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Financing constraints, employment, and labor compensation: evidence from the subprime mortgage crisis

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Jörg Rocholl

Financing constraints,
employment, and labor
compensation:
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Abstract

This paper identifies the effect of financing constraints on firms' labor demand. We exploit exogenous funding shocks to German savings banks during the US mortgage crisis that are unrelated to local conditions. We find that firms with credit relationships with affected banks experienced a significant decline in employment and in labor compensation relative to firms whose credit relationships were with healthy banks. We also find that the employment effect increases, and the wage effect decreases with firm size. The decline in employment at firms attached to affected banks appears to be more long-lasting than the decline in labor compensation.

JEL classification: D92, G01, G21, J23, J31

Keywords: Credit constraints, financial crisis, employment, labor compensation

Non-technical summary

The question of how credit constraints affect firms' labor demand and induce changes in employment and compensation is an important one, for a number of reasons. First, while much of the literature has looked at the effect of credit constraints on firms' capital investment, evidence on the effect of credit constraints on firms' employment and especially compensation is scarce. Second, unemployment spells can have significant negative effect on workers' employability. Job-specific skills deplete quickly in an environment of continuous adoption of new technologies, and this process can turn cyclical unemployment into permanently high structural one. Third, by potentially inducing higher unemployment, tighter credit can have important negative social consequences, such as an increase in income inequality and crime.

We identify the effect of credit constraints on firms' labor demand by exploiting the exogenous variation in firm credit constraints induced by the heterogeneous impact across banks of the US subprime mortgage crisis. Our experimental setting is that of German public banks lending to German corporates. When in 2007 and 2008 five Landesbanken recognised substantial losses on assets following the decline in the US housing market, their respective savings banks had to make guarantees or equity injections into the affected Landesbanken. This creates an ideal experimental setting whereby we can estimate the employment adjustment by firms attached to "affected" banks (i.e., savings banks associated with Landesbanken with substantial exposure to the US mortgage market) relative to employment adjustment by similar firms attached to "non-affected" banks. We do so for a sample of 64,745 firms with credit relationships with a total of 359 savings banks (of whom 169 are "affected"), over the period 2005-2012.

We find that firms with a credit relationship with at least one affected bank experienced a significant decline in employment and in average labor compensation after this event. Our estimates imply that relative to firms attached to non-affected banks, firms with credit relationships with affected banks reduced employment by up to 1.6% and average wages for

the retained employees by up to 1.8%. We find evidence that the employment effect increases, and the wage effect decreases with firm size, suggesting that small firms face higher firing costs (potentially because they have stronger relationships with their workers) and so their labor adjustment in response to impaired external finance is primarily in the dimension of compensation. We also find that both effects are stronger in industries where firms have high external financing needs. Finally, the employment effect of credit constraints appears to be more long-lasting than the wage effect, with firm-level employment at firms attached to affected banks taking four years to go back to its pre-shock levels.

The importance of the link between financial and labor markets has been underscored by the recent global financial crisis and the “Jobless recovery” that has followed suit. The latter term refers to the fact that while output recovered very quickly in the wake of the global financial crisis, unemployment did not, and in many countries, including the US, it is still higher than it was in 2007. While some have suggested that the quickest and most efficient way to reduce unemployment is fiscal expansion, others have proposed that policy makers focus on the fact that the recession was caused by a severe financial crisis which left the financial system crippled and reduced dramatically credit flows to the real economy. Our paper provides evidence to that end by identifying the negative micro-level effect of balance sheet shocks to financial institutions on employment and compensation at firms which borrow from these institutions.

1. Introduction

There is a wide consensus in the economic literature that capital market imperfections can have adverse consequences for real decisions made by non-financial corporations. Empirical studies have documented the negative effect of credit constraints on capital investment (Love, 2003), R&D investment (Brown, Fazzari, and Petersen, 2009), advertising expenses (Fee, Hadlock, and Pierce, 2009), and on-the-job training (Popov, 2014), among others. However, considerably less is known about the effect of credit constraints on firms' demand for labor. Do firms cut employment, or wages, or both, in response to impaired access to external finance? Does the elasticity of adjustment to external financing vary across firms and industries? Is the effect short-lived or permanent?

We go to the heart of these questions by exploiting the exogenous variation in firm credit constraints induced by the heterogeneous impact across banks of the US subprime mortgage crisis. Our experimental setting is that of German public banks lending to German corporates. The German economy exhibited stable growth and record-low levels of unemployment until 2008, and the German housing market experienced none of the significant increase and rapid decline in prices that occurred in the US and in selected European markets, such as Ireland and Spain. At the same time, some of the German federal state banks (Landesbanken) had large exposures to the US subprime market and were substantially hit at the onset of the crisis. Landesbanken are in turn owned by the savings banks, which had to make guarantees or equity injections into the affected Landesbanken. Overall lending by savings banks in Germany, and corporate lending in particular, had been increasing steadily until the beginning of the financial crisis. However, after the summer of 2007, retail lending by savings banks showed a slow and continuous decrease. Puri, Rocholl, and Steffen (2011) document a significant supply side effect on credit, with loan rejection rates at affected banks significantly higher than loan rejection rates at non-affected banks after the beginning of the crisis, for the same set of banks and a similar subset of retail customers. The combination of deteriorating credit supply conditions and of declining demand for German exports had a sharp negative effect on the overall

economy, with GDP declining by 5.1% in 2009, and unemployment rising sharply, from a low of 7.2% in 2008 to a high of 8% in 2009.

Law mandates savings banks in Germany to serve only their respective local customers and thus operate in precisely and narrowly defined geographic regions, following a version of narrow banking. This creates an ideal experimental setting whereby we can estimate the employment adjustment by firms attached to “affected” banks (i.e., savings banks associated with Landesbanken with substantial exposure to the US mortgage market) relative to employment adjustment by similar firms attached to “non-affected” banks. We do so for a sample of 64,745 firms with credit relationships with a total of 359 savings banks (of whom 169 are “affected”), over the period 2005-2012. For the firms in the sample, we observe a large number of balance sheet items over the full sample period, such as employment, total labor compensation, total assets, debt, equity, profit, and cash flows, among others. For the banks in the sample, we observe actual financial distress in the form of publicly announced support by the savings banks related to Landesbanken which had to recognise large losses on their exposures to the US subprime mortgage market 2007-08.

We find that firms with a credit relationship with at least one affected bank experienced a significant decline in employment and in average labor compensation after this event. Our estimates imply that relative to firms attached to non-affected banks, firms with credit relationships with affected banks reduced employment by up to 2.2% and average wages for the retained employees by up to 1.8%. We find evidence that the employment effect increases, and the wage effect decreases with firm size, suggesting that small firms face higher firing costs (potentially because they have stronger relationships with their workers) and so their labor adjustment in response to impaired external finance is primarily in the dimension of compensation. We also find that both effects are stronger in industries where firms have high external financing needs for technological reasons such as project scale, gestation period, the ratio of hard vs. soft information, the ratio of tangible vs. intangible assets, etc. Finally, the employment effect of credit constraints appears to be more long-lasting than the wage effect,

with firm-level employment at firms attached to affected banks taking four years to go back to its pre-shock levels.

Our empirical design takes advantage of shocks to external financing which are reliably orthogonal to local investment opportunities. Nevertheless, our difference-in-differences strategy is potentially subject to a number of non-trivial endogeneity concerns. Our estimates could be driven by: 1) shocks to labor demand unrelated to the supply of credit (e.g., agency cost problems at firms became more severe for firms borrowing from affected banks); 2) non-random assignment of firms to banks (e.g., firms whose labor demand is more sensitive to credit constraints chose to become associated with banks that became distressed during the crisis); or 3) pre-existing trends (i.e., firms borrowing from affected banks were already cutting back before their lender became impaired). To address 1), we employ a rich set of time-varying firm-level balance sheet characteristics and firm fixed effects and show that the labor adjustment we observe is not driven by changes in borrower demand and/or quality. In particular, we show that the effect of credit constraints on employment and compensation is also observed for firms with no access to foreign markets, alleviating concerns that the reported empirical patterns are generated by a disproportionate dependence of firms whose exports were hit by the decline in global demand on credit lines granted by affected banks. To address 2), we employ a propensity score matching procedure to choose the closest control sample based on pre-crisis observables, and show that the main results are immune to this alternative specification. Moreover, our results survive specifications with region-specific trends, alleviating concerns that they are driven by unobservable changes in labor regulation that vary across regions. We also note that the nature of the German banking market, where savings banks are mandated by law to lend to local firms only, makes it unlikely that firms which anticipated a future need to reduce employment and wages, have chosen to be associated with a bank that later became affected. Regarding 3), we perform a placebo test and show that the break in trends between affected and non-affected firms disappears once we look at the pre-crisis period, implying that it is intimately related to the supply shock which followed the US subprime mortgage crisis. We also show that the correlation between credit constraints and

labor demand is not spurious in that it holds for firms that borrow from a single bank and so cannot substitute one bank funding source for another.

The question of how credit constraints affect labor demand and induce changes in employment and compensation is an important one, for a number of reasons. First, while much of the literature has looked at the effect of credit constraints on firms' capital investment,¹ evidence on the effect of credit constraints on firms' employment and especially compensation is scarce. Presenting evidence to that end would provide economists with a more complete view of how firms adjust their production inputs in response to impaired financing. Second, unemployment spells can have significant negative effect on workers' employability. Job-specific skills deplete quickly in an environment of continuous adoption of new technologies, and this process can turn cyclical unemployment into permanently high structural one (Ljungqvist and Sargent, 1998). Third, by potentially inducing higher unemployment, tighter credit can have important negative social consequences, such as an increase in income inequality and crime (Raphael and Winter-Ebmer, 2001; Garmaise and Moskowitz, 2006).

The rest of the paper is organized as follows. In Section 2, we discuss the relevant literature on financing constraints, investment, and employment. Section 3 presents the institutional setting. Section 4 discusses the empirical strategy. Section 5 summarizes the data. Section 6 presents the empirical results. Section 7 concludes.

2. Related literature

2.1. Financing constraints and investment

The question of the impact of financing frictions originating in various agency problems on firms' real investment decisions is a central theme in corporate finance research. La Porta,

¹ For a comprehensive literature review, see Hennessy and Whited (2006), among others.

Lopez-de-Silanes, Shleifer, and Vishny (1998) argue that differences in financial systems can explain much of the variation across countries in firm performance. Cooley and Quadrini (2001), Clementi and Hopenhayn (2006), and Wang, Wang, and Yang (2013), among others, develop theoretical models of entrepreneurship in the presence of capital market imperfections to support the conjecture that borrowing constraints have important implications for firm entry, growth, and survival.

Starting with the influential study by Fazzari, Hubbard, and Petersen (1988), the empirical corporate finance literature initially focused on the sensitivity of capital investment to internal cash flows. The underlying assumption is that capital market frictions increase the cost of outside capital relative to internally generated funds (e.g., Greenwald, Stiglitz, and Weiss, 1984; Myers and Majluf, 1984), and so the positive association between cash flows and investment constitutes evidence of underinvestment by cash-constrained firms. Greater cash holdings thus allow firms to undertake value-increasing projects that would have otherwise been dropped (Denis and Sibilkov, 2009). However, the literature has also recognized that the association can be spurious if a firm's cash flows are correlated with (usually unobservable) investment opportunities (e.g., Alt, 2003; Cleary, 1999; Kaplan and Zingales, 1997, 2000; Moyen, 2004). Researchers have recently attempted to overcome this problem by identifying exogenous shocks to firms' financing constraints. For example, Lamont (1997) exploits the mechanics of internal capital markets and identifies a large decrease in investment by nonoil units of oil companies following the drop in oil prices in 1986. Rauh (2006) uses mandatory pension contributions as an exogenous shock to firms' internally generated cash flows, and documents a significant negative association between capital expenditures and mandatory pension contributions. Faulklender and Petersen (2012) use the American Jobs Creation Act, which temporarily lowered the cost of repatriating foreign capital, and by extension the cost of funding domestic investment with internal foreign cash. They find that firms which were more likely to have underfunded investment prior to the Act, allocated a large portion of the repatriated funds to domestic investment.

We contribute to the recent empirical literature by identifying a different type of exogenous shocks to the relative cost of external finance. In particular, we focus on the availability of bank credit for firms with long-standing credit relationships. Losses on the banks' asset side which raise banks' funding costs generate adverse shocks to the availability of external funding to firms which rely on bank credit for their real investment decisions. We implicitly assume that banks transmit their funding shocks to the real sector, an assumption supported by a large and growing empirical literature (e.g., Peek and Rosengren, 1997; Kashyap and Stein, 2000; Paravisini, 2008; Ivashina and Sharfstein, 2010; Cetorelli and Goldberg, 2011; Chava and Purnanandam, 2011; Jimenez, Ongena, Peydro, and Saurina, 2012; Popov and Udell, 2012; Schnabl, 2012). Using a similar sample of banks as we do, Puri, Rocholl, and Steffen (2011) identify a substantial reduction in credit to private borrowers by German banks affected by the US subprime mortgage crisis.

2.2. Financing constraints and employment

Our paper is closely related to studies on the effect of financial market imperfections on employment. In the absence of direct measures of financing constraints, early studies relied, in the spirit of Gertler and Gilchrist (1994), on indirect measures, such as firm size, to identify the effect of monetary policy and the business cycle on firm employment (e.g., Sharpe, 1994; Nickell and Nicolitsas, 1999). Recent studies have attempted to gauge the effect of shocks to external finance on employment using more direct measures of financing constraints. Duygan-Bump, Levkov, and Montoriol-Garriga (2010) find that during recessions, workers in small firms are more likely to become unemployed if they work in industries with high external financial needs. Benmelech, Bergman, and Seru (2011) find that following the large decline in real estate values in Japan, unemployment increased by about 1% in US metropolitan state areas dominated by Japanese-affiliates banks. Greenstone and Mas (2012) show that the predicted decline in small business lending at the regional US level maps into lower rates of new business formation and higher unemployment. Boeri, Garibaldi, and Moen (2012) shows that more leveraged sectors exhibit higher employment-to-output elasticities during banking crises. We

are also aware of several studies that have used micro data to estimate the response of employment to credit constraints. Campello, Graham, and Harvey (2010) interview a global sample of 1050 CFOs and show that firms which report credit constraints plan to cut investment and employment more than unconstrained firms. Chodorow-Reich (2014) uses syndicated loan data to show that small firms which before the crisis were borrowing from banks that subsequently became impaired, reduced employment more than small firms associated with healthier banks. Acharya, Eisert, Eufinger, and Hirsch (2014) find that during the recent Eurozone sovereign debt crisis, large firms with higher exposure to syndicated lending by periphery banks experienced lower growth of employment, sales, and capital expenditures. Closest to our paper is the one by Bentolila, Jansen, Jimenez, and Ruano (2013) who use matched bank-firm data from the Spanish Credit Register and show that relative to 2006, in 2010 firms with credit relationships with weak banks had substantially lower employment levels than firms borrowing from non-affected banks.

Our paper extends upon these studies in a number of important ways. Relative to Duygan-Bump, Levkov, and Montoriol-Garriga (2010), Benmelech, Bergman, and Seru (2011), Greenstone and Mas (2012), and Boeri, Garibaldi, and Moen (2012), we employ matched bank-firm data to study the effect of shocks to bank balance sheets on firms' labor demand. This is important as it allows us to control for firm-specific time-varying observable characteristics related to creditworthiness, as well as for time-invariant firm-specific unobservable characteristics (such as project or management quality) in order to identify a supply effect that is not contaminated by a concurrent demand effect. Relative to Campello, Graham, and Harvey (2010) and Chodorow-Reich (2014), we identify affected banks directly because they were subject to a publicly announced intervention, and we have small and medium firms in our sample, rather than large firms only, which enables us to draw aggregate implications from our micro results. Finally, relative to Bentolila, Jansen, Jimenez, and Ruano (2013) and Acharya, Eisert, Eufinger, and Hirsch (2014), we do not have to worry about selection in bank-firm relationships due to the matching of firms and banks on a strict geographic principle mandated

by German law, and in addition, our data enable us to compare the short-run and the long-run effect of credit constraints.

Most importantly, relative to all quoted papers, we look at the wage aspect of adjustment in labor demand in response to negative shocks to borrowing capacity, not only at the employment effect. This is crucial for two reasons. First, a reduction in employment can take place even if labor demand does not change, as long as there is an inward shift in labor supply in response to credit shocks. Observing a reduction in employment *and* in wages is therefore necessary to identify an inward shift in labor demand as credit constraints tighten. Second, the negative welfare implication of credit constraints can be considerably larger if in addition to the reduction in employment, wages for retained employees go down, too.

3. Institutional setting and the recession in Germany

The German banking system comprises three pillars: private banks, cooperative banks, and public banks. The latter group consists of Landesbanken and savings banks. In 2011, there were 11 Landesbanken, which cover different federal states, and 431 savings bank, which cover different municipalities within the federal states. The owners of the Landesbanken are – often in equal terms – the federal states in which the Landesbanken are headquartered and the savings banks in these federal states. A strict regional principle applies, i.e. a savings bank can only become the owner of the Landesbank that operates in its federal state. The matching between Landesbank and savings banks is thus uniquely driven by geography.

While savings banks concentrate on providing financial services for customers in their municipality, often with a strong focus on retail customers, Landesbanken concentrate on serving as commercial banks, being the clearing banks for their local savings banks, and offering wholesale business such as syndicated lending or underwriting, cooperating strongly with their respective savings banks.

In case of distress, Landesbanken can rely on the support of their owners, including the savings banks in their region. These support mechanisms are either agreed upon formally, or they arise from the various ways in which savings banks benefit from the well-being of the respective Landesbank in their federal state. For example, Moody's (2004) states that "savings banks would, for the foreseeable future, support Landesbanken", incorporating this support in their ratings for Landesbanken.²

The economic outlook in Germany before the global financial crisis of 2008-09 was overwhelmingly positive. The German economy grew strongly and unemployment kept declining, over the period 2005-2008. In addition to sustaining a robust real growth, Germany experienced none of the housing bubbles that emerged in other countries during the early-to-mid 2000s. In fact, according to the OECD (2008), even in nominal terms German house prices did not increase in any single year since 1999. Thus at the onset of the crisis, German banks did not face particular risks related to domestic developments.

At the same time, a number of banks had invested substantially in the US subprime mortgage market before the financial crisis, and they incurred significant losses from these investments once the housing market in the US started deteriorating. Several Landesbanken were hit in particular: Sachsen LB was the first Landesbank to be rescued in the summer of 2007, due to its significant losses in the US subprime market. The next two Landesbanken to announce massive losses were West LB in November 2007 and Bayern LB in February 2008. Both banks state in their reports that these losses stem directly from their investments in the US subprime market. Landesbank Baden-Württemberg (LBBW) and HSH Nordbank were the final two Landesbanken that publicly announced losses from the US subprime market in November 2008. In each of these cases, savings banks in the respective federal states were directly affected and had to provide significant support to their Landesbanken. As described in

² More details are provided in Puri, Rocholl, and Steffen (2011).

detail in Puri, Rocholl, and Steffen (2011), the geographical location of the affected Landesbanken is dispersed over Germany, while the affected federal states are highly heterogeneous in their degree of economic development.

Germany's economy experienced a growth of 2.5% in 2007 and it kept expanding at the beginning of 2008. Overall GDP growth for 2008 amounted to 1.3% and became slightly negative only in the second half of 2008, while unemployment reached a 16-year low in October 2008. In 2009, the German economy shrank by 5.1%, which represented the largest annual economic decline in post-war Germany. However, the economy recovered very quickly and showed an increase of 2.1% in 2010. The overall economic development in Germany (not only) over this time period showed a high dependence on the development of the world economy, reflecting the high export-orientation of German businesses.

At the same time, there were large differences across affected and unaffected regions in unemployment dynamics. Germany-wide, unemployment rose by 0.8 percentage points in one year, from a low of 7.2% in 2008 to a high of 8% in 2009. On average, the population-unweighted unemployment rate in the 18 affected German regions increased by 0.7% between 2008 and 2009, while it actually declined by 0.1% on average in the 20 unaffected German regions.

In our subsequent analysis, we employ this regional heterogeneity to our advantage by differentiating between public German banks that were affected by the subprime mortgage crisis and public German banks that were not affected. In both groups, we have both Landesbanken and savings banks. While Landesbanken were directly affected by their losses in the US subprime market, savings banks in regions of affected Landesbanken were affected indirectly, as they were required to provide substantial financial support to their respective Landesbanken. In the remainder of the paper, we analyze whether borrowers at affected banks show different labor demand patterns than similar borrowers at non-affected banks.

4. Data

4.1. Firm-level data

Our firm-level data come from the Dafne database. Dafne is a commercial database provided by Bureau van Dijk, containing financial information on over 1 million public and private companies in Germany.³ The notably rich database contains detailed firm-level accounting data on 568 separate balance sheet items, including financial ratios, activities, ownership, sector, etc. Crucially, for the purpose of our paper, Dafne provides information on the number of bank relationships that the firm has, including the names of the banks. The database also reports firm-level information on total employment and on total labor expenses. All variables are reported with annual frequency. Finally, Dafne reports each firm's industrial sector at the 2-digit NACE level of disaggregation, which allows us to control for a number of technological differences across firms. We focus on firms that have at least 1 observation on employment and on labor expenses before the financial crisis, and at least one observation after that. We focus on the period 2005-2012. In the final sample, there are 56,773 firms with sufficient data on employment, and 37,935 firms with sufficient data on wages.

Table 1 shows definitions and summary statistics of the main firm-level variables that we use in the paper. Around 22% of the firms in our final dataset have an association with an “affected” bank. The median firm in the sample has 22 employees, but the firm size distribution is heavily positively skewed, with mean employment of 71. Median average wage (calculated as total annual labor expenses divided by total employment) is around 37,300 euro, or around 3,000 euro per month. The median firm also has 3.42 mln. euro worth of physical assets; its capital (equity-to-assets) ratio is 0.27; its profit-to-assets ratio is 0.03; and its cash flow-to-assets ratio is 0.08. Finally, each firm has on average credit relationships with 2 banks. At the

³ Dafne drops bankrupt companies after several years of inactivity. This survivorship bias, however, works in our favour because we do not observe the companies that experienced the largest declines in employment.

same time, 48% of the firms have a credit relationship with a single bank, and 10% of the firms have credit relationships with 4 banks or more.

In the main empirical exercises, we use all firms associated with non-affected banks, as a control group. However, if firms in the control group and firms in the treatment group vary systematically, an estimation strategy that does not account for these differences may be biased. Table 2 provides support to this concern. It illustrates the difference between firms associated with affected banks and firms associated with non-affected banks, with respect to a number of variables (all in terms of average pre-financial crisis values). Before the crisis, firms associated with banks that subsequently became affected were on average larger (in terms of employment, but not in terms of assets) and had slightly lower capital ratios. They also had, on average, relationships with a larger number of banks (2.2 vs. 1.7). In robustness tests, we explicitly control for these differences, and for the potential non-random selection of firms into the treatment group related to these.

4.2. Bank data

We match the 64,745 firms in our final dataset to all banks with which they have a lending relationship. Dafne reports these relationships for a minimum of 1 bank and a maximum of 6 banks. The total number of savings banks to whom the firms in the dataset are credit-related is 359. Out of those, 169 are related to one of the five Landesbanken that required financial assistance in late 2007 and throughout 2008; and 190 are related to one of the remaining Landesbanken. The number of Landesbank-savings bank associations ranges from 75 savings banks connected to West LB, and only two savings banks connected to Bremen LB.

We define an “affected” firm to be a firm that has a relationship with at least one savings bank that is a shareholder of an affected Landesbank. Clearly, because half of the firms have more than one credit relationship, this classification goes against us finding any result, as firms are capable of substituting credit across their multiple bank relationships. At the same time, the literature has documented that even when such substitutions take place, overall borrowing

tends to decline (Jimenez, Ongena, Peydro, and Saurina, 2012). In robustness tests we also look at the subset of banks that are connected to one bank only, which allows us to gauge the effect of external dependence on an impaired lender that the firm cannot substitute away from.

For main variables definitions and sources, see Table A1.

5. Empirical strategy and identification

We analyze whether credit constraints, proxied by a credit relationship with a bank affected by the US subprime mortgage crisis, have a negative impact on the firm's labor decisions. In particular, we employ a difference-in-differences approach to analyze two questions. First, do firms associated with affected banks adjust their labor demand on the *employment* margin, relative to firms associated with unaffected banks? Second, do firms associated with affected banks adjust their labor demand on the *compensation* margin, relative to firms associated with unaffected banks? We address these two questions by exploiting the specific setting in Germany, where savings banks represent a homogenous group of banks that operate according to a model of narrow banking throughout the country and are the owners of their respective regional Landesbanken. The identification for the empirical test is based on the fact that some but not all of the Landesbanken and thus some but not all of the savings banks were affected by the financial crisis, resulting in different shocks to access to finance for firms associated with these two groups of banks.

The Landesbanken in Saxony, North Rhine-Westphalia, Baden-Wurtemberg, Bavaria, and the states of Hamburg and Schleswig-Holstein are the only Landesbanken that publicly announced losses from the US subprime crisis in late 2007 and throughout 2008. The savings banks in these regions are thus affected as well due to their respective ownership. We define the exact crisis event date for these savings banks based on the first public announcement of losses by their respective Landesbanken, which is the third quarter of 2007 for Sachsen LB, the fourth quarter of 2007 for West LB, the first quarter of 2008 for Bayern LB, and November 2008 for LBBW and HSH Nordbank. Because firms need a reasonable adjustment period to adjust

their production inputs in response to a change in credit conditions, we treat 2009 as the first post-crisis year. Puri, Rocholl and Steffen (2011) show that the recognition of losses by Landesbanken and their respective savings banks is followed by a substantial reduction in credit to private borrowers. Hence, in this paper we take the reduction of credit by affected banks to their corporate clients as given, and evaluate its real consequences in terms of firm-level employment and compensation.

All the remaining Landesbanken do not show losses from the US subprime crisis during the sample period. The savings banks in these regions are thus classified as non-affected banks. Consequently, all firms associated with these banks are treated as non-affected in the empirical tests.

We use two sources of identifying variation: the time before and after the financial crisis as well as the cross section of firms affected and not affected by the crisis because of the negative balance sheet shocks experienced by their bank(s). We estimate the following two regressions:

$$\text{Log}(\text{Employment})_{it} = \beta_1 \text{Post}_t \times \text{Affected}_i + \beta_2 X_{it} + \beta_3 \varphi_i + \beta_4 \eta_t + \varepsilon_{it} \quad (1)$$

$$\text{Log}(\text{Average wage})_{it} = \beta_1 \text{Post}_t \times \text{Affected}_i + \beta_2 X_{it} + \beta_3 \varphi_i + \beta_4 \eta_t + \varepsilon_{it} \quad (2)$$

Here Affected_i is a dummy variable equal to 1 if firm i has a credit relationship with at least one savings bank that became affected in 2007 or 2008, and to 0 otherwise; Post_t is a dummy variable equal to 1 in and after 2009, and to 0 otherwise; X_{it} is a vector of time-varying firm-level control variables; φ_i is a firm fixed effect; η_t is a year fixed effect; and ε_{ijt} is an i.i.d. error term. Affected_i and Post_t are not included in the specification on their own because the effect of the former is subsumed in the firm fixed effects, and the effect of the latter is subsumed in the year fixed effects.

The coefficient of interest is β_1 . In a classical difference-in-differences sense, it captures the change in the variable of interest (employment or average labor compensation), from the pre-treatment to the post-treatment period, for the treatment group (firms associated with affected banks) *relative to* the control group (firms associated with non-affected banks). A negative coefficient β_1 would imply that all else equal, employment or average labor compensation increased less (decreased more) for the group of affected banks. The numerical estimate of β_1 captures the difference in the change in the variable of interest between the pre- and the post- period induced by switching from the control group to the treatment group. The vector of firm-level controls X_{it} allows us to capture the independent impact of various firm-specific developments, such as shocks to overall debt, profits, or cash flow, as well as losses on assets.

We also include firm fixed effects and year fixed effects. By including firm fixed effects, we address the possibility that changes in labor demand are driven by a time-invariant firm-specific unobservable factor, such as managerial risk appetite or growth opportunities. Firm fixed effects also subsume other types of time-invariant variation across firms, such as sectoral and regional variation. By including year fixed effects we aim to alleviate concerns that our results might be driven by product market demand shocks that vary heterogeneously over the business cycle.

Our sample period is 2005–2012. Given that we let our post-period start in 2009, the resulting sample period is symmetric, with four pre-crisis and four post-crisis years. The model is estimated using OLS and standard errors are clustered at the firm level to account for the fact that the unobservable component of firms' investment decisions can be correlated over time.⁴

⁴ The main results of the paper are robust to clustering at the regional level, to account for cross-sectional dependence (results available upon request).

The combination of time-varying firm-level characteristics and firm fixed effects addresses the concern that our estimates can be contaminated by shocks to labor demand unrelated to the supply of credit. While agency cost problems may have become more severe and/or growth opportunities may have deteriorated more for firms borrowing from affected banks, this will be picked by the rich set of balance sheet information, as well as by the firm fixed effects.

Nevertheless, we need to address a number of remaining issues with our empirical strategy. The first one is related to the assumption that the “treatment” (association with a bank affected by the crisis) is random. The nature of the German banking market, i.e., the regulatory dependence of firms on their local banks and in turn on their Landesbank, makes it unlikely that firms which anticipated a future need to reduce employment and wages, have chosen a credit association with a bank that later became affected. However, there are other ways in which this assumption can be violated. For example, affected banks may be operating in regions where the local economy is skewed towards sectors with naturally high elasticity of labor adjustment to shocks to external financing. Table 2 does imply that firms attached to affected banks are on average smaller than firms attached to non-affected banks. To the degree that observable differences across the two types of firms may result in distributions of balance sheet characteristics that exhibit insufficient overlap across the two groups of firms, simply controlling for these differences in an OLS setting may not be enough to address such potential selection bias. To that end, we employ a propensity matching procedure whereby we choose a control group of firms that is observationally identical to the treatment group of firms, based on pre-crisis characteristics.

Another related concern is that if there were different trends between the two types of firms prior to the crisis (for example, because of systematic differences in risk taking between the two groups of firms), we might incorrectly interpret our results as being driven by exposure to affected banks. To test for different trends between the two types of banks, we perform a placebo test on an earlier period.

6. Empirical results

6.1. Main result

We analyse the effect of credit constraints, proxied by association with at least one affected bank, on firms' labor demand in a difference-in-differences framework aimed at identifying a differential effect on affected versus nonaffected firms. The key identifying assumption is that trends related to labor demand are the same among affected and nonaffected firms in the absence of changes in access to finance that are induced by the financial crisis. We evaluate this assumption explicitly later.

The main results of the paper are reported in Table 3. In it, we estimate two different versions of Models (1) and (2). The effect of credit constraints on labor demand in the dimension of employment is estimated in the first two columns. In column (1), we include $Affected_i$ and $Post_t$ on the right-hand side, but do not include firm and year fixed effects. We also control for a number of firm-level characteristics, such as the firm's size (proxied by the natural logarithm of firm assets), and the firm's capital-to-assets ratio, profit-to-assets ratio, and cash flow-to-assets ratio. We find that larger firms have more employees, and that firms with a higher average cash flow also employ more workers. As labor and capital are complements in production, our evidence is consistent with the evidence in Blanchard, Lopez-de-Silanes, and Shleifer (1994), Lamont (1997), and Rauh (2006), among others, who establish a robust link between cash flow and investment. Firms that use more equity also tend to have a larger employment base. Controlling for those, profit is negatively correlated with the size of the firm's labor force.

Turning to the main variable of interest, the estimate of the regression implies that association with an affected bank had a strong negative effect on the firm's demand for labor after the occurrence of the credit supply shock. The interpretation of the coefficient is in a difference-in-differences sense: relative to a firm whose credit relations are to non-affected banks only, a firm with a credit relation with at least one affected bank reduced employment by

1.4% on average, between the 2005-2008 and the 2009-2012 period. In addition to that, the estimates on the individual components of $Affected_i \times Post_t$ imply that affected firms employ more workers, but pay lower wages on average, and that both firm-level employment and compensation were higher on average after 2008 than before, suggesting that the shocks to access to external finance arrested this trend by affecting negatively a sub-sample of the population of firms.

In column (2), we drop $Affected_i$ and include firm fixed effects instead, to account for the fact that changes in labor demand may be correlated with a time-invariant component of the firm's production function that is unobservable to the econometrician. We also exclude $Post_t$ but add year fixed effects, to account for shocks to the business cycle that are common to all firms in the sample. In this way, we aim to identify the firm-specific time-varying component of labor demand.

Importantly, the effect of an association with an affected bank on employment is still significant at the 1% level. The magnitude of the coefficient is even higher than in column (1), implying that between the 2005-2008 and the 2009-2012 period, and relative to a firm whose credit relations are to non-affected banks only, a firm with a credit relation with at least one affected bank reduced employment by 1.5% on average (or by 1 employees, given a sample mean of 71).⁵⁶

⁵ The results are qualitatively unchanged when we exclude the 296 firms with 1 employee which by definition cannot reduce employment without exiting. Results are available upon request.

⁶ In Table A2, we show that after the shock, firms attached to affected banks reduce their asset base and post a decline in sales and in profits. This is consistent with a mechanism whereby companies experience a reduction in lending by their creditors, therefore investing less and, as a consequence, employing fewer workers than before. Importantly, these results are derived from a cross-firm within-industry comparison, so they are not contaminated by changes in the demand for industry-specific products.

In columns (3) and (4), we repeat the same set of exercises, but this time the outcome variable is the natural logarithm of average labor compensation. The estimates imply that firms respond to shocks to external financing by adjusting the labor compensation margin as well as the employment margin. In both specifications, the effect is significant at the 1% statistical level. The estimates from the model that accounts for time-varying firm-level balance sheet characteristics reported in column (4) imply that larger and better capitalised firms tend to pay higher compensation to their employees. The coefficient on the main variable of interest implies that between the 2005-2008 and the 2009-2012 period, and relative to a firm whose credit relations are with non-affected banks only, a firm with a credit relation with at least one affected bank reduced average labor compensation by about 420 euro per year.

Our empirical strategy allows us to come up with a rough estimate of the aggregate labor consequences of the credit shock stemming from exposure of a number of German banks to the US mortgage market. In 2008, the German firms employed 35.8 mln. persons. Our data implies that 22% of the firms are associated with affected banks (Table 1), and that before the crisis, the average affected firm had 71 employees relative to 59 for a non-affected firm (Table 2). Consequently, around 26.5% of German workers were employed at affected firms, or around 9.5 mln. persons. Our estimates imply that all else equal, overall employment declined by around 142,500 persons, and aggregate compensation declined by 3.9 bln. euro, due to the credit shock.⁷

6.2. Accounting for alternative explanations

While the negative effect of credit constraints on labor demand and compensation detected so far appears robust, a number of alternative mechanisms could be at play, diluting

⁷ This is a *ceteris paribus* extrapolation which is based on the assumption that labor demand at non-affected firms stays constant. This does not need to hold in reality. For example, it is possible that while affected firms are shedding jobs, non-affected firms are hiring more because the shift in global demand away from durables has increased demand for their goods, or because wages are falling.

the causal interpretation of this result. In particular, firms associated with affected banks could be systematically different from firms associated with non-affected banks, in ways that matter for their labor demand. For example, they may be systematically different in terms of size and net worth; they may be predominantly exporting firms that are facing the dual shock of collapsing global demand and tightening credit constraints; or they may have been subject to different trends already before the crisis started. In what follows, we review these potential problems and discuss the strategies we have employed to deal with them.

6.2.1. Systematic balance sheet differences between treatment and control firms

6.2.1.1. Propensity score matching

The first concern relates to the possibility that firms with credit relationships with affected banks are reducing their labor demand and compensation for reasons other than a reduction in bank credit. This could be because adverse economic conditions are increasing bank agency costs and firm agency costs at the same time, for example, because low-net worth firms may be more likely to be borrowing from low-net worth banks (Gertler and Gilchrist, 1994). The structure of the German banking market discussed in the previous section goes some way towards alleviating this concern. Law mandates savings banks in Germany to serve only their respective local customers, and they can only become owners of the Landesbank of their respective state. This creates a direct link between an affected Landesbank and a borrowing firm and makes it unlikely that low-net worth firms chose to become associated with Landesbanked that would become impaired. In addition to that, we control for a number of balance sheet characteristics that should proxy for time-varying net worth.

Nevertheless, Table 2 does suggest that affected and non-affected firms differed in their pre-crisis characteristics. Firms whose saving bank became affected by association were on average larger, less capitalized, and had more banking relationships. While the latter goes in our favour in the sense that these firms were better able to substitute between funding sources, we do need to account for the fact that smaller and less capitalized firms could be low-

net worth ones, and consequently more likely to reduce their scope of operation in a recessionary environment. Simply controlling for those will not address the issue if the overlap in the distributions of these variables is not sufficient across control and treatment groups (see Rosenbaum and Rubin, 1983).

We address this problem by applying a propensity score matching procedure whereby we choose a sub-sample of control (non-affected) firms that are as close as possible a match for the sample of affected firms. We choose the most similar control sample based on a propensity score after conditioning on pre-crisis size, capital, profitability, cash flow, geographic region, and number of banking relationships. The sample is reduced by 11,062 non-affected firms in the estimation of Model (1), and by 14,157 non-affected firms in the estimation of Model (2). Panel A of Table 4 reports the first stage, suggesting that all right-hand side variables have high statistical power in predicting the probability of a firm being affected. The second-stage estimates reported in Panel B demonstrate that even in this alternative specification, we continue to record a strong negative effect of credit constraints on labor demand, both in the employment and in the compensation dimension. The results continue to be statistically significant at the 1%, and are of somewhat larger magnitude than their counterparts in Table 3.

6.2.1.2. Accounting for regional variation

Another concern related to systematic differences across firms stems from different industrial dynamics across German regions. The divergence in unemployment trends across affected and non-affected regions displayed in Figure 1 can in theory be due to the activation of mechanisms that affect firms' labor demand, other than shocks to credit supply. One such mechanisms is related to labor regulation: if non-affected regions have local regulation that makes it more difficult to fire workers during a recession, this could explain a more gradual decline in unemployment for the firms in the control group. And even if such regulation varies by industry rather than by region, it could also affect different regions differently depending on their industrial structure.

In order to diffuse such concerns, we modify our main regression in two different ways. First, we download regional information for all firms in the dataset for which such information is available, and add Region×Year fixed effects to the regressions. The inclusion of this interaction term should net out all trends that are region-specific but common to all firms within a region. Columns (1) and (2) of Table 5 report that our main results are immune to this alternative procedure. However, compared to columns (2) and (4) of Table 3, the magnitude of the effect goes down and its statistical significance declines, implying that unobservable time-varying regional heterogeneity plays an important role in explaining changes in firms' labor demand. Second, we only compare affected and non-affected firms within affected regions (column (3) and (4)), eliminating the effect of cross-regional differences. Once again, our main results survive.

6.2.2. Exporters vs. non-exporters

Another observable dimension across which affected and non-affected firms might differ is the export dimension. The German economy is heavily dependent on foreign markets, with exports accounting for around 48% of GDP in 2008 (compared with 13% for the US, 35% for China, 18% for Japan, 27% for France, and 29% for the UK).⁸ At the same time, global trade fell by around 30% during the recession of late 2008 – early-to-mid 2009, driven to a large degree by a decline in the global demand for the products that the Germany economy specializes in, such as manufacturing goods, and in particular durables (Eaton, Kortum, Neimar, and Romalis, 2011). German exports declined by about 17% over the course of 2009 relative to 2008. Some of the German states whose Landesbanken were affected by the crisis, are also home to a large

⁸ Data come from the World Bank Development Indicators Database.

manufacturing base: for example, the headquarters of three of the largest German automobile producers are in states whose Landesbanken became impaired in late 2007 or in 2008.⁹

While the latter concern is addressed in the previous table where we account for region-specific trends over time, it is still possible that within the same region, exporting firms are systematically more likely to be attached to affected banks. If so, the estimates reported in Table 3 could be biased by the unobservable decline in global demand which is firm-specific and therefore captured neither by the firm fixed effects nor by the year fixed effects. To address this concern, we split the sample in exporting and non-exporting firms. We classify non-exporting firms as firms whose production is fully sold in the domestic market. Conversely, exporting firms are ones for whom at least 1% of total output is sold in foreign markets.¹⁰ We then run our saturated Models (1) and (2) on the two subsets of firms.

The estimates from this test are reported in Table 6. They imply that between the 2005-2008 and the 2009-2012 period, and relative to firms associated with non-affected banks, firms associated with affected banks reduced employment and wages strongly and significantly regardless of whether they were exporters or not. This result is important in alleviating concerns that the effect we measure is contaminated by an export demand effect that is stronger for firms that are simultaneously affected by shocks to their lenders. However, we also record important differences in the behaviour of exporters vs. non-exporters. In particular, affected exporters were somewhat more likely to reduce employment than affected non-exporters (columns (1) and (2)). At the same time, affected exporters were almost twice as likely to reduce wages as were affected non-exporters (columns (3) and (4)). One potential interpretation of these differences is related to the fact that exporting firms are usually the

⁹ Daimler-Benz, the maker of Mercedes, has its headquarters in Stuttgart, the capital of Baden-Wurtemberg, and the headquarters of BMW and Audi are in the Bavarian cities of Munich and Ingolstadt, respectively.

¹⁰ The empirical estimates from this test are only strengthened when we compare firms with 0% exports and firm with 100% exports, but the sample size declines substantially.

most productive firms in the market (Helpman, Melitz, and Yeaple, 2004) and so their workforce may to a larger degree be endowed with valuable industry-specific skills. The termination of labor relationships would then be more costly to exporters than to non-exporters, and so they would prefer to adjust to shocks to external financing by renegotiating wages rather than by reducing employment.

6.2.3. Parallel trends

Another possible concern is related to the possibility that the different trends in labor demand we observe during the crises may have already been in place before the shock to credit supply. While in the previous two sub-sections we conditioned on observables, there could still be pre-existing trends related to unobservable factors, such as growth opportunities. If this were to be the case, we might incorrectly interpret pre-determined trends as evidence of the negative effect of credit constraints. To test for different trends between the two types of firms, we perform a placebo test in which we compare the group of affected firms to the group of unaffected firms over a four-year period (2005-2008), and setting the *Post* period to begin in 2007. If treatment and control observations were already facing different prospects before the crisis, one should observe statistically significant differences between the two groups over the earlier period, too. However, the estimates reported in Table 7 imply that this is not the case. While both estimates are negative, they are nowhere near any meaningful level of statistical significance. The evidence thus strongly suggests that the effect we capture is indeed due to changes in firms' behavior specific to the period after the shocks to the asset side of a subset of banks took place.

6.3. Classification issues

The next set of concerns is data-related. We have made a number of assumptions in our empirical tests which are not innocuous. For one, we do not observe actual credit flows between banks and firms, and so we have assumed that all credit relationships the firms report are also active. It is possible that with some of the banks they report being related to, firms only

have deposit accounts rather than credit lines. Second, we have classified firms as affected if they have an association with at least one affected bank. This might be inaccurate if the affected bank is a bank the firm only deposits with, as well as in the context of multiple banking relationships that firms can substitute across.

To be sure, in most cases the potential bias goes in our favour: if associations with affected banks are not always credit associations, and if firms can substitute across banks, it makes it more difficult to find any effect of credit constraints on firms' labor demand. However, if firms could perfectly substitute away from affected banks, but we still find an effect of association with an affected bank, it would imply that the correlation between supply shocks and firm responses that we have captured is a spurious one.

To that end, in Table 8, we focus on firms with a single bank relationship. We run our main test on two different sub-sets of firms. First, we use all firms associated with a non-affected bank in the control group. This strategy is risky as firms with a single bank relationship may be systematically different from firms with multiple banking relationships; for instance, they can be smaller, younger, and face worse growth opportunities (Farinha and Santos, 2002). If these are also the firms that face higher agency costs, and they tend to bank with low-net worth banks (Gertler and Gilchrist, 1994; Jimenez, Ongena, Peydro, and Saurina, 2012), then single-bank affected firms could be systematically different from single-bank non-affected firms in a way that biases our results upwards. To account for this possibility, we also perform a version of the test reported in Table 4 whereby we employ a propensity score matching procedure to choose a sub-sample of control (non-affected) firms that are as close as possible to the sample of affected firms in terms of pre-crisis size, capital, profitability, and cash flow.

The estimates reported in Table 8 imply that the negative effect of credit constraints on labor demand holds for the sub-sample of firms that only bank with one creditor, too. In particular, negative shocks to external financing strongly affect employment both in the full sample (column (1)), as well as when we focus on firms that are as similar based on observable

pre-crisis characteristics (column (2)). The effect is numerically close to what we recorded when looking at firms with more than one bank. The negative impact of credit constraints on wages is also apparent in both types of sub-samples (columns (3) and (4)). Table 8 thus confirms that the statistical association between changes in credit constraints and changes in firms' labor demand that we have uncovered is not spurious in that it also holds in the extreme case when firms cannot substitute between affected and non-affected banks.

6.4. Heterogeneous impact of credit constraints on firms' labor demand

We next study which firms are most sensitive to the transmission of bank balance sheet conditions. There are clear arguments in the literature about which firms and industries should be most affected by a decline in credit. The firms' risk and the tangibility of their assets, for example, are expected to play an important role in explaining differences in credit availability across firms. High-risk firms tend to be most affected by changes in credit conditions, and these tend to be small and young (Berger, Klapper, and Udell, 2001). Regarding asset tangibility, Berger, Ofek, and Swary (1996) show that firms with fewer tangible assets are more likely to lose access to credit when banks reprice risk. The rationale is that lenders rely more on collateral when making lending decision rather than investing in costly screening technologies, and this problem will tend to be exacerbated in an environment where risk is suddenly priced higher.

In Table 9, we evaluate the effect of credit constraints on employment after differentiating across firm-specific characteristics that proxy for the above considerations. In particular, we expect less profitable firms and firms with lower cash flow to be less capable of substituting internal financing for bank credit and hence be more affected by a credit shock. We also expect firm size to matter, although the direction of the effect is unclear. On the one hand, small firms in general should be more susceptible to credit shocks as banks retract from riskier and more opaque borrowers first. On the other hand, conditional on the size of the credit

shock, small firms where labor relations are more personal and long-lasting (a family firm would be the extreme example) may be more reluctant to reduce employment.

The regression estimates imply that in response to a negative shock to access to finance, firms with more than 20 employees are more likely to reduce employment (column (1)) while firms with less than 20 employees are more likely to reduce wages (column (4)). This implies that smaller firms may be facing lower flexibility in the employment dimension. This is consistent with a mechanism whereby labor regulation preventing firms from firing employees is tighter for smaller firms, or whereby there is higher solidarity between employers and workers when there are fewer hierarchical levels. Consequently, smaller firms are more likely to adjust on the wage margin in the presence of binding constraints on external financing. The estimates also imply that firms with higher cash flows are less likely to reduce wages if their credit institutions are hit by a funding shock (column (5)). Finally, more profitable firms are less likely to reduce employment (column (3)) and wages (column (6)) when the cost of external financing goes up, albeit in both cases the effect is insignificant.

While informative, this latest test is intrinsically imperfect because firm characteristics such as size and cash flow are endogenous in that they can be adjusted by the firm in response to credit shocks and are in general determined together with labor demand. In Table 10, we perform a version of this test where we take advantage of the predetermined technological characteristics of the industry the firm operates in. This alternative approach is based on using data on mature US firms and using it to construct industry benchmarks for risk and asset tangibility. The rationale for doing so goes back to Rajan and Zingales (1998) who argue that the actual corporate structure of small firms is a function of financial constraints, while the corporate structure of large mature firms is more representative of the cross-industry variations in the scale of projects, gestation period, the ratio of tangible vs. intangible assets, R&D investment, etc. In addition, doing so for large US firms ensures that what is taken as a "natural" industry feature is not contaminated by shallow financial markets. The idea is that

large listed US firms are not constrained in their choice of a corporate structure, so their financing decisions reflect the industry's natural demand for external funds.

Table 10 reports a version of the main model where the interaction of the *Affected* and the *Post* dummies is also interacted with one of three industry characteristics: “External dependence”, “Employment-capital ratio”, and “R&D intensity”.¹¹ All double interactions are also included in the regressions (not reported for brevity). The estimates suggest that firms are more likely to reduce employment if their production process is more R&D-intensive (column (3)). Unlike firms in physical capital-intensive industries, firms with R&D-intensive processes are less able to pledge more tangible collateral in order to convince a bank in distress to keep lending to them. We also find that firms in industries that rely on external finance for technological reasons (i.e., more likely to be using a lot of bank credit in the first place) are more likely to reduce wages in response to negative shocks to credit constraints (column (4)). Finally, firms are less likely to reduce wages if their production process is more labor dependent (i.e., there are more employees per unit of capital to begin with; column (5)), which in combination with the negative coefficient in column (2) implies that firms where labor is relatively abundant are more likely to adjust in the employment margin, while firms where labor is relatively scarce are more likely to keep their employees and adjust in the wage margin.

6.5. Short-run vs. long-run

We have so far identified the causal effect of credit constraints on labor demand. Our estimates have demonstrated that firms simultaneously reduce employment and wages when faced with shocks to access to external finance. However, are these effects short-lived or

¹¹ The three benchmarks are constructed by calculating - for each mature Compustat firm between 1990 and 2000 - the firm's ratio of capital expenditures not financed with internal funds (in the case of “External dependence”); the ratio of the number of employees to total physical capital used in production (in the case of “Employment-capital intensity”); and of research and development expenses to sales (in the case of “R&D intensity”). We then take the industry median value. The three benchmarks should ideally capture partially risk and partially asset tangibility.

permanent? Bentolila, Jansen, Jimenez, and Ruano (2013) show that employment in 2010 was lower than in 2006 at Spanish firms borrowing from affected banks, but they do not compare the short-run and the long-run response. Because we have four post-crisis years, we can differentiate the immediate response from the long-term one. To that end, we interact $Post_t \times Affected_i$ with a dummy equal to 1 for each year during the 2009-2012 period.

Table 11 reports the estimates from this alternative test. We observe three important facts. First, the data suggest a very strong short-run effect of credit constraints on both employment (column (1)) and on wages (column (2)) in that the decline in employment and in labor compensation is very pronounced in 2009 and in 2010, and then it dissipates over time. Second, while the wage effect is most pronounced immediately after the shock (in 2009), the employment effect takes more time to build, with the biggest decline in firm-level employment taking place two years after the shock, in 2010. Finally, while the wage effect disappears after 2010, firm-level employment recovers more slowly and only goes back to pre-crisis levels in 2012. One potential explanation for this more prolonged negative effect of credit constraints is related to employment hysteresis, whereby an increase in unemployment can become permanent because human capital depletes during an unemployment spell and so firms are unwilling to re-hire the same worker, even when their labor demand returns to the level from before the shock (Blanchard and Summers, 1986). Another explanation relates to intertemporal increasing returns whereby firms active in the past face lower costs of production today, leading to a slower return to trend production for firms that have shed a lot of workers in the previous period (Acemoglu and Scott, 1997). Either way, our results suggest that negative shocks to credit constraints can have a long-lasting negative effect on aggregate employment levels, providing evidence to the importance of reactivating credit flows quickly in the wake of financial crises (Calvo, Coriceslli, and Otonello, 2013).

7. Conclusion

In this paper, we identify the effect of credit constraints on firms' labor demand by exploiting exogenous shocks to access to external finance induced by German banks' heterogeneous exposure to the US subprime mortgage market. We identify affected banks based on guarantees or equity injections they had to make into affected Landesbanken. We then match a sample of 64,745 firms with complete balance sheet information to a total of 359 savings banks over the period 2005-2012. The resulting dataset is notably rich in terms of firm-specific information and precise in its classification of distressed financial institutions. We find that firms with a credit relationship with at least one affected bank experienced a significantly larger decline in employment and in average labor compensation after the beginning of the global financial crisis. Our estimates imply that relative to firms associated with non-affected banks, firms associated with affected banks reduced employment by up to 1.6% and average wages for the retained employees by up to 1.8%. We also find that the employment effect increases, and the wage effect decreases, with firm size, and that both effects are stronger in financially dependent industries. Finally, while the wage effect appears to weaken after the initial shock, employment at firms attached to affected banks remains permanently below the levels prior to the negative shock to external financing. This implies that financial (and in particular, banking) crises can induce a persistent increase in unemployment.

The question of how shocks to financial institutions affect employment is a crucial one and it has been underscored by the recent global financial crisis and the "Jobless recovery" that has followed suit. The latter term refers to the fact that while output recovered very quickly in the wake of the global financial crisis, unemployment did not, and in many countries, including the US, it is still higher than it was in 2007. While some have suggested that the quickest and most efficient way to reduce unemployment is fiscal expansion, while fiscal contractions achieve the exact opposite (Guajardo, Leigh, and Pescatori, 2011), others have proposed that policy makers focus on the specific nature of the Great Recession. Namely, the recession was caused by a severe financial crisis which left the financial system crippled and reduced

dramatically credit flows to the real economy, thus affecting negatively overall employment (Calvo, Coricelli, and Otonello, 2013). Our paper provides evidence to that end by identifying the negative micro-level effect of balance sheet shocks to financial institutions on employment and labor compensation at firms which borrow from these institutions.

We have stopped short of a number of interesting and important extensions. For one, why does the employment effect of financial shocks appear to be long-lasting given that the credit shock to the German banking sector was short-lived? Second, how does employment legislation affect the incentive of credit constrained firms to retain workers during recession? More flexible labor regulation could result in sharper job losses but also in quicker job recoveries, altering the dynamics described in this paper. Investigating these mechanisms in a cross-country setting could lead to more complete macroeconomic insights and presents itself as an attractive avenue for future research.

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Table 1. Summary statistics

This table presents summary statistics for the variables used in the empirical tests. 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Employment' denotes the number of the firm's total employees. 'Average wage' denotes the firm's total wage bill in euro, divided by total number of employees. 'Assets' denotes the firm's total assets, in mln. euro. 'Capital' denotes the ratio of the firm's equity to total assets. Profit denotes the ratio of the firm's total profits to total assets. 'Cash flow' denotes the ratio of the firm's total cash flows to total assets. 'No. bank relationships' reports the total number of banks with which the firm has a credit relationship. The sample period is 2005-2012. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. The values reported are calculated over all firm-year observations.

Variable	# firms	Mean	Median	St. dev	Min	Max
Affected	64,745	0.22	0.00	0.42	0.00	1.00
Employment	56,773	70.62	22.00	302.73	1.00	131,313.00
Average wage	37,935	41,097.95	37,313.70	29,490.08	200.00	500,000.00
Assets	64,745	6.04	3.42	81.17	0.00	21,625.59
Capital	64,711	0.31	0.27	0.27	-28.81	2.08
Profit	40,072	0.05	0.03	0.53	-47.53	161.39
Cash flow	40,072	0.10	0.08	0.92	-25.73	250.36
No. bank relationships	64,745	1.84	2.00	1.06	1.00	6.00

Table 2. Affected vs. non-affected firms, pre-crisis

This table presents difference-in-differences estimate from a Mann-Whitney two-sided test on pre-2008 mean values of the variables used in the empirical tests, for affected vs. non-affected firms. 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Employment' denotes the number of the firm's total employees. 'Average wage' denotes the firm's total wage bill in euro, divided by total number of employees. 'Assets' denotes the firm's total assets, in mln. euro. 'Capital' denotes the ratio of the firm's equity to total assets. 'Profit' denotes the firm's the ratio of the firm's total profits to total assets. 'Cash flow' denotes the ratio of the firm's total cash flows to total assets. 'No. bank relationships' reports the total number of banks with which the firm has a credit relationship. The sample period is 2005-2008. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. Standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Variable	Non-affected	Affected	Difference
Employment (pre-2009)	59.80	70.51	-10.71***
Average wage (pre-2009)	43,489.27	38,207.43	5,281.84
Assets (mln.) (pre-2009)	5.88	5.98	-0.10
Capital (pre-2009)	0.30	0.29	0.01***
Profit (pre-2009)	0.05	0.05	0.00
Cash flow (pre-2009)	0.11	0.10	0.01
No. bank relationships	1.73	2.22	-0.49***

Table 3. The effect of financing constraints on firms' employment and compensation: Main result

This table presents difference-in-differences estimates of changes in firm employment (columns (1)-(2)) and average wage (columns (3)-(4)). 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. 'Log (Assets)' denotes the natural logarithm of the firm's total assets. 'Capital' denotes the ratio of the firm's equity to total assets. 'Profit' denotes the firm's the ratio of the firm's total profits to total assets. 'Cash flow' denotes the ratio of the firm's total cash flows to total assets. The sample period is 2005-2012. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. All regressions include fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Employment)		Log (Average wage)	
	(1)	(2)	(3)	(4)
Affected × Post_2008	-0.0144*** (0.0039)	-0.0150*** (0.0039)	-0.0102*** (0.0030)	-0.0104*** (0.0030)
Affected	0.1689*** (0.0142)		-0.0098* (0.0058)	
Post_2008	0.0210*** (0.0021)		0.0246*** (0.0016)	
Log (Assets)	0.3769*** (0.0072)	0.2904*** (0.0096)	0.1360*** (0.0060)	0.1507*** (0.0191)
Capital	0.0518*** (0.0151)	0.0285*** (0.0165)	0.0774*** (0.0096)	0.0439*** (0.0146)
Profit	-0.0310** (0.0140)	-0.0268** (0.0114)	0.0387 (0.0253)	0.0265 (0.0290)
Cash flow	0.0096 (0.0064)	0.0072* (0.0049)	0.0318** (0.0160)	0.0365** (0.0169)
Year fixed effects	No	Yes	No	Yes
Firm fixed effects	No	Yes	No	Yes
No. Observations	132,548	132,548	164,507	164,212
No. Firms	30,732	30,732	32,760	32,760
R-squared	0.24	0.24	0.13	0.14

Table 4. The effect of financing constraints on firms' employment and compensation:
Propensity score matching result

This table presents the first stage (Panel A) and the second stage (Panel B) of a propensity score matching procedure. Panel B reports difference-in-differences estimates of changes in firm employment (column (1)) and average wage (column (2)) where firms are matched based on the propensity score estimates in Panel A. 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. 'Log (Assets)' denotes the natural logarithm of the firm's total assets. 'Capital' denotes the ratio of the firm's equity to total assets. 'Profit' denotes the firm's the ratio of the firm's total profits to total assets. 'Cash flow' denotes the ratio of the firm's total cash flows to total assets. 'No. bank relationships' reports the total number of banks with which the firm has a credit relationship. The sample period is 2005-2012. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. The regressions in Panel B include all firm controls from Table 3, as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Panel A	
	Affected
Log (Assets), pre-2009	-0.0457*** (0.0038)
Capital, pre-2009	-0.1092*** (0.0235)
Profit, pre-2009	0.0536* (0.0355)
Cash flow, pre-2009	-0.0389* (0.0217)
No. bank relationships, pre-2009	0.4201*** (0.0044)
Region fixed effects	Yes
No. Observations	226,064
No. Firms	46,135
R-squared	0.07

Panel B		
	Log (Employment)	Log (Average wage)
	(1)	(2)
Affected × Post_2008	-0.0207*** (0.0043)	-0.0108*** (0.0034)
Firm controls	Yes	Yes
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
No. Observations	84,609	90,633
No. Firms	19,670	18,603
R-squared	0.23	0.10

Table 5. The effect of financing constraints on firms' employment and compensation: Accounting for regional differences

This table presents difference-in-differences estimates of changes in firm employment (columns (1) and (3)) and average wage (columns (2) and (4)). The regressions are performed on the sub-sample of firms with information of region of incorporation (columns (1)-(2)) and on the sub-sample of firms in affected regions only (columns (3)-(4)). 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. The sample period is 2005-2012. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. All regressions include all firm controls from Table 3, as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Employment)	Log (Average wage)	Log (Employment)	Log (Average wage)
	(1)	(2)	(3)	(4)
Affected × Post_2008	-0.0085* (0.0048)	-0.0081** (0.0041)	-0.0119*** (0.0047)	-0.0089** (0.0039)
Firm controls	No	No	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Region × Year fixed effects	Yes	Yes	No	No
No. Observations	114,420	111,850	70,853	69,716
No. Firms	26,876	23,134	16,339	14,311
R-squared	0.24	0.09	0.25	0.10

Table 6. The effect of financing constraints on firms' employment and compensation: Exporters vs. non-exporters

This table presents difference-in-differences estimates of changes in firm employment (columns (1)-(2)) and average wage (columns (3)-(4)). The regressions are performed on the sub-samples of exporting (columns (1) and (3)) and non-exporting (columns (2) and (4)) firms. 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. The sample period is 2005-2012. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. All regressions include all firm controls from Table 3, as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Employment)		Log (Average wage)	
	Exporters	Non-exporters	Exporters	Non-exporters
	(1)	(2)	(3)	(4)
Affected × Post_2008	-0.0153*** (0.0056)	-0.0122** (0.0050)	-0.0138*** (0.0053)	-0.0074** (0.0037)
Firm controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
No. Observations	35,340	97,208	43,880	120,332
No. Firms	7,387	23,345	8,444	24,316
R-squared	0.29	0.22	0.11	0.14

Table 7. The effect of financing constraints on firms' employment and compensation: Placebo test

This table presents difference-in-differences estimates of changes in firm employment (column (1)) and average wage (column (2)). 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2006' is a dummy equal to 1 after 2006 and to 0 before that. The sample period is 2005-2008. Only firms with at least one observation during the pre- period and at least one observation during the post-period are included. All regressions include all firm controls from Table 3, as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Employment)	Log (Average wage)
	(1)	(2)
Affected \times Post_2006	-0.0070 (0.0046)	-0.0031 (0.0045)
Firm controls	Yes	Yes
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
No. Observations	65,266	82,151
No. Firms	22,347	25,333
R-squared	0.24	0.13

Table 8. The effect of financing constraints on firms' employment and compensation: Single-bank firms

This table presents difference-in-differences estimates of changes in firm employment (column (1)) and average wage (column (2)). All firms in the sample have only one banking relationship. 'Single affected' is a dummy variable equal to 1 when the firm has a credit relationship with one bank only, and this bank is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. The sample period is 2005-2012. In columns (2) and (4), the control group of non-affected firms is selected by a propensity score matching procedure based on pre-2008 values of log (assets), capital, profit, and cash flow. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. All regressions include all firm controls from Table 3, as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Employment)		Log (Average wage)	
	(1)	(2)	(3)	(4)
Single Affected \times Post_2008	-0.0134* (0.0077)	-0.0219*** (0.0089)	-0.0182** (0.0085)	-0.0108* (0.0067)
Firm controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Propensity score matching	No	Yes	No	Yes
No. Observations	42,798	17,896	50,493	16,478
No. Firms	11,140	5,353	10,566	3,859
R-squared	0.27	0.41	0.14	0.13

Table 9. The effect of financing constraints on firms' employment and compensation:
Differentiating by firm characteristics

This table presents difference-in-differences estimates of changes in firm employment (columns (1)-(3)) and average wage (columns (4)-(6)). 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. 'Small' is a dummy variable equal to 1 if the firm has fewer than 20 employees, and to 0 otherwise. 'Cash flow' denotes the ratio of the firm's total cash flows to total assets. 'Profit' denotes the firm's the ratio of the firm's total profits to total assets. The sample period is 2005-2012. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. All regressions include all firm controls from Table 3, as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Employment)			Log (Average wage)		
	(1)	(2)	(3)	(4)	(5)	(6)
Affected × Post_2008 × Small	0.1244*** (0.0191)			-0.0483*** (0.0150)		
Cash flow		-0.0045 (0.0227)			0.0527*** (0.0190)	
Profit			0.0017 (0.0266)			0.0245 (0.0251)
Double interactions	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	132,548	132,548	132,548	164,212	164,212	164,212
No. Firms	30,732	30,732	30,732	32,760	32,760	32,760
R-squared	0.30	0.24	0.24	0.14	0.14	0.14

Table 10. The effect of financing constraints on firms' employment and compensation:
Differentiating by industry characteristics

This table presents difference-in-differences estimates of changes in firm employment (columns (1)-(3)) and average wage (columns (4)-(6)). 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. 'External dependence' is the industry median fraction of capital expenditures not financed with internal funds for mature COMPUSTAT companies during 1980-1990. 'Employment-capital ratio' is the industry median ratio of employment to total physical capital for mature COMPUSTAT companies during 1980-1990. 'R&D intensity' is the industry median ratio of R&D expenditures to total sales for mature COMPUSTAT companies during 1980-1990. The sample period is 2005-2012. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. All regressions include all firm controls from Table 3, as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Employment)			Log (Average wage)		
	(1)	(2)	(3)	(4)	(5)	(6)
Affected × Post_2008 ×						
External dependence	-0.0070 (0.0189)			-0.0237** (0.0126)		
Employment-capital ratio		-0.0001 (0.0003)			0.0004** (0.0002)	
R&D intensity			-0.1438* (0.0854)			-0.0626 (0.1001)
Double interactions	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	62,437	62,437	59,197	80,437	80,437	76,616
No. Firms	14,016	14,016	13,236	15,769	15,769	15,012
R-squared	0.32	0.32	0.30	0.15	0.14	0.15

Table 11. The effect of financing constraints on firms' employment and compensation: Short- vs. long-run

This table presents difference-in-differences estimates of changes in firm employment (column (1)) and average wage (column (2)). 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. The sample period is 2005-2012. '2009 dummy' is a dummy equal to 1 in 2009, and to 0 otherwise. '2010 dummy' is a dummy equal to 1 in 2010, and to 0 otherwise. '2011 dummy' is a dummy equal to 1 in 2011, and to 0 otherwise. '2012 dummy' is a dummy equal to 1 in 2012, and to 0 otherwise. Only firms with at least one observation during the pre- period and at least one observation during the post- period are included. All regressions include all firm controls from Table 3, as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Employment) (1)	Log (Average wage) (2)
Affected × Post_2008 × 2009 dummy	-0.0146*** (0.0037)	-0.0129*** (0.0032)
Affected × Post_2008 × 2010 dummy	-0.0179*** (0.0046)	-0.0093*** (0.0036)
Affected × Post_2008 × 2011 dummy	-0.0102* (0.0063)	-0.0074 (0.0048)
Affected × Post_2008 × 2012 dummy	0.0442 (0.0496)	-0.0043 (0.0254)
Firm controls	Yes	Yes
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
No. Observations	132,548	164,212
No. Firms	30,732	32,760
R-squared	0.24	0.13

Table A1. Variables: Definitions and sources

Variable	Definition	Source
Affected	Dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007: Sachsen LB, West LB, Bayern LB, LBBW, and HSH Nordbank.	Puri, Rocholl, and Steffen (2011)
Post_2008	Dummy variable equal to 1 after 2008.	
Post_2006	Dummy variable equal to 1 after 2006.	
Employment	The number of the firm's total employees.	Dafne
Average wage	The firm's total wage bill in euro, divided by total number of employees.	Dafne
Assets (mln.)	The firm's total assets, in mln. euro.	Dafne
Capital	The ratio of the firm's equity to total assets.	Dafne
Profit	The firm's the ratio of the firm's total profits to total assets.	Dafne
Cash flow	The firm's total cash flows to total assets.	Dafne
No. bank relationships	The number of banks with which the firm has a credit relationship.	Dafne
Small	Dummy variable equal to 1 if the firm has fewer than 20 employees.	Dafne
External dependence	The median fraction of capital expenditures not financed with internal funds for mature COMPUSTAT companies during 1980-1990, for the firm's 2-digit NACE industry.	Compustat North America
Employment-capital ratio	The median ratio of employment to total physical capital for mature COMPUSTAT companies during 1980-1990, for the firm's 2-digit NACE industry.	Compustat North America
R&D intensity	The median ratio of R&D expenditures to total sales for mature COMPUSTAT companies during 1980-1990, for the firm's 2-digit NACE industry.	Compustat North America

Table A2. The effect of financing constraints on firms' asset, sales, and profit growth

This table presents difference-in-differences estimates of the natural logarithm of the firm's total assets (column (1)), the natural logarithm of the firm's total sales (column (2)), and the natural logarithm of the firm's total profits (column (3)). 'Affected' is a dummy variable equal to 1 when at least one of the firm's banks is an owner of one of the five Landesbanken that were affected by the US subprime mortgage crisis after August 2007, and to 0 otherwise. 'Post_2008' is a dummy equal to 1 after 2008 and to 0 before that. The sample period is 2005-2012. Only firms with at least one observation during the pre- period and at least one observation during the post-period are included. All regressions include all firm controls from Table 3 (with the exception of column (1), which excludes Log (Assets)), as well as fixed effects as specified. Standard errors (clustered at firm level) are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Log (Assets) (1)	Log (Sales) (2)	Log (Profit) (3)
Affected × Post_2008	-0.0118** (0.0061)	-0.0145* (0.0078)	-0.0723*** (0.0154)
Firm controls	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
No. Observations	97,925	97,925	123,764
No. Firms	24,269	24,269	29,050
R-squared	0.57	0.61	0.45

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