Winners and Losers of Financial Crises:
Evidence from Individuals and Firms[*]

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Abstract

We use a comprehensive employer-employee dataset from German social security records to examine the impact of an exogenous shock to bank capital on individual workers' careers. German regional banks' trading losses from U.S. mortgage-backed securities cause a large contraction in the supply of capital to private firms in banks' exclusive geographic domains. Workers in affected firms experience persistent earnings losses of over €1,500 per year and additional three weeks of unemployment. Affected firms limit the layoffs but cut hiring, especially into vocational training programs. Employees who are most negatively affected by the shocks include the unskilled, less educated, and less experienced workers with shorter tenures. Their complements, particularly employees in the higher-skill categories, are the relative winners.

1. Introduction

Do economic fluctuations and financial crises lead to creative destruction, i.e., a reallocation of resources to more productive uses, or do they merely impose deadweight losses? This question is at the forefront of an ongoing policy debate regarding the role of government intervention during financial crises. On the one hand, policy makers wish to limit the destruction of firm-specific human capital due to financial shocks that are unrelated to fundamentals. On the other hand, such shocks could be catalysts for change. They might allow firms to replace less efficient employees with cheaper or better-skilled ones and dissolve inefficient matches that otherwise persist due to labor market frictions and regulation. From the workers' perspective, shocks may lead displaced employees to switch careers to find a better match for their skills or go through retraining to increase life-long earnings. According to this latter view, interventions could reduce macroeconomic efficiency and welfare. This paper helps inform this debate by studying how exogenous shocks to credit supply affect firms' employment decisions and individuals' careers.

An empirical investigation of these questions faces two key challenges. First, existing data sets do not typically allow researchers to follow both individual employees and their past, present, and future employers over time. As a result, the literature has only measured employment changes due to credit shocks, but hasn't been able to measure long-run effects of financial shocks on individuals' earnings, unemployment spells, occupation changes, and vertical mobility within and outside the firm, as well as on the productivity and financial strength of their employers. In addition, to make statements about aggregate welfare, a researcher must be able to observe economy-wide flows of labor across industries, geographic regions, and levels of social hierarchy. The second key challenge is to identify an exogenous financial shock that is not driven by local economic conditions to distinguish between the effect of credit supply and credit demand. The design must also provide a control group that serves as a plausible counterfactual.

To meet these challenges, we exploit a unique institutional feature of the German banking system, combined with a comprehensive employer-employee dataset from German social security records. The dataset contains individual employees' wages, job titles, complete employment histories, and geographic locations of jobs and private residences. Further, workers are matched to establishments, which are in turn

matched to their firms. These features allow for the tracking of individual-level labor flows inside a firm, across firms, and across geographic boundaries. The second advantage of the dataset is that it contains firm-level financial information for both public and private firms such as partnerships and limited liability companies. This feature allows us to study how the impact of financial shocks on individual outcomes varies with a firm's access to public capital markets, reliance on bank financing, and ownership structure.

Our identification strategy exploits plausibly exogenous shocks to bank lending that are sharply confined to geographic regions. Specifically, German savings banks, which provide nearly 40% of bank credit in the economy, are prohibited from conducting business outside their geographic domains. These banks hold ownership in the public banks of their federal state – Landesbanks. Some of these regional Landesbanks speculated in U.S. mortgage-backed securities during the run-up to the financial crisis and lost billions when the market collapsed, forcing the local savings banks in their state to provide capital support to their Landesbanks. This mechanism produced significant negative shocks to savings banks' capital in seven federal states, and these shocks were plausibly unrelated to local economic conditions.

We first document how the capital shocks affect bank lending and corporate investment in the treated local economies. Using bank-level balance sheets, we find that the affected banks reduce loan growth by 20 percentage points after absorbing their Landesbank's foreign trading losses, compared to the control group of unaffected banks. Next, we show that the reduction in bank lending in the affected states leads to an extra annual output decline of 0.6 percentage points and an extra annual increase in unemployment of 1.4 percentage points in 2007-2010, over and above the unaffected states.

Next, we turn to an employee-level analysis. We find that a reduction in credit from the bank shocks affects employees of privately-held partnerships and limited liability companies more strongly than those of publicly-listed firms. Establishments of private firms in affected states reduce net hiring by 24 percentage points and cut investment by one-half, relative to establishments of public firms. This result is robust to a variety of firm-level controls, suggesting that the wedge between the private and public firms reflects the difference in access to public capital markets rather than differences in size, leverage, and other observable characteristics. We then study how firms' access to bank credit affects individuals'

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careers. Workers in affected firms experience persistent earnings losses of over €1,500 per year, an extra three weeks of unemployment, and a lower probability of promotion than workers in unaffected firms.

When we investigate employment outcomes between workers that stay with their employers and those that leave, we find that the income losses are driven entirely by the separated workers, who experience annual income losses up to $6,000. These losses result primarily from unemployment spells or a temporary exit from the labor force rather than from the lower wages in the subsequent job. In contrast, employees who stay with their employers throughout credit crises do not experience significant wage cuts relative to the control group. This outcome is consistent with downward rigidity in wages and suggests that firms affected by credit shocks adjust their labor costs by altering the size of their staff rather than by cutting wages. As another margin of adjustment in response to a credit shock, firms replace fixed-term staff with the more flexible, part-time workforce.

Next, we study how employees' personal characteristics affect their labor outcomes during a credit crisis, aiming to identify the relative winners and losers of a credit shock. Using an individual's earnings as a measure of economic performance during a credit crisis, we find that employees most negatively affected by the shocks include the unskilled, less educated, and less experienced workers with shorter tenures. This differential in performance is linked to the greater likelihood of being laid off and, conditional on separation, a longer time period spent without employment. These results also suggest that the wage gap between the more and less educated employees expands during adverse economic shocks.

These results constitute the first evidence on how financial shocks affect individual outcomes. Most of the existing literature has focused on a firm or establishment as the unit of observation and has been unable to follow workers from one job to another (e.g., Chodorow-Reich 2014). As a result, the effect of financial shocks on individual outcomes has remained beyond the scope of academic research – and so have the welfare effects. Without following individuals, no research to date was able to tell what the career consequences were of being laid off, and to thus distinguish between a Schumpeterian "cleansing" theory from the alternative view that separations caused by financial shocks are inefficient. Also, the existing literature has focused on small versus large firms as proxies for access to financing and has not typically had access to financial data on private firms.

Our results help inform labor market policy, for example by measuring parameters that determine the optimal length of unemployment insurance and government-sponsored retraining programs. Our results also inform financial regulators about the costs and benefits of locally concentrated versus geographically dispersed banking systems – a tradeoff discussed as early as Smith (1776). On the one hand, the region-specific relationship banking system prevalent in the German economy may alleviate informational asymmetries between borrowers and lenders in normal times. Also, the geographic confinement of the banks' domains mitigates negative spillovers across the financial system amid crises. On the other hand, such a system leaves the regional economy vulnerable to financial shocks that are magnified through their impact on the real sector.

2. Institutional Setting and Credit Supply Shocks

This section provides an overview of the German financial system and discusses its institutional features that underlie our identification strategy. After discussing the setting, we explain the emergence of external shocks to bank capital and evaluate their relevance and exclusion criteria as instruments for credit supply.

2.1. German Banking System

The German financial system has three institutional features that make it a convenient empirical setting for the questions we study. First, Germany has a bank-based financial system where firms depend heavily on bank capital provided by local savings banks.[1] As a result, a shock to bank capital provides a powerful instrument for the overall supply of capital to a firm. Second, all public savings banks in Germany operate within sharply-defined geographic boundaries. This feature permits a clean delineation of geographic regions affected by bank capital shocks. Third, the German banking system shares important similarities with the U.S. banking system. For example, like in the U.S., the majority of German banks are community banks, which serve as the primary lenders to local private firms. With over 1,500 active banks, Germany has the second largest number of banks after the U.S. (about 8,000) and comparable ratios of the number of banks per capita and the number of banks to GDP.

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[1] See Schmidt, Hackethal, and Tyrell (1999) and Allen and Gale (2000) for an international comparison of financial systems.

The German banking system consists of three types of banks: private banks, cooperative banks, and public banks. In 2010, there were 218 private banks, over 900 cooperative banks, and 426 public savings banks in Germany. While our identification focuses on public savings banks, we briefly discuss each type of financial institutions to provide a perspective on their respective roles in credit supply.

The private banks include nationwide commercial banks, investment banks, private banking and asset management companies, and branches and subsidiaries of foreign banks. Deutsche Bank would be an example. These are large financial institutions that serve the biggest firms and have a significant international clientele. During our sample period, 1997-2010, private banks comprise only 17% of all German banks, but account for 54% of total bank assets (untabulated).

The cooperative banks are organized as mutuals, in which each customer is also an owner/member of the bank. Each member has one vote, regardless of the capital share in the cooperative. These banks provide credit to retail clients, farmers, proprietors, and some small firms. The small size of these financial institutions, consistent with their focus on retail banking, is illustrated by the fact that they hold only 8.5% of total bank assets, despite accounting for 55% of all German banks.

The public banks – the banks affected by the credit shocks we use for our identification strategy – consists of the local savings banks (Sparkassen) and regional state-owned banks (Landesbanks), both of which are not-for-profit entities.[2] The savings banks serve as the primary lenders to local small and medium enterprises. A key characteristic of these banks is a sharp delineation of their geographic domains, with one bank serving one county. These banks are prohibited from competing across county boundaries, and they are obligated to reject credit requests from clients outside their domains. The importance of savings banks for local lending is illustrated by the fact that they hold 38% of the total bank assets and comprise 29% of all banks during our sample period. The next subsection discusses the relation between savings banks and Landesbanks that underlies our empirical design.

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[2] Their mandate is to supply the local economy with an "appropriate" level of credit. Surpluses are broadly committed to social issues, including the arts, sports, cultural development, and educational issues within the region.

2.2. Landesbanks and Savings Banks

This subsection discusses the institutional mechanism through which capital shocks to Landesbanks are transmitted to savings banks and passed on to industrial firms.

Landesbanks are regional state-owned banks, which serve as central banks for one or several federal states. In 2007, the year immediately preceding the financial crisis, ten Landesbanks covered the sixteen German federal states. Figure 1 shows the regional distribution of the German Landesbanks and the federal states they cover.

The Landesbanks perform three functions. First, they serve as clearing houses for the local savings banks in their regions. Second, they provide lending to finance infrastructure and social housing. Third, they serve as commercial banks to some of the largest firms (Moody's 2004, Hughes 2008). Local savings banks often syndicate larger business loans with their affiliated Landesbanks.

The ownership structure of the Landesbanks explains how shocks to their equity capital are transmitted to the local savings banks. Each Landesbank is owned by its federal state (Bundesland) and the local savings banks in its home state, either directly or indirectly through their regional associations. Because the federal law requires the local savings bank associations to support and maintain liability for the Landesbanks (Moody's 2004), significant shocks to the equity of a Landesbank promulgate to the balance sheets of the savings banks in its region. If a Landesbank's capital is eroded, the local savings banks in its state are obligated to replenish the Landesbank's capital position. This mechanism is sharply delineated by state boundaries. In particular, savings banks are prohibited from owning shares in any Landesbank outside of their region.

Several institutional features are important for evaluating the savings' banks role in supplying credit to industrial firms. First, the savings banks are authorized to operate only within their home regions (typically, one county), and are prohibited from serving any firms from outside these regions. This regional principle also mandates that savings banks form associations only with banks from the same federal state, thereby preventing banking networks across state boundaries. Second, savings banks have a public mandate to promote economic and business development in their region. A supervisory board, consisting of local council representatives and employees, helps oversee this public mandate, but has no

impact on day-to-day bank operations. All bank operating decisions are made by the management board, which consists of banking professionals. Finally, the legal status of savings banks prevents them from being taken over by private institutions. This feature introduces additional barriers to entry for private banks into the federal states affected by capital shocks.

In summary, because savings banks and their associations are obliged to provide capital support for the Landesbank of their state, they absorb negative shocks to their Landesbank's capital. As a result of geographic restrictions on bank lending and bank networks, this effect is confined within state boundaries, creating a geographically well-defined treatment group.

2.3. Bank Capital Shocks

To provide clean evidence on the effect of credit supply on firms' labor policies and individual employee outcomes, an experiment must meet two criteria. First, it should rely on a large enough credit supply shock that would be exogenous to the local economy. Second, an experiment must provide a well-defined control group that would serve as a plausible counterfactual. In this subsection, we propose exogenous, geographically confined shocks to bank capital that were "imported" into Germany by five Landesbanks that speculated in U.S. mortgage-backed securities and suffered steep trading losses.

To provide institutional detail on this experiment, we review the example of WestLB, the Landesbank of the federal state North Rhine-Westphalia and the central clearing house for the state's savings banks. This example illustrates the sequence of events that lead to the bank's trading losses, the magnitude of the capital shock, and the mechanism through which it is ultimately absorbed by the local savings banks in the Landesbank's home state.

On August 27, 2007, WestLB announced that it had €1.25 billion of exposure to U.S. mortgage-backed securities (Clark 2007). This exposure stemmed from five subsidiaries which borrowed money by selling short-term commercial paper and invested the funds in U.S. mortgage-backed securities. In an attempt to limit the fallout from its exposure to U.S. mortgage assets, WestLB announced on December 3, 2007, it would guarantee full liquidity to its subsidiaries exposed to U.S. asset-backed securities, with each having the option of drawing as much as €25 billion (Dougherty 2007). However, in February 2008,

WestLB had itself to request a €5 billion rescue package from the state of North Rhine-Westphalia and the two local savings banks associations in this state (Rheinischer Sparkassen- und Giroverband and Westfälisch-Lippischer Sparkassen- und Giroverband). The two local savings bank associations held the majority ownership of the Landesbank's shares (Puri, Rocholl, and Steffen 2011), and, consequently, absorbed the capital losses, thereby eroding the equity of their member savings banks in the state of North Rhine-Westphalia. The size of the bailout package amounts to roughly 1% of the state's GDP.

Similar scenarios of steep trading losses unfolded in four other Landesbanks. Appendix Table A1 summarizes the identified Landesbanks exposed to the U.S. subprime crisis and shows the date each bank announced its first losses, the time period when each bank likely experienced its first trading losses, and the affected federal states where each Landesbank served as the central bank. Appendix A discusses the background for each of these cases, detailing the toxic asset holdings, the amount of losses, and the mechanism through which these losses affected the local savings banks.

Banks' financial data, auditor reports, and media articles indicate that five of the ten Landesbanks had significant exposure to the U.S. subprime crisis via their holdings of mortgage-backed securities: SachsenLB, HSH Nordbank, WestLB, BayernLB, and LBBW. These banks served as the central banks for seven of the sixteen German federal states: Saxony, Schleswig-Holstein, Hamburg, North Rhine-Westphalia, Bavaria, Baden-Wurttemberg, and Rheinland-Palatinate.

Figure 2 shows a map of the affected and unaffected German federal states. The map reveals significant geographical dispersion among the affected states: they are located in the north, east, south, and west. Further, each affected state borders on an unaffected state, allowing for stark regional variation.

Appendix Table A1 illustrates the timing of credit supply shocks. SachsenLB, HSH Nordbank, and WestLB announced their first losses on toxic assets within ten days of each other in August 2007. While BayernLB did not announce its first losses until February 2008, evidence shows that the bank experienced its first losses in the third quarter of 2007, around the same time as SachsenLB, HSH Nordbank, and WestLB. These four Landesbanks experienced their first steep losses in the third quarter of 2007, affecting the savings banks in five German states: Saxony, Schleswig-Holstein, Hamburg, North Rhine-Westphalia, and Bavaria. The final exposed Landesbank, LBBW, went into crisis a year later,

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affecting the savings banks of Wurttemberg and Rheinland-Palatinate. To be conservative, and acknowledging that the occurrence of the losses could be more dispersed in time than their disclosure, we use the year 2007 as the onset of the credit crisis in the affected states for the remainder of the study.

2.4. The Effect of Capital Shocks on Credit Supply and Real Economy

In this subsection, we examine several identification assumptions that underlie our empirical strategy. First, we examine the trends of loan growth in affected and unaffected states and test the effect of bank capital shocks on local credit supply. Second, to show relevance of the shocks, we demonstrate that bank capital shocks were passed on to the industrial sector and had significant real effects.

To examine loan growth in affected and unaffected states, we obtain financial information for the universe of German banks in 1997-2010 from Bankscope, a dataset compiled by Bureau van Dijk. By combining the information on bank type (e.g., cooperative bank, savings bank, or private bank) and address, we identify the savings banks exposed to the subprime crisis via their ownership in the respective Landesbanks and delineate these banks' geographic domains.

Figure 3 provides descriptive evidence on the trends in loan growth in affected and unaffected states before and after bank capital shocks. This figure shows the time series of total loans aggregated for the nine unaffected states (blue line) and the seven affected states (red line). For ease of comparison, loan values are expressed in 2005 euros and indexed to 100 in 2004.

Figure 3 shows a pattern consistent with parallel trends in loan growth between affected and unaffected states before the treatment effect, followed by a sharp divergence after the treatment. In particular, the growth in total loans between unaffected and affected states is nearly identical until 2007. Beginning in 2007, when the Landesbanks incurred the first large trading losses, the total loans for the affected states start to contract, while those in the unaffected states continue to grow. This pattern results in a sharp divergence in credit origination between affected and unaffected states after 2007.

Appendix Table B1 quantifies the effect of bank capital shocks on loan growth. Columns 1-2 show summary statistics for the aggregate, state-level bank balance sheets in 1997-2010. A comparison of the values of total assets and total loans during the crisis (2007-2010) with those over the entire sample

shows that the value of assets and loans were, on average, larger during the crisis than earlier in the sample.[3] This observation is attributed to trend growth for both variables. A comparison of the average annual growth rates in assets and loans during the crisis and over the entire sample shows a contraction in both total assets and total loans during the crisis. Average asset growth is 3.11 percentage points lower during the crisis relative to the whole sample, and loan growth is 1.93 percentage points lower.

Columns 3-4 compare the state-level bank balance sheets between the affected and unaffected federal states. In the unaffected states (column 3), total asset growth and loan growth remain robust during the crisis, averaging 4.72% and 4.62%, respectively. In contrast, the affected states (column 4) experience a significant contraction in bank asset growth and loan growth during the crisis. In the affected states, the total bank asset growth and loan growth during the crisis average -10.48% and -8.02%, respectively. This pattern is in stark contrast with that observed in unaffected states. In particular, the affected states experience a 15.20 percentage point lower growth rate in total assets and a 12.64 percentage point lower growth rate in total loans during the crisis.

Appendix Table B2 provides formal evidence on the effect of bank shocks on loan growth and bank asset growth in a regression setting, using a difference-in-differences framework. The dependent variable is bank asset growth (column 1) or bank loan growth (column 2), aggregated to the state level, and the unit of observation is a state-year. The main independent variables of interest include the binary indicator *Crisis* (equal to one in 2007-2010), the binary indicator *Affected state* (equal to one for the seven affected states), and their interaction term, which captures the difference in loan and asset growth between affected and unaffected states during the crisis. Other variables include controls for East-German states and the 2001-2004 economic recession.

The evidence shows that during the crisis, the affected states experience a 24.5% lower growth rate in assets and a 20.2% lower growth rate in loans than unaffected states. This effect is captured by the coefficients on the interaction term *Crisis * Affected state*, which are negative and reliably significant at

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[3] Total assets include total loans, other earning assets such as advances to banks, derivatives, and securities, and fixed assets. Total loans include mortgage loans, consumer and retail loans, and corporate and commercial loans.

the 1% level. After considering the baseline effect of the indicator *Affected state*, these economic magnitudes align closely with those reported in Appendix Table B1.[4]

While our empirical design exploits shocks to capital supply, an important caveat is that loan growth is also affected by changes in loan demand. However, using data on individual loan applications, Puri, Rocholl, and Steffen (2011) show that the decline in loan origination in the federal states affected by their Landesbanks' trading losses is attributed entirely to a reduction in bank capital supply. The authors find that the savings banks in affected states sharply reduce their loan approval rates. In contrast, the demand for capital in affected states, proxied by the number of loan applications, remains unchanged following the shocks to bank capital. While these results provide validation of the premise of our study, our research design does not rely on the assumption that only credit supply changed: we use within-state and within-industry variation in the dependence on the local savings bank for identification, thus differencing out changes in credit demand at the region or industry level.

In our final analysis in this section, we test the identification assumption that the shocks to savings banks' capital are transmitted to the real sector and the local workforce, the focus of our main analysis. Appendix Table B3 tests whether banking shocks lead to differential real outcomes between the affected and unaffected states during the crisis, using the same difference-in-differences framework as in Appendix Table B2. The dependent variables in Table B3 are several measures of state-level aggregate economic outcomes: real output growth (column 1), employment growth for full-time and part-time workers (columns 2-4), and the unemployment rate (column 5). The unit of observation is a state-year, and the macroeconomic data come from the German statistical agency.

The results in Appendix Table B3 indicate that bank capital shocks produce large real effects. Column 1 shows that the affected states experience a 60 bps reduction in the annual real output growth in 2007-2010, as shown by the negative coefficient on the interaction term *Crisis * Affected state*. This drop in the annual output growth rate is comparable to the sample-wide mean (0.7%), indicating a large real

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[4] The difference between the estimated coefficients on the interaction term in the regressions compared to the summary statistics in Appendix Table B1 is explained by the coefficient on the indicator *Affected state*. This indicator shows that affected states have, on average, a 9.3 percentage point higher growth rate in assets and an 8.0 percentage point higher growth rate in loans over the sample period. After adding in this baseline effect, the asset growth and loan growth regressions yield a difference between the affected and unaffected states of 15.2 and 12.2 percentage points, respectively, nearly identical to the values in Table B1.

effect. The point estimates on the said interaction term in columns 2-3 show that the states affected by bank capital shocks experience 80-90 bps reductions in part-time and total annual employment growth, respectively. These changes indicate large real effects that exceed the respective sample averages. Finally, column 5 shows that the affected states experience a 140 bps increase in unemployment during the crisis relative to unaffected states. This incremental increase is equivalent to 15% of the sample-wide average unemployment rate (9.4%).

In summary, credit origination in affected and unaffected states shows comparable growth trends before the crisis. Beginning in 2007, when Landesbanks experience large capital shocks absorbed by the savings banks in their states, the affected states experience a rapid drop in credit supply, while the unaffected states remain on their pre-existing growth trajectories. The rapid divergence in the availability of credit between the affected and unaffected states produces large real effects. In the empirical section, we provide micro-level evidence on the consequences of credit supply shocks on firms' labor policies and individual employee outcomes.

3. Data and Summary Statistics

Our dataset allows us to observe a large fraction of the German economy over 15 years in a stratified, linked employer-employee sample. Our primary data source is a novel establishment-worker panel database from German social security records that allows us to follow individual workers across establishments and firms. This section describes these data.

Data on workers and establishments come from the administrative and survey data from the Institute for Employment Research (IAB) of the German Federal Employment Agency (BA) at the Institute for Employment Research.[5] Our sample is constructed from several data sources at IAB that combine information on employers and employees.

The establishment sample is based on the IAB Establishment Panel, a survey conducted annually by IAB since 1993. The sample includes all West German establishments that completed a survey in at least one year from 1997 to 2011 and identified themselves as part of a privately-held partnership or

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[5] Data access was provided through the ISR-FDZ at the University of Michigan, an U.S. on-site location of the Research Data Center of the Federal Employment Agency at the Institute for Employment Research.

limited liability company, or a publicly-traded corporation. An establishment in this sample refers to a local unit of a firm, such as a specific plant or building. We match establishments to firms via the FDZ crosswalk and obtain firms' balance sheet data from Bureau van Dijk's Orbis database. An advantage of this dataset is that it covers not only publicly-listed firms, but also all of the privately-held partnerships and limited liability companies in our sample. Our sample includes 14,994 establishments and 7.52 million employees.

We obtain complete job histories for every worker who was employed and liable to social security at any establishment in our sample for at least one day in 1997-2011. The worker-level employment history provides an array of professional characteristics, including the employer, type of employment, exact start and end dates, wages, professional and occupational status, and white-collar versus blue collar job status. We also obtain workers' personal characteristics, such as gender, birth year, nationality, education, and vocational training. Overall, we are able to observe the workers' entire employment, unemployment, and wage histories from 1975 through 2010, even when the workers move to an establishment outside the sample. Dorner et al. (2010) provide a detailed description of these data.

We complement the individual-level employment histories with administrative establishment data from the Establishment History Panel (BHP), a dataset described in Spengler (2008). The BHP includes industry classification codes and state- and district-level location identifiers for each establishment.[6] We exploit the establishments' geographic locations and the regional segmentation of the German banking system to identify the establishments affected by the bank shocks. The BHP also contains an extension file with information on establishments' births, deaths, and re-classifications. This extension file allows us to distinguish establishment closures that result from spin-offs, takeovers, and downsizing.

The data on establishments is merged with the IAB Establishment Panel Survey. Because this survey is supported by the German Ministry of Labor, it yields a high response rate of about 80% among the establishments that stay in the panel (Janik and Kohaut 2014). The survey provides information about an establishment's investment in plant, property, and equipment, the fraction of investment financed through a particular financing channel (e.g., internal cash flow, bank loans, or government subsidies), and

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[6] Districts in Germany are comparable to counties in the United States.

qualitative measures of financial constraints (e.g., whether the establishment had difficulty acquiring bank loans). Further, the 2010 wave of the survey devotes a special section to the impact of the financial crisis on the establishments' investment and financing activities. The survey questions help shed light on whether establishments in privately-held companies had a differential experience compared with establishments in publicly-traded companies during the crisis. These data help to validate our identification strategy, which exploits such differences, and provide additional qualitative evidence, as discussed further below.

Table 1 provides summary statistics on our main dataset, where Panels A and B focus on establishments and individual employees, respectively. Panel A shows that the overwhelming majority (91.3%) of establishments are privately-held. The mean (median) establishment employs 226 (48) workers, of whom approximately three quarters are full-time employees. For the median establishment, the fraction of workers added every year (13.9%) is approximately equal to the number of workers that leave the firm (14.3%), resulting in a stable workforce indicated by the median net hiring rate of about zero. The average net hiring rate is higher (15.7%), an outcome driven by a number of fast-growing establishments in the sample. The mean (median) value of investment per employee is €12,822 (€6,651) per establishment-year, and the standard deviation is €55,053.

Panel B shows summary statistics for individual employees. The average employee is 40 years old, has 13.5 years of education, and earns approximately €22,000 per year. About 61% of employees are male. Over three quarters of employees perform skilled tasks and work full-time. The average employee has tenure of almost three years with the present establishment. When an employee transitions to unemployment, the average unemployment spell is 135 days.

Appendix Table B4 shows the establishments' responses to survey questions related to financing channels and the financial crisis. These responses indicate that the establishments of privately-held firms are more dependent on bank loans than establishments of publicly-listed firms. The data also show that privately-held firms had a more difficult time obtaining bank loans during the credit crisis than the publicly-listed firms. For example, in 2009-2010, the fraction of privately-held firms across all states that report difficulties with obtaining bank financing is 15.4% and 16.5%, respectively, almost twice that

observed among the publicly-listed firms in the same years: 8.4% and 8.9%, respectively. The survey also reveals that the financial crisis has had the strongest effect on private firms in affected states. For example, among the privately-held firms in affected states, nearly one half (48%) were strongly or very strongly affected by the crisis, and over another one third (36%) were moderately affected. Further, the privately-held firms in affected states report being more strongly affected by the crisis than their publicly-listed peers in affected states or their privately-held counterparts in unaffected states. This evidence bolsters our empirical strategy, which exploits the difference in reliance on bank capital between privately-held and publicly-listed firms. The next section details our empirical design.

4. Empirical Results

4.1. Methods

The goal of our empirical strategy is to identify how credit supply shocks affect the careers of individuals employed in firms affected by such shocks. To that end, we seek to find variation in credit supply across otherwise comparable individuals. An ideal experiment would achieve comparability of employees across the following characteristics: (i) individual characteristics, (ii) the characteristics of their employers (before the credit supply shock), and (iii) the macro-economic environment, including the labor market.

On first thought, a difference-in-differences specification comparing firms in affected and unaffected states before and after the onset of the banking crisis (enhanced with individual-level controls and establishment fixed effects) would afford such a comparison. The difference-in-differences would measure if individuals employed by firms in affected states lose relative to individuals employed in unaffected states, and if so how much. One can easily imagine that a comparison across these dimensions could satisfy the first two criteria above. However, the assumption that the difference in macro-economic environments across states is held constant from before to after the shock could be challenged.

A potential violation of the difference-in-differences identification assumption is related to differences across German regions in their industrial structure. If the global economic contraction in 2008 and 2009 caused industry-level shocks, omitted industry-time controls could introduce a bias in such a difference-in-differences strategy. For example, this would be the case if the industrial structure of a

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region correlates by chance with the propensity of a region to have an affected Landesbank. Under this scenario, the test would not identify the effect of a credit supply shock, but the effect of an industry-level demand shock. Because three of the affected regions, Baden-Wurttemberg, Bavaria, and North Rhine Westphalia indeed have a more industrialized and manufacturing-based economy than other states, we consider this concern to be important.

To respond to this identification challenge, we employ a triple-difference approach that controls for industry-year fixed effects and state fixed effects. To be able to do so, we compare private, more bank-dependent firms with publicly traded, less bank-dependent firms within the same state and industry in a given year. Using i to index an individual, k an establishment, j an industry, s a state, and t time, the baseline specification is as follows:

$$Y_{i, k, j, s, t} = \beta \cdot Affected_s * Private_k * Post_t + \gamma_1 \cdot Affected_s * Private_k + \gamma_2 \cdot Affected_s * Post_t +$$
$$+ \gamma_3 \cdot Private_k * Post_t + \gamma_4 \cdot Private_k + \gamma_5 \cdot v_{j, t} + \delta \cdot X_{i,t} + \varepsilon_{i, k, j, s, t}$$

where *Affected* is an indicator equal to one for the five affected states and zero otherwise; *Private* is a an indicator that marks an establishment of a privately-held firm; *Post* is an indicator equal to one in 2007-2010 and zero otherwise; $v_{j, t}$ are industry*year fixed effects, and $X_{i,t}$ are potentially time-varying individual characteristics. The key coefficient of interest is the triple-difference coefficient β.

This approach substantially weakens the identifying assumptions, compared to the hypothetical difference-in-differences approach discussed above. In particular, the triple-difference approach differences out the effect of local economic conditions and industry-wide macroeconomic shocks. Hence, the identification assumption is that the individual-level outcomes are not systematically related to the propensity of their employer to organize as a private or publicly traded corporation in a given region in ways that correlate with that regions' propensity to be affected by the U.S. mortgage crisis via its Landesbank's trading activities.

To illustrate that assumption, an example of a violation would be that individuals educated more than others in imperfectly controlled-for ways are more productive and therefore earn more. Those

individuals also better foresee not only the US mortgage crisis, but also their Landesbank's exposure to it, and move before the crisis to firms, industries, or states that are going to be less affected by the shock.

While such a violation appears less likely in our setting, we take steps to explicitly rule out such a scenario by controlling for establishment fixed effects in addition to the controls specified above. As a result, if time-invariant but unobservable quality of some establishments versus others determined whether they make themselves more financially vulnerable, such an effect would be differenced out. In alternative specifications, instead of establishment fixed effects, we employ individual fixed effects, thus differencing out unobserved individual-level characteristics.

4.2. Establishment-level Results

In Appendix Table B5, we show how establishments adjust their labor and investment policies when hit with a negative credit shock. Specifically, we examine the triple-difference effect on establishments' net hire rates and investment per employee.

Columns 1-2 show the net hire rate regression results, and columns 3-4 show the investment per employee regression results. Columns 1 and 3 differ from columns 2 and 4 based on the inclusion of the establishment-level employment measure dummies that indicate whether an establishment has instituted a policy of short-time work, reduced the offering of overtime hours, on average, for its employees, or reduced normal working hours for its employees within the given year.

For the net hire rate regression in column 2 (with full controls), the key estimated coefficient on the triple interaction term is -0.239 and statistically significant at the 1 percent level. The interpretation is that establishments belonging to privately-held firms in affected states had a 23.9 percentage point lower net hire rate during the crisis relative to establishments belonging to publicly-listed firms in affected states during the crisis.

For the investment per employee regression, the estimated coefficient on the triple-difference term in column 4 is -6,021 and statistically significant at the 1 percent level, meaning that establishments belonging to privately-held firms in affected state had a differential reduction in investment per employee of €6,021 during the crisis relative to establishments belonging to publicly-listed firms in affected states

during the crisis. The average level of investment per employee at establishments in privately-held firms is €10,829. Hence, affected firms reduce investment per employee by 56 percent.

Overall, the establishment-level empirical results show a large and significant negative effect on net hiring and investment per employee at establishments belonging to privately-held firms compared to establishments belonging to publicly-listed firms in affected states compared to unaffected states during the crisis. These results are consistent with the hypothesis that an exogenous shock to bank credit will affect more bank-dependent, privately-held firms compared to publicly-listed establishments that have access to equity markets that they can turn to during a bank loan credit crisis. These results validate our identification strategy and establish comparability to existing results in the literature on the impact of credit shocks on employment outcomes (e.g., Chodorow-Reich 2014). We are now ready to zoom in on the main results of the paper: the impact of credit shocks on individual employment outcomes.

4.3. Main Results

This section presents the empirical results on the effect of credit supply shocks on individuals' career outcomes. We first present results on individuals' income, unemployment, and non-employment for the full sample. We then discuss differences in these results across the subsamples of workers that are retained at their employer and those that are separated. After that, we focus on the sample of affected workers and examine how personal characteristics determine the sign and magnitude of the wage change, who gets retained, and who gets fired.

4.3.1. Income

This section reports results from triple-difference regressions with an individual's annual income as the dependent variable. The main coefficient of interest is the interaction term *Affected * Private * Post*, which compares the marginal effect of credit shocks on employee outcomes between public and private firms in affected states. All regressions control for job characteristics, such as full-time or part-time employment, and individual-level characteristics, such as gender, education, age, and tenure. All regressions also employ state fixed effects and industry*year fixed effects. We alternate between

specifications with establishment fixed effects and employee fixed effects. Note that the latter identifies the credit shock from individuals who moved from unaffected to soon-to-be-affected states, or from public to private firms before the shock.

Column 1 in Table 2 presents a triple-difference coefficient of -1,779.9 from a regression with establishment fixed effects. The dependent variable is individual wages; hence, individuals employed in privately-held affected firms suffer wage losses of over €1,500 per year, compared to otherwise similar individuals in publicly-held firms in the same state. In regressions that use natural logarithm of wages as the dependent variable, we find that the effect corresponds to an 11% wage loss, compared to the control groups.

Column 3 presents a raw wage regression with individual-fixed effects. The effect of banking shocks on individual wages here is precisely estimated to be negative €2,423.2 per year, notably higher than the estimate from the previous specification. It corresponds to a 13% wage loss (column 4). The larger coefficient indicates that firms first adjust labor costs of the most costly employees; we investigate below whether they do so mainly by wage cuts or by adjustments on the extensive margin. The triple-difference result disappears within the sample of employees who get retained by their employer throughout the crisis (columns 5 and 6), consistent with downward rigidity of wages. These results suggest that the reduction in individual income is driven by employees who separate from the firm affected by the credit shock.

Individuals that voluntarily separate from the firm suffer annual earnings losses of €6,921.1 (column 7). These losses are even more pronounced than those of involuntarily separated workers, €3,133.6 (column 8), a pattern explained by the fact that a fraction of individuals who voluntarily separate from the firm tend to leave the labor force. The difference between voluntarily and involuntarily separated workers is much smaller in regressions with logged wages as the outcome variable, indicating that the group of voluntary separaters tends to earn higher wages to start with, and finding employment as a high-priced worker in a crisis likely appears to be difficult. However, the difference between the specification with employee fixed effects is larger than the establishment fixed effects specification for the group of

involuntarily separated workers, suggesting that employees getting fired find it more difficult to find new employment of similar quality in the future.

In unreported regressions, we investigate if the reduction in annual income of affected individuals is driven by a reduction in the number of jobs they work or by their employers cutting wages. A similar pattern emerges as the one described for annual income: any reduction in the daily wage from the main job is driven by the group of individuals that change their employer. That is, employers don't significantly reduce the wages of their existing employees. However, job changers do have to accept lower wages conditional on leaving their former employer.

In sum, the credit supply shocks are associated with a decline in the annual income of affected workers by up to €2,400 per year, corresponding to a 13% decline. These results are driven by workers who are separated from their pre-crisis employer either by being fired, or by leaving the labor force altogether. Wages of retained workers remain rigid. Separated workers more likely lose income by going into unemployment or leaving the labor force rather than finding a comparable job at a different employer – on average separated workers lose between €3,000 and €6,000 in annual income. We next turn our analysis to unemployment and non-employment as outcome variables.

4.3.2. Unemployment and Exit from the Labor Force

Table 3 presents the results on unemployment and non-employment: how much longer (if at all) does an individual spend without work if his establishment is affected by the credit shock? We examine this question with a similar triple-difference strategy as employed above for workers. Columns 1 and 2 work off the sample of all individuals in the sample. The triple-difference coefficient indicates that affected workers spend 2.45 days longer per year in unemployment, and about 5.2 more days per year without work (which includes being outside the labor force) if their employer is hit by a credit shock, compared to the control group. Because the crisis dummy is defined over the four-year period 2007-2010 and the work week has five days, the correct reading of the table is that the average worker spends 2 additional weeks in unemployment and 4 additional weeks without employment than a worker from the control group.

These estimates reflect the marginal effect over and above the control group of public firms in affected states.

Columns 3 and 4 show the same regression for the subsample of voluntarily separated workers. There is no significant effect on unemployment. The likely interpretation is that voluntarily separated workers leave only if they know they will immediately find a new job, or if they plan to leave the labor force. Indeed, the latter is a significant driver of voluntary separations: the effect on the days of non-employment is 6.861. That is, those workers spend an additional 4*6.861=5.5 weeks without employment – the additional half a week compared to the full sample is driven by individuals leaving the labor force.

Finally, columns 5 and 6 show the results for the involuntarily separated workers – those that get laid off. As expected, the results are strongest for this subsample. The effect on unemployment is 3.4 days per year, and the effect on non-employment is about 7.5 – that is, these workers spend an additional 6 weeks without employment, compared to the control group.

In summary, the average individual who works in an establishments soon to be affected by a credit shock is bound to experience on average 4 weeks more without employment over the next four years. Conditional on leaving the firm, the length of the non-employment spell is longer for individuals who separate from their employer: among those fired during the crisis, it is 6 additional weeks without employment. A key takeaway is that many individuals leave the labor force as a result of the credit shock. We now investigate which characteristics help explain how well individuals fare during a credit crisis.

4.3.3. Individual-level Determinants of Wages and Employment Status

This section describes which personal characteristics affect an individual's labor market outcomes during a credit crisis. Table 4 investigates cross-sectional differences in the effects documented in Tables 2 and 3. It studies which personal characteristics predict which employees are most likely to suffer wage losses or the loss of employment after credit shocks, and which ones fare comparatively better. This analysis helps identify the relative winners and losers of financial shocks. To avoid a quadruple-difference estimation, we restrict the sample to the set of affected establishments – i.e., those that belong to private

firms in affected states – and interpret the coefficient of the interaction between individual characteristics and the indicator *Post*.

The cross-sectional determinants of wages are presented in Panel A. First, we learn that, as expected, full-time employees earn more than part-time ("marginal") workers, who in turn earn more than young individuals in vocational training. As expected, education, employee skill category, and tenure with the firm are positively reflected in earnings. Next, we examine how these characteristics help individuals fare during the credit crunch, focusing on the interaction terms of these characteristics with the indicator *Post*.

Among the sample of all employees (column 1 in Panel A), fulltime workers are mildly better off in terms of their income after the shock, compared to marginal workers, and vocational workers. Education and skill level also help withstand the shock, as does age. These effects exacerbate wage differentials existing before the crisis. Women seem to be hit harder – they lose an additional €389 in annual earnings if their establishment is affected by the shock, relative to the control group. The unconditional indicator *Female* is absorbed by person-fixed effects in this regression.

Among the retained employees, these relationships only partly hold up. Specifically, among the women retained by the firm, there is no exacerbation of the wage gap. Also, the education and skill premium is larger after the crisis, whereas the age premium disappears. Among voluntary separators, by contrast, women's wages take a particularly big hit – they lose almost €800 of their income, and the other variables become mostly insignificant. Lastly, among the fired employees, education is the only strong determinant helping to keep income up during an adverse credit shock.

In summary, credit shocks reinforce existing income differentials across individuals with different characteristics. An interesting distinction arises between retained and separated workers. Among the retained category, women do not suffer particularly deep income losses, neither do they seem to face a particularly tough labor market if fired. The general loss in women's income seems to stem from women leaving the labor force in response to credit shocks. Next, we examine if such differences across individuals also determine the length of unemployment and non-employment outcomes.

4.3.4. Individual-level Determinants of Employment Outcomes

Panel B of Table 4 describes the personal characteristics that determine whether an individual who gets separated from his pre-crisis employer goes into unemployment, whether he immediately finds a new job, or whether he leaves the labor force. We provide these results for the entire sample of individuals who were employed in a private firm in an affected state as of 1 January 2007, as well as for the subsamples of individuals who voluntarily or involuntarily separate from the firm.

The interaction coefficients show that some of these relationships get *reversed* during the credit crunch. Vocational trainees are a lot more likley to spend significant time unemployed, or non-employed, and marginal workers are less likely to spend time unemployed. That is, firms do not renew the contracts of some graduating trainees and convert them into full-time employees – instead, they appear to replace these jobs with marginal, flexible workers. These results are qualitatively consistent throughout the subsamples.

In summary, firms replace more fixed-term contracts with more flexible workers in the crisis. One consequence is that graduating trainees are less likely to find stable employment when they start their careers in a crisis. We now turn to an analysis of separations, to investigate in more detail what happens to employees who do not find employment with their present firm after the credit shock.

4.3.5. Separations

The previous unemployment and non-employment results took the perspective of an individual employed with a soon-to-be affected firm at the beginning of 2007. These results aimed to estimate an ex ante additional unemployment or non-employment spell, depending on personal characteristics. In Table 5, we use a linear probability model to examine which individuals are most likely to lose their jobs when their establishment experiences a credit shock. We also investigate whether these individuals go into unemployment or find work at other firms. These results study whether separations resulting from credit shocks should be interpreted as a negative event from an employee perspective.

We distinguish among three types of separations: (i) job-to-unemployment separations, (ii) job-to-job separations, and (iii) all separations. Note that (iii) is not redundant, because it also includes

separations to non-employment, an outcome that arises when an employee leaves the labor force. The sample, as before, is restricted to private firms in affected states. The main coefficient of interest is the interaction term between personal characteristics and the indicator *Post*.

We first examine the pre-shock cross-sectional differences across employees that increase the likelihood of separation, focusing on all separations reported in column 3. In normal times, part-time workers are 4.3% more likely to be separated from their employer than full-time workers, as expected from the flexible nature of their jobs. Vocational trainees are the least to separate from their employer (a 5.5% lower probability of separation). More educated workers are slightly less likely to separate from their employer.

These relationships are partly reversed during the credit crunch. For example, full-time workers are less likely to leave the labor force, but they are indeed more likely to lose their job and become unemployed. The formerly safe vocational training system becomes highly unsafe – trainees are more than 8% more likely to leave the firm. A bit more than a third of them find employment in other firms, but others become unemployed (a 6% higher probability). In the crisis, women are not more likely to be fired (involuntarily separated, columns 7 to 9) but are 5% more likely to leave their firm than men. Conditional on leaving voluntarily, they are about 5% less likely to find a different job.

4.4. Summary

In summary, our results are less consistent with the interpretation of financial shocks as catalysts for change, which allow the separated workers to quickly find better employment in other firms. Instead, individuals affected by credit shocks suffer wage losses, especially if they get laid off or voluntarily leave the firm, and they are likely to get discouraged and spend additional time outside the labor force. These effects likely erode human capital employed in productive use from a macroeconomic perspective. From an individual perspective, education, skill, and experience help mitigate these shocks. As a result, the more skilled and more experienced employees remain more insulated from the negative shocks. We also find that individuals escape unemployment by providing more flexible labor inputs, a characteristic in high demand during crises.

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5. Related Literature

This paper is the first to document how individuals' careers are affected by credit shocks suffered by their employers. It thus is the first to approach the question what the welfare consequences are of layoffs incurred at firms that suffer credit supply shocks. Before knowing individual-level outcomes, the welfare effects could be positive or negative depending on whether contractions due to financial shocks are viewed as "cleansing" events for the economy or as market failures.

We complement a large literature showing that loan supply shocks affect real economic activity (Bernanke et al., 1991; Hancock and Wilcox, 1992, 1997; Kashyap et al., 1993; Kashyap and Stein, 1994, 1995; Peek and Rosengren, 1995; Peek et al., 1995; Peek and Rosengren, 1997; Peek et al., 2000; Calomiris and Mason, 2003; Schmalz et al., 2015). The recent financial crisis has led to renewed interest in this question. De Haas and Van Horen (2012) document that shocks from the U.S. financial crisis were transmitted internationally through inter-bank lending relationships. Aiyar (2012) documents the effect of such drying up of banks' international funding sources on the UK economy. Ivashina and Scharfstein (2010) show that U.S. banks that had better access to deposit financing cut their lending less in response to the dry-up of commercial paper markets in the U.S., indicating that the dry-up of banks' funding markets was a major determinant of their reduction in lending. In contrast, Puri et al. (2011) show the effect of a shock to bank capital (as opposed to a shock to the banks' funding liquidity) on lending behavior in Germany, using the same institutional setting as this paper. The most closely related paper to our study is Chodorow-Reich (2014), who shows that especially smaller firms suffer more from reduced bank lending and shed more labor as a result; the observation that small firms are especially vulnerable to loan supply shocks is reflected also in studies by Khwaja and Mian (2008) and Greenstone et al. (2014). All these studies are conducted at the level of the macroeconomy, economic region, or at most the firm. By contrast, we analyze also effects on individual employee outcomes. Without following individuals over time, it is not clear whether laid-off workers go into long-term unemployment, or if they immediately find jobs again. Hence, it is unclear if the layoffs due to credit shocks documented in the

existing literature are a catalytic for change, "cleanse" the economy in a Schumpeterian way, and thus improve economic efficiency, or whether such layoffs constitute a market failure. Needless to say, resolving this question is at the very core of considerations of policy interventions amid financial shocks.

Aside from focusing on the individual as the unit of observation, the present paper also contributes particularly clean identification. Our empirical approach relies on multiple, geographically confined banking shocks, rather than a single shock implied by the 2007 financial crisis and the Lehman bankruptcy which may also have affected firms' and banks' expectations about future economic prospects. Also, the shocks employed here are entirely imported from a different economic system and thus exogenous to local economic activity. Also, the funding of the savings banks is almost entirely through deposits, which isolates the shock to capital from a dry-up of funding markets. The granularity of the banking shocks in the data and the resulting identification benefits is a key distinction from the studies by Duygan-Bump et al. (2015) and Jimenez and Ongena (2012). Similarly, in contrast to Campello et al. (2010), the dataset used in this paper allows for the distinction between affected and unaffected states within a country and between privately-held and publicly-listed firms. This granularity allows for a cleaner differentiation of local bank loan supply shocks due to capital constraints from reductions in credit supply due to worries about future economic prospects of the economy.

More subtle distinctions from previous work on the real effect of banking shocks are that our dataset allows for the study of differential effects of banking shocks not only on small versus large firms but also but also for privately-held versus publicly-listed firms, controlling for size. Consistent with previous results, small firms are more affected by bank shocks. We find that the key determinant for the sensitivity to bank shocks is not necessarily size, but the legal form of the firm and the varying methods of financing business activities associated with those legal forms.

Relatedly, the results speak to a literature on labor relations across different types of firms. Bach (2010), Bassanini et al. (2013), Ellul et al. (2014), and Sraer and Thesmar (2007) show that family firms provide more employment and wage insurance than firms without family control, see also Mueller and

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Philippon (2011). We complement these findings by showing that the provision of wage and employment insurance is particularly vulnerable to funding shocks in private firms. Similar to Chava and Purnanandam (2011), we find that firms that rely more on banks are more affected by larger shocks to their bank's capital than firms with access to other forms of financing. A key distinction from this and other previous papers such as (Becker and Ivashina, 2014) is that we focus on labor-related outcome variables rather than firm-level outcomes such as value or investment. Again, previous studies were not able to measure individual-level outcomes due to data constraints.

Next, the effect of banking shocks in Germany is propagated through the banking system because of the commitment of banks within a state to replenish each others' capital and the associated Landesbanks' capital, whereas previous work by Cornett et al. (2011) focuses on banks in isolation.

Lastly, our results provide insights for macroeconomics. Our results are consistent with the existence of a "financial accelerator" Bernanke et al. (1999), in the sense that bank capital is an important state variable for aggregate economic activity in terms of employment outcomes.

Conclusion

This paper uses a comprehensive employer-employee dataset from German social security records to examine the impact of exogenous shocks to bank capital on firms' employment policies and individual employee outcomes. We identify five German regional Landesbanks covering seven federal states that suffered large trading losses from U.S. mortgage-backed securities. The local savings banks in the affected states absorbed their respective Landesbanks' trading losses onto their balance sheets, leading to a deep economic contraction in the banks' exclusive geographic domains. Loan growth and output growth decline by an average of 20 and 0.6 percentage points, respectively, and the unemployment rate rises by 1.4 percentage points in affected states, compared to unaffected states in each of the four crisis years. The effect is stronger for establishments belonging to privately-held, bank-dependent firms than for establishments in publicly-listed firms. Private firms in affected states reduce net hiring by 24 percentage points and cut investment by more one-half, relative to publicly listed firms.

Our main results on individual workers show that when credit shocks are transmitted to the real sector, they produce significant negative consequences for the average employee. Our evidence for the average worker is less consistent with the interpretation that financial shocks catalyze positive change, allowing the separated workers to quickly find better employment in other firms. Instead, individuals affected by credit shocks suffer wage losses, especially if they get laid off or voluntarily leave the firm, and they are more likely to temporarily exit the labor force. From a macroeconomic perspective, credit shocks appear to erode the productive use of human capital.

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Figure 1: German Landesbanks as of 2007
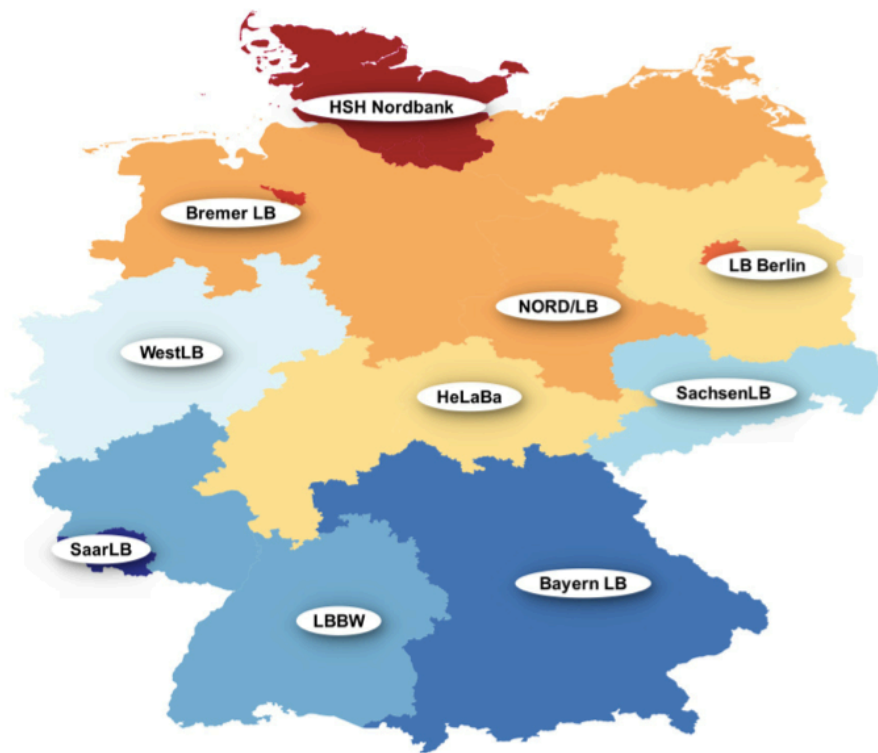
Figure 2: Affected States versus Unaffected States due to Landesbank Exposure

Figure 3: Total Real-Valued Bank Loans, Affected versus Unaffected State
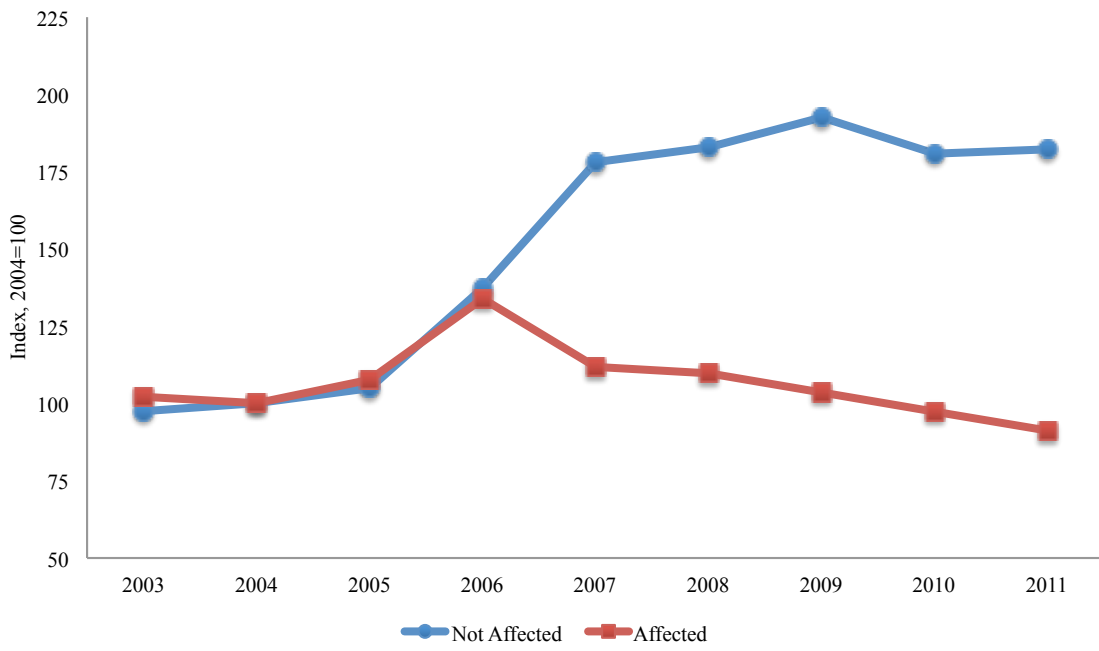
Appendix A: Institutional Detail on Bank Capital Shocks

This appendix provides institutional detail on the evolution of trading losses at German Landesbanks and their consequences for savings banks in affected federal states.

Table A1: German Landesbanks Exposed to the U.S. Subprime Crisis

This table identifies the German Landesbanks exposed to the U.S. subprime crisis via holdings of mortgage-backed securities. The table shows the timeline of events, the exposed Landesbanks, and the affected federal states.

Exposed Landesbank	Announcement date of first losses	Period when first losses occurred	Affected federal states
SachsenLB	August 17, 2007	3Q 2007	Saxony
HSH Nordbank	August 23, 2007	3Q 2007	Schleswig-Holstein, Hamburg
West LB	August 27, 2007	3Q 2007	North Rhine-Westphalia
BayernLB	February 13, 2008	3Q 2007	Bavaria
LBBW	November 27, 2008	4Q 2008	Baden-Wurttemberg, Saxony Rheinland-Palatinate

Institutional Background on Landesbanks' Trading Losses

The first signs of a Landesbank's exposure to the U.S. subprime crisis occurred on August 17, 2007, when Sachsen LB, the Landesbank of the German federal state Saxony was forced to take an emergency rescue loan in the amount of €17.3 billion from the German savings bank association, Sparkassen-Finanzgruppe, due to its exposure to U.S. asset backed securities (Simensen 2007). Sachsen LB's exposure to the U.S. subprime crisis stemmed from an off-balance sheet subsidiary, Ormund Quay, located in Dublin, Ireland. Ormund Quay borrowed significantly in short-term commercial paper and invested in long-term asset-backed securities, a transaction supported by a credit line from Sachsen LB. As the U.S. subprime crisis unfolded, investors refused to refinance Ormund Quay's commercial paper debt, and Sachsen LB was unable to meet its pledged line of credit, necessitating the emergency credit bailout (Moody's 2008). At the time, Spiegel Online reported that Sachsen LB's losses due to its direct involvement in subprime mortgages approached €500 million, whereas the German newspaper Süddeutsche Zeitung reported Sachsen LB had as much as €65 billion in five funds at Ormund Quay.[7]

State officials announced on August 26, 2007, that Sachsen LB would be sold to Landesbank Baden-Wurttemberg (LBBW), the central clearing house for the savings banks located in Baden-Wurttemberg and Rheinland-Palatinate, due to the subprime losses. Sachsen LB no longer existed as a separate entity as of April 2008, at which point the local savings banks of Saxony transferred their holdings to LBBW. LBBW would now serve as the central clearing house for the savings banks in Baden-Wurttemberg, Rheinland-Palatinate, and Saxony.[8]

The second Landesbank to report losses due to exposure to the U.S. subprime crisis was HSH Nordbank, the central clearing house for the savings banks of the federal state Schleswig-Holstein and city-state Hamburg and with total assets of €174 billion. Though reporting strong profits for most of 2007, on August 23, 2007, HSH Nordbank said it had €1.8 billion invested in securities backed by U.S.

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[7] http://www.spiegel.de/international/business/debt-exposure-and-off-balance-sheet-loans-banks-in-germanywobble-a-500833.html

[8] The politically aftermath of the Sachsen LB emergency bailout and sale resulted in Georg Milbradt, the premier of Saxony, resigning from his position in April 2008.

subprime mortgages, primarily through its subsidiaries, Poseidon and Carrera, and HSH chief executive Hans Berger remarked, "We have a liquidity squeeze in the market, especially for lending between banks" (Kirchfeld and Schmidt, 2007). Berger stepped down in September 2008 as a result of the exposure to the U.S. crisis and subsequent writedowns and announced a plan to restructure its business and focus more on its core in Northern Germany going forward. HSH Nordbank had writedowns of €1.1 billion and a loss of €210 million in 2007 (Seuss and Kirchfeld, 2008).

Moody's downgraded HSH Nordbank's long-term outlook in a November 2008 report, citing its increased risk profile and stretched financial profile due to direct exposure to Lehman Brothers. Moody's also expected HSH to rely on strong support from the public banks going forward (Moody's 2008). In December 2008, HSH Nordbank was guaranteed notes of €30 billion from the German federal government's rescue fund. On February 24, 2009, HSH Nordbank announced a deal with the federal state Schleswig-Holstein and the city state of Hamburg to receive a capital injection of €3 billion and a state backed credit guarantee of €10 billion.

Germany's second largest Landesbank with assets of €353 billion in 2007, BayernLB, the Landesbank of the federal state Bavaria and the central clearing house for Bavaria's savings banks, was the fourth Landesbank to report significant losses due to the U.S. subprime crisis. The state of Bavaria and the savings banks association, Sparkassenverband Bayern, each owned 50 percent of BayernLB in 2007. BayernLB announced on February 13, 2008, it would write down €1.9 billion with direct losses of €150 million due to U.S. subprime related investments in 2007 (Morajee and Atkins, 2008). BayernLB's chief executive, Werner Schmidt, resigned less than a week later over the losses (Morajee, 2008). By March 2008, BayernLB's writedowns reached €4.3 billion, with estimated losses at €6 billion. Of the estimated €6 billion in losses, Bayern LB would be responsible for €1.2 billion, whereas the two owners of Bayern LB, the state of Bavaria and the savings bank association, Sparkassenverband Bayern, would be responsible for €2.4 billion each (Reuter 2008). In April 2008, a Spiegel Online report brought BayernLB under heavy criticism, as it discovered the Landesbank knew about its U.S. subprime related

losses in the second half of 2007, but did not reveal those losses to the public until February 2008.[9]

Losses in the second half of 2007 would place the U.S. subprime crisis's impact on Bayern LB on a similar timeline to the impact on Sachsen LB and WestLB.

On October 21, 2008, BayernLB became the first bank to draw on support from the German federal government's €500 billion bailout fund, applying for €5.4 billion of the rescue funding. BayernLB also announced it faced an additional loss of up to €3 billion by the end of 2008 due to further exposure to the U.S. subprime crisis and the recent collapse of Lehman Brothers. The additional unexpected losses prompted the resignation of the Bavaria's finance minister, Erwin Huber, the first politician to resign over Landesbank crisis.[10] In November 2012, BayernLB began repaying the aid received in 2008 with a payment of €350 million to the state of Bavaria. To complete the agreement for receiving the 2008 aid, BayernLB must repay the full €5.4 billion of rescue funding by 2019 and reduce its balance sheet to half its 2008 level (Seuss, 2012).

The fifth and final Landesbank to report losses directly attributed to exposure in the U.S. subprime crisis was Germany's largest Landesbank, Landesbank Baden-Wurttemberg (LBBW), with total assets in 2007 of €443 billion and an ownership structure of 40.5 percent by the State of Baden-Wurttemberg, 40.5 percent by the savings bank associations of Baden-Wurttemberg and Rhineland-Palatinate, and 19 percent by the City of Stuttgart (Moody's 2008). LBBW serves as the central clearing house for the savings banks of three German federal states: Baden-Wurttemberg, Rheinland-Palatinate, and Saxony.[11] While LBBW remained bullish on its operating business in early 2008, due to its strong market position in the core businesses of Baden-Wurttemberg and Rheinland Palatinate, LBBW announced in November 2008 that it faced €800 million of writedowns and €1.1 billion of losses, citing

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[9] See http://www.spiegel.de/wirtschaft/parteichef-am-pranger-bayernlb-krise-erschuettert-csu-huber-in-not-a-545159.html for more details.

[10] See http://www.spiegel.de/international/germany/financial-crisis-aftermath-bavarian-finance-minister-quits-overbank-losses-a-585739.html for more details.

[11] While always serving as the central bank for the saving banks of Baden-Wurttemberg, LBBW assumed complete central banking responsibilities for Saxony in April 2008, after SachsenLB failed due to its exposure to U.S. subprime asset-backed securities, and for Rheinland-Palatinate in July 2008 when Landesbank Rheinland-Palatinate was completely integrated into LBBW and LBBW assumed a 100 percent ownership share of Landesbank Rheinland-Palatinate.

direct exposure to U.S. subprime mortgage-backed securities (Luttmer and Simensen, 2008). By the end of 2008, LBBW reported a loss of €2.1 billion.

In November 2008, the state of Baden-Wurttemberg, the city of Stuttgart, and the regional savings bank associations of Baden-Wurttemberg and Rheinland-Palatinate agreed to a €5 billion capital injection and a €12 billion lifeline to support LBBW. While a Moody's (2008) review of LBBW viewed the capital injection and LBBW's commitment to reduce secondary market activities and related investments as a long-term positive, Moody's also expected this to be a slow process. LBBW did not return to profit until 2012.

Appendix B: The Effect of Capital Shocks on Credit Origination and Real Economy

This appendix provides evidence on the effect of bank capital shocks on credit availability, macroeconomic outcomes, and establishments' labor policies.

Table B1

Bank Assets and Loan Growth in Affected and Unaffected States

This table provides summary statistics on asset and loan growth in German federal states affected and unaffected by their Landesbanks' trading losses in U.S. mortgage-backed securities. The list of affected states and the timeline of their exposure appear in Appendix Table A1. The unit of observation is a state-year, and all values are aggregated to the state level. Monetary values are expressed in 2005 euros. Standard deviations are shown in brackets. Data on bank assets and loans are from Bankscope.

	1997-2010	2007-2010	2007-2010	
			Unaffected states	Affected states
Average Total Assets (€ mil.)	369,481	435,619	418,137	458,096
	[463,428]	[542,012]	[638,121]	[395,850]
Average Asset Growth (%)	1.18	-1.93	4.72	-10.48
	[26.52]	[23.66]	[21.87]	[23.49]
Average Total Loans (€ mil.)	156,084	190,944	178,216	207,422
	[182,677]	[220,860]	[256,415]	[166,860]
Average Loan Growth (%)	1.02	-0.91	4.62	-8.02
	[25.91]	[23.58]	[25.75]	[18.55]

Table B2
The Effect of Capital Shocks on Credit Origination

This table studies the effect of bank capital shocks on credit origination in affected federal states. The dependent variable is one of two measures of credit origination: annual growth in bank assets (column 1) or annual growth in bank loans (column 2). Bank assets and loans are aggregated to the state level and expressed in 2005 euros. The unit of observation is a state-year. *Crisis* is an indicator equal to one in 2007-2010 and zero otherwise. *Affected state* is an indicator equal to one for the seven federal states affected by their Landesbanks' trading losses in U.S. mortgage-backed securities. The list of affected states and their Landesbanks appears in Appendix Table A1. *2001-2004 Recession* is an indicator equal to one in 2001-2004 and zero otherwise. East Germany is an indicator equal to one for federal states in East Germany and zero otherwise. Standard errors are shown in brackets, and significance levels are indicated as follows: *=10%, **=5%, ***=1%.

Dependent variable	Annual growth in bank assets (1)	Annual growth in bank loans (2)
Crisis	0.052 [0.060]	0.074 [0.059]
Affected state	0.093** [0.043]	0.080** [0.042]
Crisis*Affected state	-0.245*** [0.077]	-0.202*** [0.076]
2001-2004 Recession	0.035 [0.046]	0.035 [0.046]
East Germany	0.001 [0.038]	0.010 [0.038]
Observations	240	240
R-squared	0.052	0.036

Table B3
The Effect of Bank Capital Shocks on the Real Economy

This table studies the effect of bank capital shocks on the real economy of affected federal states. The dependent variable is one of the measures of macroeconomic outcomes: real output growth rate (column 1), employment growth rate (columns 2-4), and the rate of unemployment (column 5). The unit of observation is a state-year, and all dependent variables are aggregated to the state level. *Crisis* is an indicator equal to one in 2007-2010 and zero otherwise. *Affected state* is an indicator equal to one for the seven federal states affected by their Landesbanks' trading losses in U.S. mortgage-backed securities. The list of affected states and their Landesbanks appears in Appendix Table A1. *2001-2004 Recession* is an indicator equal to one in 2001-2004 and zero otherwise. East Germany is an indicator equal to one for federal states in East Germany and zero otherwise. Standard errors are shown in brackets, and significance levels are indicated as follows: *=10%, **=5%, ***=1%.

Dependent variable	Real output growth rate	Employment growth, all workers	Employment growth, full-time	Employment growth, part-time	Unemployment rate
	(1)	(2)	(3)	(4)	(5)
Crisis	-0.011*	0.012***	0.010***	0.018***	-0.022***
	[0.006]	[0.003]	[0.003]	[0.006]	[0.007]
Affected state	0.003	0.004**	0.004**	0.004	-0.025***
	[0.003]	[0.002]	[0.002]	[0.004]	[0.004]
Crisis*Affected state	-0.006**	-0.009**	-0.008**	-0.009	0.014*
	[0.003]	[0.004]	[0.004]	[0.007]	[0.008]
2001-2004 Recession	-0.009	-0.018***	-0.018***	-0.029***	-0.006
	[0.008]	[0.005]	[0.005]	[0.009]	[0.010]
East Germany	0.007	0.026***	0.036***	-0.044	-0.032
	[0.008]	[0.005]	[0.005]	[0.009]	[0.010]
Observations	240	240	240	240	240
R-squared	0.079	0.549	0.572	0.476	0.718

Table B4
Survey Responses by Establishments: Effects of Credit Shocks on Private and Public Firms in Affected and Unaffected States

The establishment provides the proportion of investments financed through cash, equity, private loans, and government subsidies, which add to 100 percent for each establishment, each year. The table reports the average fraction for each financing method across all establishments within a given year... For the question "Did you have difficulties acquiring a loan capital from private credit institutions?" the survey asks the establishment to qualitatively answer the question Yes/No/No response. The table reports the fraction of establishments reporting Yes/No/No response in each year.

	2010		2010
Full Sample		*Full Sample*	
Yes	57.12%	Strong/Very Strong	44.63%
No	34.32	Moderate	36.44
Don't Know	8.35	Slight	18.93
No Response	0.21		
		Affected State and Private	
Affected State		Strong/Very Strong	47.74%
Yes	60.39%	Moderate	35.72
No	31.96	Slight	16.54
Don't Know	7.65		
No Response	0.00	*Affected State and Public*	
		Strong/Very Strong	44.83%
		Moderate	32.76
Unaffected State		Slight	22.41
Yes	54.87%		
No	35.94	*Unaffected State and Private*	
Don't Know	9.19	Strong/Very Strong	42.34%
No Response	0.00	Moderate	37.29
		Slight	20.37
		Unaffected State and Public	
		Strong/ Very Strong	43.06%
		Moderate	34.72
		Slight	22.22

What fraction of your overall financing was provided by the following methods?

Did you have difficulties acquiring loan capital from private credit institutions?

(Note: The 2003 survey does not delineate between a cash response and an equity response and are thus lumped together.)

	2008	2009	2010
Full Sample			
Yes	3.35%	14.70%	15.90%
No	87.12	84.67	84.10
No Response	9.52	0.63	0.00

	2003	2004	2007
Full Sample			
Cash Flow	78.01%	71.73%	73.98%
Equity		10.55	7.90
Bank Loans	19.22	14.45	14.98
Subsidies	2.74	3.20	3.12

	2008	2009	2010
Private			
Yes	3.56%	15.41%	16.46%
No	86.95	84.02	83.54
No Response	9.49	0.57	0.00

	2003	2004	2007
Private			
Cash Flow	77.66%	72.07%	73.59%
Equity		9.70	7.79
Bank Loans	19.66	14.91	15.49
Subsidies	2.65	3.29	3.10

	2008	2009	2010
Public			
Yes	10.79%	8.43%	8.89%
No	89.21	91.57	91.11
No Response	0.00	0.00	0.00

	2003	2004	2007
Public			
Cash Flow	81.30%	68.39%	78.70%
Equity		19.01	9.29
Bank Loans	15.13	9.93	8.68
Subsidies	3.57	2.40	3.33

Table B5

The Effect of Credit Shocks on Establishments' Labor Policies

This table studies the effect of credit shocks on establishments' labor policies. In columns 1-2, the dependent variable is the net hiring rate, defined as the total worker inflows less total worker outflows for the calendar year divided by the establishment's employment level on the last day of the previous calendar year. In columns 3-4, the dependent variable is annual investment per employee, defined as total investment in a calendar year divided by the establishment's employment level on the last day of the previous calendar year. The unit of observation is an establishment-year. *Crisis* is an indicator equal to one in 2007-2010 and zero otherwise. *Affected state* is an indicator equal to one for the seven federal states affected by their Landesbanks' trading losses in U.S. mortgage-backed securities. The list of affected states and their Landesbanks appears in Appendix Table A1. *2001-2004 Recession* is an indicator equal to one in 2001-2004 and zero otherwise. All regressions are weighted by the square root of the establishment's employment level. Employment measures include whether an establishment implemented short-time work, reduced overtime, or reduced hours for its workers within the calendar year. Standard errors are shown in brackets, and significance levels are indicated as follows: *=10%, **=5%, ***=1%.

Dependent variable	Net hiring rate		Investment per employee	
	(1)	(2)	(3)	(4)
Crisis*Affected state*Private	-0.243***	-0.239***	-6,931**	-6,021**
	[0.078]	[0.079]	[2,793]	[2,860]
Crisis	-0.170***	-0.144***	-693	1,034
	[0.053]	[0.056]	[1,934]	[2,125]
Affected state	-0.143***	-0.142***	4,095***	4,144***
	[0.030]	[0.030]	[1,063]	[1,063]
Private	-0.098***	-0.097***	1,264	1,310
	[0.034]	[0.030]	[1,193]	[1,194]
Crisis*Affected state	0.117***	0.117*	6,719***	5,953**
	[0.009]	[0.063]	[2,228]	[2,313]
Affected state*Private	0.152***	0.152***	-3,509**	-3,553**
	[0.040]	[0.040]	[1,392]	[1,393]
Crisis*Private	0.215***	0.204***	798	-350
	[0.064]	[0.066]	[2,323]	[2,401]
2001-2004 Recession	-0.030	-0.029	742	805
	[0.024]	[0.024]	[834]	[835]
Employment measures	No	Yes	No	Yes
Observations	56,612	56,612	40,678	40,678
R-squared	0.021	0.021	0.021	0.021

Table 1
Summary statistics

This table reports summary statistics for the main sample which includes 14,994 establishments and 7.52 million employees covered by the administrative and survey data from the Institute for Employment Research (IAB) of the German Federal Employment Agency (BA) at the Institute for Employment Research. Panels A and B provide data on establishments and employees, respectively. The sample period is 1997-2010, and the reported figures are sample-wide statistics, unless stated otherwise. All monetary variables (expressed in euros) are scaled to the prices of the year 2005, using Germany's consumer price index.

Panel A: Establishments

	Mean	25th percentile	Median	75th percentile	Standard deviation
Privately-held indicator (%)	91.3	100	100	100	28.2
Number of employees	225.5	15	48	175	987.1
Fraction of full-time employees (%)	71.5	59.3	79.8	90.0	25.2
Annual employee inflow (%)	38.3	7.7	13.9	25.0	7.2
Annual employee outflow (%)	20.3	8.7	14.3	25.0	17.7
Net annual hiring rate (%)	15.7	-6.7	0	6.6	6.8

Panel B: Employees

	Mean	25th percentile	Median	75th percentile	Standard deviation
Age (years)	40.2	31	41	49	11.7
Education (years of school)	13.5	13	13	13	2.8
Gender (male indicator, %)	61.2	0	100	100	48.7
Annual earnings (€)	21,954	2,429	18,062	36,540	20,433
Tenure at the firm (years)	2.8	1	2	4	2.2
Duration of unemployment (days)	135.4	0	0	55	379.1
Low-skill indicator (%)	21.0	0	0	0	20.2
Part-time indicator (%)	25.2	0	0	100	43.4

Table 2
Earnings

This table studies the effect of credit shocks on the annual income of affected employees. The dependent variable is an individual's annual income (in euros) or the natural logarithm of an individual's annual income (in columns 2 and 4). The unit of observation is an individual-year, and the sample period is from 1997 to 2010. *Post* is an indicator that equals one in 2007-2010 and zero otherwise. *Affected* is an indicator that equals one for workers who were employed (at the beginning of 2007) in the seven federal states affected by their Landesbanks' trading losses in U.S. mortgage-backed securities. The list of affected states and their Landesbanks appears in Appendix Table A1. *Private* is an indicator that equals one for workers who were employed at privately-held firms at the beginning of the year 2007 and zero otherwise. *Full-time worker*, *Vocational trainee*, and *Female* are indicators that equal one for full-time workers, vocational trainees, and females, respectively. All regressions include state fixed effects and industry-year fixed effects. In addition, specifications include individual fixed effects or establishment fixed effects, as indicated in respective columns. Standard errors are in brackets, and significance levels are as follows: *=10%, **=5%, ***=1%.

	All individuals				Retained workers		Voluntary Separations	Involuntary Separations
Dependent variable	Income	Log income	Income	Log income	Income	Income	Income	Income
Column	(1) Est. FE	(2) Est. FE	(3) Indiv. FE	(4) Indiv. FE	(5) Est. FE	(6) Indiv. FE	(7) Indiv. FE	(8) Indiv. FE
Affected * Private * Post	-1779.9*** [302.021]	-0.116*** [0.033]	-2423.2*** [659.545]	-0.129*** [0.037]	-607.1 [560.948]	-682 [683.1]	-6921.1*** [978.537]	-3133.6*** [619.148]
Affected * Post	3060.1*** [270.02]	0.113*** [0.027]	2410.9*** [609.23]	0.123*** [0.035]	568.1 [495.49]	729 [617.645]	6883.2*** [969.142]	3403.1*** [561.046]
Private * Post	1369.9*** [353.826]	-0.0989*** [0.022]	1023.1* [570.429]	0.0797*** [0.029]	-2973.4*** [438.689]	-655 [542.976]	5925.9*** [917.223]	3153.9*** [495.968]
Private	-4112.3*** [234.644]	0.286*** [0.016]			3864.9*** [318.417]			
Affected x Private	-7439.6*** [346.471]	0.0407* [0.022]			1424.3*** [433.151]			
Private			-475.2* [245.084]	-0.0175 [0.016]		-412.2* [227.267]	-1075.9** [488.34]	-300.6 [837.386]
Affected x Private			618.3 [473.196]	0.0237 [0.026]		869.8 [534.844]	503.7 [528.873]	-659.2 [754.861]
Full-time worker	10269.2*** [163.481]	0.475*** [0.009]	4859.6*** [387.407]	0.213*** [0.021]	10619.7*** [164.563]	4347.8*** [426.159]	6096.2*** [333.154]	3023.9*** [397.756]
Vocational trainee	-1063.3*** [272.852]	-0.255*** [0.014]	-5254.3*** [471.361]	-0.387*** [0.025]	-1174.7*** [285.52]	-6669.5*** [564.057]	-4172.9*** [446.166]	-4936.5*** [493.39]
Female	-4318.4*** [86.352]	-0.138*** [0.004]			-4502.1*** [91.561]			
Age	1053.6*** [24.644]	0.0526*** [0.001]	296.8* [163.939]	-0.00759 [0.01]	1063.2*** [25.507]	1637.6*** [182.79]	-359.1 [320.487]	-829.6** [327.727]
Education and firm tenure controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE and Industry*year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	No	No	Yes	Yes	No	Yes	Yes	Yes
Establishment FE	Yes	Yes	No	No	Yes	No	No	No
Observations	5,555,922	5,555,922	5,555,922	5,555,922	4,315,024	4,315,024	853,258	387,640
R-Squared	0.637	0.627	0.899	0.868	0.646	0.922	0.812	0.826

Table 3: Unemployment and Exit from the Workforce

This table studies the effect of credit shocks on individuals' employment. In odd-numbered columns, the dependent variable is the number of days an individual spends in registered unemployment. In even-numbered columns, the dependent variable is the number of days an individual spends without employment, including time spent in registered unemployment and time spent out of the labor force. Columns 1-2 examine all employees. Columns 3-4 examine employees who voluntarily leave their establishment. Columns 5-6 examine employees who involuntarily leave their establishment. The unit of observation is an individual-year, and the sample period is from 1997 to 2010. *Post* is an indicator that equals one in 2007-2010 and zero otherwise. *Affected* is an indicator that equals one for workers who were employed (at the beginning of 2007) in the seven federal states affected by their Landesbanks' trading losses in U.S. mortgage-backed securities. The list of affected states and their Landesbanks appears in Appendix Table A1. *Private* is an indicator that equals one for workers who were employed at privately-held firms at the beginning of 2007 and zero otherwise. All regressions include state fixed effects, industry*year fixed effects, and individual fixed effects. Standard errors are shown in brackets, and significance levels are indicated as follows: *=10%, **=5%, ***=1%.

Sample:	All Employees		Voluntary Separations		Involuntary Separations	
Dependent Variable:	Unemployment	Non-Employment	Unemployment	Non-Employment	Unemployment	Non-Employment
	(1)	(2)	(3)	(4)	(5)	(6)
Affected x Private x Post	2.45***	5.178***	-0.0723	6.861***	3.416***	7.49***
	[0.44]	[0.73]	[0.90]	[2.15]	[0.68]	[1.09]
Affected x Post	-3.93***	-6.752***	0.456	-3.44*	-4.889***	-9.166***
	[0.39]	[0.63]	[0.76]	[1.85]	[0.55]	[0.86]
Private x Post	-16.25***	-43.76***	-3.474***	-72.84***	-14.54***	-37.55***
	[0.39]	[0.63]	[0.77]	[1.85]	[0.55]	[0.88]
Private	0.38	3.404***	2.069**	15.93***	-1.285***	1.806*
	[0.29]	[0.68]	[0.82]	[2.27]	[0.43]	[0.95]
Affected x Private	2.70***	2.437***	2.431**	-0.685	2.562***	0.373
	[0.35]	[0.85]	[0.98]	[2.74]	[0.56]	[1.26]
Part-time worker	-5.79***	-5.44***	-2.424***	-2.275*	-8.752***	-7.607***
	[0.20]	[0.46]	[0.41]	[1.31]	[0.36]	[0.81]
Vocational trainee	-11.91***	-39.12***	-11.58***	-62.94***	-11.71***	-35.74***
	[0.45]	[1.10]	[0.94]	[2.63]	[0.67]	[1.61]
Mini job	-0.46	27.11***	-1.141	24.64***	-1.233	25.91***
	[0.45]	[1.47]	[1.13]	[3.02]	[1.01]	[2.10]
Age	-1.11***	-14.43***	-3.776***	-11.1***	-1.216***	-15.95***
	[0.25]	[0.39]	[0.36]	[0.74]	[0.44]	[0.67]
Age-squared	0.06***	0.227***	0.0447***	0.222***	0.093***	0.263***
	[0.01]	[0.39]	[0.36]	[0.74]	[0.44]	[0.67]
Above 58	14.76***	15.31***	4.262***	-1.553	23.23***	22.23***
	[0.36]	[0.53]	[0.78]	[1.38]	[0.63]	[0.83]
Education controls	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Industry*year FE	Y	Y	Y	Y	Y	Y
Individual-FE	Y	Y	Y	Y	Y	Y
R-squared	0.536	0.65	0.494	0.596	0.533	0.647
N	6,714,532	6,714,532	630,308	630,308	4,183,073	4,183,073

Table 4
Table 4
Employee Characteristics and Labor Market Outcomes

This table studies the relation between the characteristics of employees and their labor market outcomes during credit crises. In this table, the sample is restricted to the set of affected establishments – those that belong to private firms in affected states. Panel A provides cross-sectional evidence on employee income. In this panel, the dependent variable is annual income. Panel B provides cross-sectional evidence on employment status. In this panel, the dependent variable is the time spent in unemployment (odd-numbered columns) or without employment, i.e., including time spent out of the labor force (even-numbered columns). Employee education is represented by three education categories (*Edu1* to *Edu3*), where *Edu1* (the omitted category) corresponds to the lowest education level. Employee level in the corporate hierarchy is represented by five skill categories (*Skill 1* to *Skill 5*), where *Skill 1* (the omitted category) corresponds to the lowest skill level, identifying jobs classified as unskilled. *Full-time*, *Vocational*, *Marginal*, and *Female* are indicators that equal one for full-time workers, vocational trainees, part-time workers, and females, respectively. All regressions include state fixed effects, industry*year fixed effects, and individual fixed effects. Standard errors are in brackets, and significance levels are as follows: *=10%, **=5%, ***=1%.

Table 4 continues on the following two pages.

Table 4, Panel A: Cross-Sectional Evidence on Wages

	Annual income (all)	Annual income (retained)	Annual income (voluntary sep.)	Annual income (involunt. sep.)
Fulltime	4016.7***	3045.4***	5839.1***	4177.3***
	[593.445]	[621.213]	[445.517]	[493.062]
Vocation	-7244.4***	-9159.2***	-5488***	-6633.1***
	[698.462]	[741.429]	[687.694]	[649.775]
Edu2	1391.1***	824.8***	1653.7***	1689.9***
	[259.72]	[291.58]	[446.558]	[394.477]
Edu3 (high)	11936.1***	9533.3***	14894.8***	12308.3***
	[869.818]	[838.495]	[1340.51]	[1708.871]
Skill2	48.04	-73.98	812.9**	-140.5
	[306.728]	[339.341]	[332.29]	[405.421]
Skill3	2473.6***	2239.9***	2747.5***	4572.1***
	[493.513]	[512.193]	[800.788]	[1440.473]
Skill4	2400.1***	1686.1***	3882.5***	3284
	[637.095]	[622.806]	[1230.348]	[2552.056]
Skill5 (high)	-3854.1***	-3635***	-4432.4***	-2640.9***
	[840.988]	[759.671]	[1116.618]	[706.925]
Age	-839.4***	1250.4***	65.38	-635.4
	[321.935]	[475.696]	[411.674]	[503.336]
Age squared	-20.61***	-22.32***	-15.4***	-31.03***
	[0.978]	[0.883]	[2.079]	[3.301]
Tenure	13282.7***	11529.1***	14158.9***	13817***
	[611.005]	[699.756]	[735.671]	[477.977]
Tenure squared	-1721.5***	-1658.8***	-2040.8***	-1814.7***
	[110.192]	[122.276]	[129.725]	[99.245]
Fulltime * Post	450.8*	1049.1***	-518**	-778.8**
	[238.769]	[240.663]	[245.998]	[311.198]
Vocation * Post	-1271.9***	-1658.1***	-1310.8**	-687.2
	[393.616]	[412.101]	[539.623]	[455.397]
Female * Post	-389***	73.1	-799.7***	-100.5
	[118.96]	[121.833]	[180.358]	[208.367]
Edu2 * Post	572.6***	628***	-187.2	191.8
	[98.599]	[104.484]	[213.047]	[189.763]
Edu3 * Post	2169***	3187***	-629.8	1380.5***
	[205.888]	[220.388]	[429.034]	[511.316]
Skill2 * Post	777.8***	815.8***	7.485	57.95
	[119.672]	[121.566]	[226.615]	[228.314]
Skill3 * Post	1150.2***	1396.8***	-20.1	802.6
	[242.704]	[228.005]	[460.347]	[535.036]
Skill4 * Post	270.7	1232.5***	-2247.4***	-1573.5
	[352.479]	[314.026]	[866.808]	[1160.799]
Skill5 * Post	409	1716.8***	-1434.1**	116.3
	[606.106]	[401.634]	[647.962]	[442.6]
Age * Post	111.2***	-23.23	0.249	0.348
	[33.01]	[32.982]	[55.154]	[62.144]
Age Sq. * Post	-1.397***	-0.0294	-0.152	1.087
	[0.379]	[0.387]	[0.654]	[0.785]
Tenure * Post	-10350***	-9285.5***	-13340.5***	-12403***
	[555.117]	[609.643]	[706.975]	[443.032]
Tenure Sq. * Post	1842.3***	1681***	2329.2***	2143.5***
	[107.274]	[118.468]	[129.813]	[85.369]
State FE	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
Individual-FE	Yes	Yes	Yes	Yes
R-squared	0.879	0.917	0.788	0.828
N	1,898,764	1,398,756	372,582	127,426

Table 4, Panel B: Cross-Sectional Evidence on Employment Status

	Unemployed (all)	Not employed (all)	Unemployed (voluntary)	Not employed (voluntary)	Unemployed (involuntary)	Unemployed (voluntary)
	(1)	(2)	(3)	(4)	(5)	(6)
Fulltime	-1.537***	-1.601**	-0.318	-0.424	-4.407***	-3.822***
	[0.279]	[0.666]	[0.773]	[2.138]	[0.6]	[1.32]
Vocation	-18.95***	-63.42***	-15.68***	-83.62***	-19.06***	-62.99***
	[0.889]	[2.231]	[1.686]	[4.608]	[1.505]	[3.484]
Marginal	6.765***	36.53***	0.661	28.72***	4.995**	28.96***
	[1.136]	[2.559]	[2.145]	[5.242]	[2.19]	[4.488]
Edu 2	-19.64***	-53.53***	-14.59***	-50.36***	-21.92***	-50.16***
	[1.038]	[2.188]	[2.102]	[4.198]	[1.696]	[3.356]
Edu 3 (high)	-33.78***	-112.7***	-28.16***	-116***	-40.46***	-118.4***
	[1.729]	[4.037]	[3.198]	[7.376]	[2.913]	[6.382]
Skill 2	-0.177	-2.496**	1.976	-1.518	-0.849	-6.207**
	[0.487]	[1.19]	[1.27]	[3.461]	[1.129]	[2.495]
Skill 3	2.511***	-0.127	4.412**	5.35	1.617	-9.329*
	[0.911]	[2.485]	[2.036]	[6.287]	[1.939]	[4.769]
Skill 4	-1.103	-1.593	0.58	0.0912	-4.356*	-16.87***
	[1.06]	[3.003]	[2.543]	[8.277]	[2.273]	[5.447]
Skill 5 (high)	-2.854**	15.08***	-1.252	35.61***	-5.761***	-0.665
	[1.118]	[3.283]	[2.421]	[6.801]	[1.906]	[5.19]
Age	-3.698***	-21.88***	-6.186***	-29.47***	9.134***	0.87
	[0.312]	[0.698]	[0.676]	[1.68]	[1.351]	[1.828]
Age squared	0.0499***	0.128***	0.0605***	0.16***	0.116***	0.156***
	[0.002]	[0.004]	[0.005]	[0.01]	[0.004]	[0.007]
Fulltime * Post	-3.144***	-4.745***	-3.626***	-3.984**	-4.832***	-5.401***
	[0.29]	[0.624]	[0.838]	[2.009]	[0.566]	[1.094]
Vocation * Post	6.484***	6.444***	7.917***	21.42***	5.498***	11.83***
	[0.862]	[2.217]	[1.564]	[5.02]	[1.471]	[3.337]
Marginal * Post	-12.64***	-27.23***	-5.212**	-9.292**	-17.17***	-48.99***
	[1.143]	[2.092]	[2.028]	[4.249]	[2.089]	[3.454]
Female * Post	1.85***	2.753***	1.735***	3.021**	2.837***	4.291***
	[0.207]	[0.467]	[0.534]	[1.372]	[0.416]	[0.829]
Edu 2 * Post	-0.982***	-1.589***	-1.183*	3.443**	-1.01*	-2.572**
	[0.259]	[0.544]	[0.706]	[1.599]	[0.546]	[1.021]
Edu 3 * Post	-0.29	-3.289***	2.478***	16.46***	-0.62	-11.12***
	[0.339]	[0.797]	[0.894]	[2.349]	[0.689]	[1.403]
Skill 2 * Post	1.144***	3.587***	1.104**	6.487***	-0.355	0.79
	[0.179]	[0.403]	[0.524]	[1.288]	[0.384]	[0.762]
Skill 3 * Post	2.229***	7.012***	1.557*	8.83***	0.542	1.147
	[0.305]	[0.725]	[0.829]	[2.21]	[0.582]	[1.23]
Skill 4 * Post	2.301***	4.266***	0.897	2.585	2.439**	4.106*
	[0.551]	[1.396]	[1.402]	[4.336]	[1.152]	[2.421]
Skill 5 * Post	3.136**	8.6***	7.264***	22.77***	3.941*	1.345
	[1.302]	[3.08]	[2.492]	[6.244]	[2.108]	[4.431]
Age * Post	-0.47***	1.787***	0.0173	4.014***	-2.017***	1.254***
	[0.068]	[0.154]	[0.165]	[0.41]	[0.131]	[0.258]
Age sq. * Post	0.00729***	-0.00878***	0.000562	-0.0391***	0.0234***	0.000547
	[0.001]	[0.002]	[0.002]	[0.005]	[0.001]	[0.003]
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual-FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.441	0.510	0.474	0.538	0.499	0.579
N	2,127,017	2,127,017	323,398	323,398	771,145	771,145

Table 5: Separations

This table studies the effect of employee characteristics on the likelihood of separating from their establishment, using a linear probability model. The dependent variable is a binary indicator, which equals one when an employee leaves the establishment. Columns 1-3 examine all employees. Columns 4-6 and 7-9 examine voluntary and involuntary employee separations, respectively. Employee education is represented by three education categories (*Edu1* to *Edu3*), where *Edu1* (the omitted category) corresponds to the lowest education level. All regressions include unreported controls for employee level of job hierarchy, represented by five job categories, and their interaction terms with the indicator *Post* (unreported). *Full-time*, *Vocational*, *Marginal*, and *Female* are indicators that equal one for full-time workers, vocational trainees, flexible workers, and females, respectively. All regressions include state fixed effects, industry*year fixed effects, and individual fixed effects. Standard errors are in brackets, and significance levels are as follows: *=10%, **=5%, ***=1%.

	All employees			Voluntary separations			Involuntary separations		
	Job to unempl.	Job to job	All	Job to unempl.	Job to job	All	Job to unempl.	Job to job	All
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Fulltime	-0.0008	-0.002	-0.0027	-0.0012	-0.0012	-0.0020	-0.0034	-0.00076	0.0031
	[0.001]	[0.001]	[0.002]	[0.001]	[0.005]	[0.005]	[0.008]	[0.002]	[0.008]
Vocational	-0.0111***	-0.009***	-0.0524***	-0.0097***	-0.0024	-0.055***	-0.0499***	-0.0161***	-0.096***
	[0.002]	[0.003]	[0.005]	[0.002]	[0.008]	[0.009]	[0.011]	[0.004]	[0.013]
Marginal	-0.0062***	0.011***	0.0425***	-0.00033	0.0124	0.074***	-0.0122	0.0179***	0.0439***
	[0.002]	[0.004]	[0.007]	[0.002]	[0.008]	[0.011]	[0.011]	[0.005]	[0.014]
Female				-0.0010*	0.0013	0.0090**	0.00221	0.00041	0.0115*
				[0.007]	[0.004]	[0.004]	[0.006]	[0.001]	[0.007]
Edu2	0.0012**	0.0011	-0.00214	0.00085	0.00758	-0.0011	-0.00893*	-0.00043	-0.016***
	[0.001]	[0.002]	[0.002]	[0.001]	[0.006]	[0.005]	[0.005]	[0.001]	[0.006]
Edu3	-0.0005	0.0005	-0.0103***	-0.0013	0.00653	-0.012	-0.0262***	-0.0012	-0.0426***
	[0.001]	[0.004]	[0.004]	[0.001]	[0.01]	[0.008]	[0.008]	[0.002]	[0.009]
Fulltime * Post	0.0043***	-0.0056**	-0.0143***	0.0009	-0.0237***	0.0116	0.0153	-0.0019	0.0175
	[0.001]	[0.002]	[0.004]	[0.001]	[0.009]	[0.008]	[0.013]	[0.003]	[0.013]
Vocational * Post	0.0583***	0.0360***	0.0837***	0.0153***	0.103***	0.139***	0.148***	0.0233**	0.196***
	[0.009]	[0.012]	[0.018]	[0.005]	[0.028]	[0.029]	[0.041]	[0.012]	[0.041]
Marginal * Post	-0.0137***	0.0704***	0.0288***	0.00066	0.0658***	0.0129	0.0202	0.0485***	-0.0019
	[0.003]	[0.007]	[0.008]	[0.002]	[0.013]	[0.012]	[0.02]	[0.008]	[0.020]
Female * Post	0.0052***	-0.0018	0.00577**	0.00060	-0.0408***	0.00129	0.00113	-0.00093	-0.0002
	[0.001]	[0.002]	[0.003]	[0.001]	[0.008]	[0.006]	[0.012]	[0.002]	[0.012]
Edu2 * Post	-0.0076***	-0.0053	-0.0129***	-0.00102	-0.0112	-0.0136*	-0.00176	0.0029	-0.00121
	[0.001]	[0.004]	[0.004]	[0.001]	[0.012]	[0.008]	[0.009]	[0.002]	[0.01]
Edu3* Post	-0.0117***	0.0068	-0.00124	-0.00008	0.0381**	0.0155	0.0076	0.0039	0.0019
	[0.001]	[0.007]	[0.007]	[0.001]	[0.019]	[0.014]	[0.015]	[0.004]	[0.015]
Skill category controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE, Industry*year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,102,192	2,102,192	2,102,192	399,152	399,152	399,152	120,176	120,176	120,176
R-Squared	0.104	0.133	0.125	0.188	0.247	0.262	0.381	0.148	0.353