's losses from 2008 to 2009? | 83 | 0 | 83 | 0 |
| 5) Does the report mention that exposure to Iceland contributed to Commerzbank's losses from 2008 to 2009? | 83 | 8 | 75 | 0 |
| 6) Does the report mention that exposure to asset-backed securities or the subprime mortgage crisis contributed to Commerzbank's losses from 2008 to 2009? | 83 | 72 | 11 | 0 |
| 7) Does the report mention that exposure to Lehman Brothers contributed to Commerzbank's losses in 2009? | 83 | 8 | 75 | 0 |
| 8) Judging in 2008, is Commerzbank's acquisition of Dresdner Bank a strategically sound move? | 11 | 9 | 1 | 1 |
| 9) Did Commerzbank stabilise after 2010? | 10 | 8 | 0 | 2 |

Notes: This table summarizes insights from the research reports listed after the reference section of the Appendix. A relevant report is a research report from the given period that contains information relevant to the given question. Reports either offer a clear conclusion (Answer yes/no) or give information in support of both sides, without committing either way (Answer unclear). For interpretation and illustrative examples, see Appendix B.

### Table A.VIII: Robustness checks for the firm survey results

| OUTCOME | (1) Bank loans | (2) Bank loans | (3) Bank loans | (4) Demand constraint | (5) Orders backlog | (6) Demand change |
|---|---|---|---|---|---|---|
| YEAR | 2009 | 2009 | 2003 | 2003 | 2003 | 2003 |
| Firm CB dep | -0.393 | -0.381 | 0.040 | -0.119 | 0.184 | -0.080 |
| | (0.185) | (0.232) | (0.367) | (0.350) | (0.292) | (0.317) |
| Dep var from 2006 | | 0.376 | | | | |
| | | (0.084) | | | | |
| Observations | 1,032 | 1.032 | 642 | 756 | 768 | 768 |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | No | Yes | Yes | Yes | Yes |
| Size Bin FE | Yes | Yes | Yes | Yes | Yes | Yes |
| ln age | Yes | Yes | Yes | Yes | Yes | Yes |
| County FE | No | Yes | Yes | Yes | Yes | Yes |

Notes: This table reports estimates from OLS cross-sectional firm regressions for different years, using data from the confidential ifo Business Expectations Panel. The outcome variables, the interpretation of the coefficients, and standard error calculations are explained in Tables III, A.IX, A.X, and A.XI.

### Table A.IX: Firm survey on product demand constraints

| YEAR | (1) 2007 | (2) 2008 | (3) 2009 | (4) 2010 | (5) 2011 | (6) 2012 |
|---|---|---|---|---|---|---|
| Firm CB dep | -0.191 | -0.196 | -0.076 | -0.121 | 0.281 | 0.194 |
| | (0.121) | (0.133) | (0.148) | (0.156) | (0.175) | (0.197) |
| Dep var from 2006 | 0.655 | 0.561 | 0.409 | 0.450 | 0.503 | 0.421 |
| | (0.032) | (0.035) | (0.034) | (0.037) | (0.044) | (0.045) |
| Observations | 980 | 991 | 1,032 | 945 | 856 | 808 |
| $R^2$ | 0.482 | 0.370 | 0.262 | 0.287 | 0.304 | 0.259 |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Size Bin FE | Yes | Yes | Yes | Yes | Yes | Yes |
| ln age | Yes | Yes | Yes | Yes | Yes | Yes |

Notes: This table reports estimates from OLS cross-sectional firm regressions for different years, using data from the confidential ifo Business Expectations Panel. The outcome variable is the answer to the question: "Are your business activities constrained by low demand or too few orders: yes or no?" It is standardized to have zero mean and unit variance. The coefficients are interpreted as the standard deviation increase in demand constraints from increasing Commerzbank dependence by one. The variables are defined and the standard errors calculated as in Table III.

Table A.X: Firm survey on the backlog of product orders

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| YEAR | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Firm CB dep | 0.108 | 0.119 | 0.025 | 0.051 | 0.048 | -0.304 |
| | (0.105) | (0.140) | (0.155) | (0.186) | (0.160) | (0.223) |
| Dep var from 2006 | 0.662 | 0.527 | 0.416 | 0.453 | 0.489 | 0.390 |
| | (0.028) | (0.039) | (0.045) | (0.043) | (0.041) | (0.050) |
| Observations | 914 | 910 | 919 | 852 | 802 | 737 |
| $R^2$ | 0.632 | 0.412 | 0.273 | 0.312 | 0.342 | 0.230 |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Size Bin FE | Yes | Yes | Yes | Yes | Yes | Yes |
| ln age | Yes | Yes | Yes | Yes | Yes | Yes |

Notes: This table reports estimates from OLS cross-sectional firm regressions for different years, using data from the confidential ifo Business Expectations Panel. The outcome variable is the answer to the question: "Currently we perceive our backlog of orders to be: comparatively large, sufficient / typical for the season, or too small?" It is standardized to have zero mean and unit variance. The coefficients are interpreted as the standard deviation increase in the backlog of orders from increasing Commerzbank dependence by one. The variables are defined and the standard errors calculated as in Table III.

Table A.XI: Firm survey on product demand changes

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| YEAR | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Firm CB dep | 0.130 | 0.014 | -0.008 | -0.243 | -0.050 | -0.042 |
| | (0.151) | (0.155) | (0.192) | (0.177) | (0.169) | (0.222) |
| Dep var from 2006 | 0.549 | 0.437 | 0.376 | 0.455 | 0.486 | 0.328 |
| | (0.054) | (0.056) | (0.057) | (0.059) | (0.064) | (0.079) |
| Observations | 914 | 910 | 919 | 852 | 802 | 736 |
| $R^2$ | 0.424 | 0.278 | 0.227 | 0.324 | 0.317 | 0.181 |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Size Bin FE | Yes | Yes | Yes | Yes | Yes | Yes |
| ln age | Yes | Yes | Yes | Yes | Yes | Yes |

Notes: This table reports estimates from OLS cross-sectional firm regressions for different years, using data from the confidential ifo Business Expectations Panel. The outcome variable is the answer to the question: "Tendencies in the previous month - The demand situation has: improved, remained unchanged, or deteriorated?" The coefficients are interpreted as the standard deviation improvement in the demand situation from increasing Commerzbank dependence by one. The variables are defined and the standard errors calculated as in Table III.

Table A.XII: Firm financial assets and Commerzbank dependence

| VARIABLES | (1) 2006-07 | (2) 2007-09 | (3) 2009-10 | (4) 2007-09 | (5) 2007-09 |
|---|---|---|---|---|---|
| Firm CB dep | -0.022 | 0.036 | 0.022 | 0.018 | -0.040 |
| | (0.094) | (0.092) | (0.084) | (0.068) | (0.112) |
| | | | | | |
| Observations | 1,816 | 1,816 | 1,816 | 1,816 | 1,816 |
| $R^2$ | 0.062 | 0.060 | 0.059 | 0.000 | 0.219 |
| ln age | Yes | Yes | Yes | No | Yes |
| Size Bin FE | Yes | Yes | Yes | No | Yes |
| Industry FE | Yes | Yes | Yes | No | Yes |
| State FE | Yes | Yes | Yes | No | No |
| County FE | No | No | No | No | Yes |
| Import and Export Share | Yes | Yes | Yes | No | Yes |
| Estimator | OLS | OLS | OLS | OLS | OLS |

Notes: This table reports estimates from cross-sectional firm regressions. The outcome is the symmetric growth rate of the value of the firm's financial assets in the given period. If a firm begins and ends the period with no financial assets, the growth rate is set to zero. The control variables and the standard error calculations are the same as in Table VI.

Table A.XIII: Loan growth and affected savings banks

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Affected savings bank | 0.080 | 0.031 | 0.083 | 0.045 | 0.080 | 0.078 |
| | (0.014) | (0.066) | (0.077) | (0.009) | (0.014) | (0.017) |
| Savings bank | -0.116 | | | -0.088 | -0.115 | -0.116 |
| | (0.019) | | | (0.013) | (0.015) | (0.019) |
| Loan growth 2003-05 | | | 0.015 | | | |
| | | | (0.112) | | | |
| Savings bank in BW or NRW | | | | | | 0.005 |
| | | | | | | (0.016) |
| | | | | | | |
| Observations | 1,284 | 1,284 | 953 | 1,528 | 1,513 | 1,284 |
| $R^2$ | 0.005 | 0.023 | 0.025 | 0.005 | 0.008 | 0.005 |
| State FE | No | Yes | Yes | Yes | No | No |
| Bank Type FE | No | Yes | Yes | Yes | No | No |
| Bank Size FE | No | Yes | Yes | Yes | No | No |
| Estimator | OLS | OLS | OLS | OLS | OLS | OLS |

Notes: This table reports estimates from cross-sectional regressions of bank loan growth on a dummy for affected savings banks. All outcomes are ln differences, except for column (5), which is the symmetric growth rate. Affected is defined as owning a Landesbank with trading losses during the financial crisis. Savings bank is a dummy for savings banks. Bank type FE are dummies for cooperative banks, real estate banks, and commercial banks. Bank size FE are ten dummies for the deciles of the distribution of the bank's lending stock in 2006. The data are from Bankscope. Standard errors are robust.

Table A.XIV: Firm employment and affected savings banks

| OUTCOME | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Ln employment growth 2008-12 | | Ln employment (panel specification) | | | | |
| Firm relation to affected savings bank | -0.015 (0.005) | -0.003 (0.005) | | | | | |
| Firm ln age | | -0.080 (0.004) | | | | | |
| Firm relation to affected savings bank*d | | | -0.005 (0.004) | 0.003 (0.004) | 0.001 (0.004) | 0.012 (0.005) | 0.001 (0.004) |
| Firm ln age*d | | | | -0.064 (0.003) | | -0.046 (0.004) | -0.062 (0.003) |
| Firm ln assets | | | | | | 0.208 (0.008) | |
| Firm equity / assets | | | | | | -0.011 (0.016) | |
| Firm cash-flow / assets | | | | | | -0.000 (0.000) | |
| Firm profit / assets | | | | | | 0.000 (0.000) | |
| Firm relation to CB*d | | | | | | | -0.019 (0.004) |
| Firm relation to affected Landesbank*d | | | | | | | -0.001 (0.008) |
| Observations | 45,537 | 45,537 | 438,254 | 438,254 | 438,254 | 173,072 | 438,254 |
| $R^2$ | 0.000 | 0.000 | 0.005 | 0.012 | 0.013 | 0.064 | 0.012 |
| Number of firms | 45,537 | 45,537 | 83,410 | 83,410 | 83,410 | 39,659 | 83,410 |
| Firm FE | No | No | Yes | Yes | Yes | Yes | Yes |
| Year FE | No | No | Yes | Yes | Yes | Yes | Yes |
| Industry FE | No | Yes | No | No | No | No | No |
| Industry FE*d | No | No | Yes | Yes | Yes | Yes | Yes |
| Age Bin*d | No | No | No | No | Yes | No | No |
| Estimator | OLS | OLS | OLS | OLS | OLS | OLS | OLS |

Notes: This table reports tests the effect of having an affected savings bank as relationship bank on employment. Affected savings banks own a Landesbank with trading losses during the financial crisis. For details, see Appendix E. The outcome in columns (1) and (2) is the ln difference in employment between 2008 and 2012. Columns (3) to (7) replicate the sample and panel specification in Popov and Rocholl (2015), where the outcome is ln employment. Standard errors are clustered at the level of the firm.

Table A.XV: Firm employment and other banks with trading losses (1)

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Firm dep on banks with trading losses*d | -0.012 (0.003) | -0.004 (0.003) | | | | | | |
| Firm CB dep*d | | | -0.011 (0.004) | -0.010 (0.004) | -0.009 (0.004) | -0.010 (0.006) | -0.011 (0.004) | -0.011 (0.007) |
| Firm dep on other banks with trading losses (except CB)*d | | | 0.001 (0.004) | | | 0.001 (0.006) | | |
| Firm dep on other banks with trading losses (except CB)*d(2008-10) | | | | 0.004 (0.004) | | | | |
| Firm dep on other banks with trading losses (except CB)*d(2007-10) | | | | | 0.005 (0.003) | | | |
| Firm DtB dep*d | | | | | | | -0.006 (0.005) | -0.009 (0.008) |
| Firm KfW dep*d | | | | | | | 0.058 (0.047) | 0.042 (0.063) |
| Firm IKB dep*d | | | | | | | 0.058 (0.066) | 0.004 (0.063) |
| Firm HypoVereinsbank dep*d | | | | | | | 0.001 (0.007) | -0.010 (0.010) |
| Firm DZ Bank dep*d | | | | | | | 0.016 (0.021) | 0.083 (0.046) |
| Firm dep on affected savings banks | 0.008 (0.003) | 0.006 (0.003) | 0.006 (0.003) | 0.007 (0.003) | 0.008 (0.003) | 0.009 (0.005) | 0.006 (0.003) | 0.012 (0.003) |
| Firm lagged change in sales | | | | | | 0.069 (0.007) | | |
| Observations | 188,233 | 188,233 | 188,233 | 188,233 | 188,233 | 73,851 | 188,233 | 314,803 |
| $R^2$ | 0.001 | 0.004 | 0.004 | 0.004 | 0.004 | 0.017 | 0.004 | 0.004 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Ln Age*d | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Size Bin*d | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry FE*d | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Import and Export Share*d | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| County FE*d | No | No | No | No | No | Yes | No | No |
| Estimator | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS |

Notes: This table reports firm regressions, replicating the specification and sample of Dwenger et al. (2015). The outcome in columns (1) to (7) is the firm's annual ln employment growth rate. In column (8), it is the annual ln growth rate of fixed assets. The sample includes the years 2006 to 2010. The other banks with trading losses banks are the German banks, except Commerzbank, that held a large share of loss-making assets during the financial crisis, as listed in Table 1 of Dwenger et al. (2015). For details, see Appendix F. Standard errors are clustered at the level of the firm.

## Table A.XVI: Firm employment and other banks with trading losses (2)

| VARIABLES | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Firm dep on banks with trading losses | -0.028 | -0.010 | | |
| | (0.011) | (0.011) | | |
| Firm CB dep | | | -0.050 | -0.054 |
| | | | (0.016) | (0.016) |
| Firm dep on other banks with trading losses (except CB) | | | 0.019 | |
| | | | (0.013) | |
| Firm DtB dep | | | | 0.005 |
| | | | | (0.018) |
| | | | | |
| Observations | 48,101 | 48,101 | 48,101 | 48,101 |
| $R^2$ | 0.000 | 0.019 | 0.019 | 0.019 |
| Ln Age | No | Yes | Yes | Yes |
| Size Bin | No | Yes | Yes | Yes |
| Industry FE | No | Yes | Yes | Yes |
| Import and Export Share | No | Yes | Yes | Yes |
| Estimator | OLS | OLS | OLS | OLS |

Notes: This table reports cross-sectional firm regressions. The outcome is ln employment growth between 2008 and 2012. The other banks with trading losses banks are the German banks, except Commerzbank, that held a large share of loss-making assets during the financial crisis, as listed in Table 1 of Dwenger et al. (2015). For details, see Appendix F. Standard errors are clustered at the level of the firm.

## Table A.XVII: County GDP and export dependence

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| | |
|---|---|
| Export-dependent*d | -0.011 |
| | (0.008) |
| Export-dependent*d(2011) | 0.012 |
| | (0.006) |
| Export-dependent*d(2012) | 0.009 |
| | (0.007) |
| CB dep*d | -0.138 |
| | (0.065) |
| | |
| Observations | 5,005 |
| $R^2$ | 0.360 |
| Number of counties | 385 |
| County FE | Yes |
| Year FE | Yes |
| Former GDR FE*d | Yes |
| Industry Shares*d | Yes |
| Population*d | Yes |
| Pop density*d | Yes |
| GDP per capita*d | Yes |
| Debt Index*d | Yes |
| Import Share*d | Yes |
| Export Share*Linear Trend | Yes |
| Landesbank in crisis*d | Yes |
| Estimator | OLS |

Notes: This table reports estimates from county panel regressions. The outcome is ln GDP. Export-dependent is a dummy variable for counties in the top quartile of the distribution of the average export share (fraction of exports out of total revenue, averaged across firms in the county). d is a dummy for the years following the lending cut, 2009 to 2012. d(2011) and d(2012) are dummies for the years 2011 and 2012 respectively. The control variables, weights, standard error calculations, the years covered by the data, and the definition of $R^2$ are explained in Table VIII.

Table A.XVIII: Firm employment and export dependence

| | |
|---|---|
| Export-dependent*d | -0.018 |
| | (0.012) |
| Export-dependent*d(2011) | 0.020 |
| | (0.007) |
| Export-dependent*d(2012) | 0.041 |
| | (0.010) |
| CB dep*d | -0.052 |
| | (0.015) |
| | |
| Observations | 12,066 |
| $R^2$ | 0.126 |
| Number of firms | 2,011 |
| Firm FE | Yes |
| Year FE | Yes |
| ln age*d | Yes |
| Size Bin FE*d | Yes |
| Industry FE*d | Yes |
| County FE*d | Yes |
| Import Share*d | Yes |
| Estimator | OLS |

Notes: This table reports estimates from firm panel regressions. The outcomes is ln employment. Export-dependent is a dummy variable for firms in the top quartile of the distribution of the export share. d is a dummy for the years following the lending cut, 2009 to 2012. d(2011) and d(2012) are dummies for the years 2011 and 2012 respectively. The data include the years 2007 to 2012. The control variables and the standard error calculations are the same as in Table VI.

## Appendix Figures

Figure A.I: Commerzbank dependence across German counties in 2006
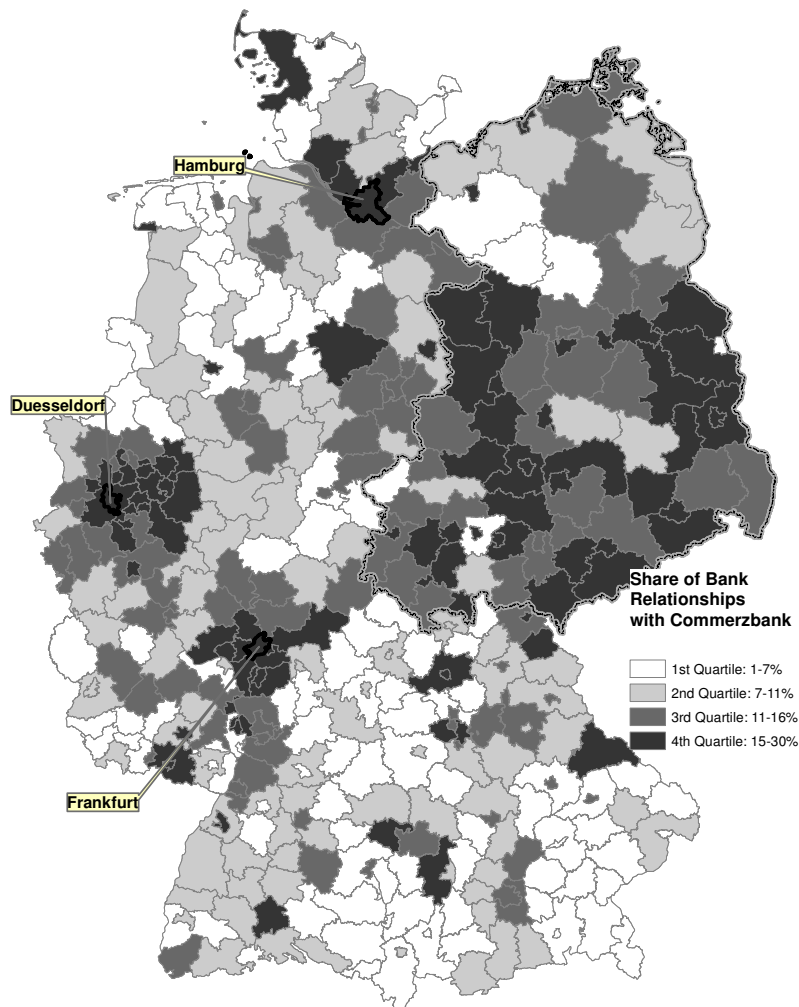


Notes: This map illustrates the Commerzbank dependence of German counties in the year 2006. I measure Commerzbank dependence using a dataset of the year 2006 relationship banks of 112,344 German firms. County Commerzbank dependence is the average of firm Commerzbank dependence for firms with their head office in the county. Two insights emerge from the map. First, counties around the post-war head offices Düsseldorf, Frankfurt, and Hamburg are more likely to depend on Commerzbank. Second, the former GDR is more dependent on Commerzbank. The reason is that Commerzbank followed a unique branch expansion strategy in the former GDR after German reunification in 1990 (Klein 1993). The other German banks simply took over the pre-existing branch networks of the former GDR state banks, while Commerzbank built up its own. The potential endogeneity resulting from Commerzbank's expansion in the former GDR is one of the motivations for the distance instrument.

Figure A.II: The lending cut to different categories of firms
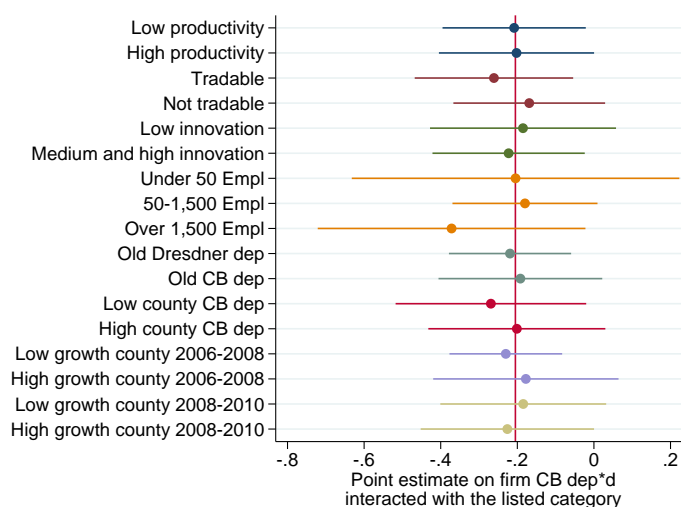


Notes: This figure plots coefficients from several firm panel regressions. The outcome is firm ln bank loans. Each color represents a different regression. The plotted point estimates are the coefficients on dummies for the category listed on the left, interacted with firm CB dep*d. The horizontal lines are 95 percent confidence intervals. The red, vertical line represents the average effect of CB dep*d on ln bank loans of -0.205. High (low) labor productivity is above (below) median 2006 valued added divided by employment. Tradability and innovation intensity are defined in Section VI.A. Old Dresdner dep refers to dependence on Dresdner Bank branches, which were then acquired and rebranded by Commerzbank. High (low) county CB dep and county growth are defined as above (below) the median. The control variables and the standard error calculations are the same as in column (4) of Table IV.