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

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Abstract

Using a comprehensive employer-employee dataset from German social security records, we examine the impact of an exogenous shock to bank capital on firms' employment and investment decisions, and on individual workers' careers. We find that German regional banks' trading losses from U.S. mortgage-backed securities cause a deep economic contraction in the banks' exclusive geographic domains. Loan growth and output growth decline by 20 and 0.6 percentage points per crisis year, respectively, and the unemployment rate rises by 1.4 percentage points during each year of the crisis in affected states compared to unaffected states. The effect is stronger for privately held, bank-dependent firms than for publicly listed firms: private firms in affected states reduce net hiring by 24 percentage points and cut investment by one-half compared to publicly listed firms. We then study how firms' access to bank credit affects individuals' wages, unemployment duration, and occupational choices. Workers in affected firms experience persistent earnings losses of approximately €1,000 per year, nine weeks longer unemployment spells, and a lower probability of climbing the job ladder than workers in unaffected firms.

JEL Codes: E22, E24, G21, G31, G32, J23, J63

1   Introduction

Do economic fluctuations and financial crises lead to creative destruction – 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 invention 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. At the same time, 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 financial shocks affect firms' employment decisions and individuals' careers, both in the short- and long-run.

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 employers over time. As a result, the literature 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 overcome 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. In addition, we can observe not only how a firm adjusts its workforce in response to a financial shock, but also how such adjustments affect the firm's cost structure, earnings, and long-run performance.

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 to conduct business outside their geographic domains. Some of these banks speculated in U.S. mortgage-backed securities during the run-up to the financial crisis and lost billions when the market collapsed, creating shocks to local bank capital unrelated to local economic conditions.

We first document how the financial shocks affect bank capital 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 foreign trading losses, compared to the control group of unaffected banks. Next, we show that the reduction in bank lending leads to an extra annual output decline of 0.6 percentage points and an extra annual increase in unemployment of 1.4 percentage points between 2007 and 2010, over and above the unaffected states.

Next, we turn to an employee-level analysis. We find that a reduction in credit caused by 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' careers. Workers in affected firms experience persistent earnings losses of about €1,000 per year, an extra 9 weeks of unemployment, and a lower probability of promotion than workers in unaffected firms.

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. 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 (ibd).

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.

The paper proceeds as follows. Section 2 describes the features of the German financial system that are necessary to explain the empirical design. Section 3 describes the data and provides summary statistics. Section 4 details the empirical strategy and discusses results: section 4.1 quantifies the bank capital shock's impact on loan growth in the affected federal state level, section 4.2 estimates the impact of the local bank credit crisis on the federal state macroeconomies, and section 4.3 shows the disproportionate impact of the local bank credit crisis on establishments in privately-held firms compared to their publicly-listed counterparts. Section 5 examines the worker-level effects of bank speculation. Section 6 reviews the relevant literature. Section 7 concludes.

2 German Banking System and Identification of Shocks

The central hypothesis of this paper is that an exogenous reduction in local credit supply leads adverse effects on local economic outcomes, with a key transmission mechanism being that local credit supply shocks adversely and differentially affect employment and investment in property, plant, and equipment at privately-held partnerships and limited liability companies compared to publicly-listed capital corporations, as the publicly-listed corporations can more readily access capital from both domestic and international equity markets. Therefore, identifying an exogenous shock unrelated to local conditions that leads to a reduction in the supply local bank credit is crucial for testing the paper's hypothesis. This section first discusses the institutional background of the German banking system that makes Germany a convenient setting to study the effects of an exogenous shock to bank credit and then identifies candidate banks that were exposed to U.S. subprime mortgages during the financial crisis, and as a result, saw significant losses in their assets.

2.1 German Bank Institutional Background

The German banking system is comprised of three types of banks: public banks, cooperative banks, and private banks. The private banks include commercial banks, investment banks, and private banking and asset management companies, among others. They have a significant international client base. The cooperative banks are built on a membership-share where each member has one vote, regardless of its capital share in the cooperative. The public banks consists of the local savings banks (Sparkassen) and Landesbanks, both of which are not-for-profit entities.[1] The Landesbanks are a group of regional state-owned banks that serve three main functions: first, the Landesbanks' business is predominantly wholesale banking services, and they are the head banking institutions (i.e. central banks and clearing houses) for the local savings banks in each

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[1] Surpluses are broadly committed to social issues, including the arts, sports, cultural development, and educational issues within the region.

Landesbank's particular region; second, the Landesbanks serve as the lending houses to their federal state(s) to finance infrastructure and social housing projects; third, the Landesbanks serve as commercial banks, primarily providing funding to big companies (Moody's 2004, Hughes 2008). Each Landesbank is owned by the federal state (Bundesland) where it is located and the collection of local savings banks (directly or indirectly through regional associations) within its particular region. Landesbanks are governed by regional rather than federal law. Which savings banks own a particular Landesbank is solely determined by the region in which the local savings bank resides, and a savings bank is prohibited by law to own shares in any Landesbank outside of its region.

Table 1, panel a, shows that the private banks own nearly 54 percent of the total bank assets from 1997 through 2011 and comprise 16 percent of all banks, whereas the cooperative banks own 8.5 percent of total bank assets and comprise nearly 55 percent of all banks. Table 1 also illustrates the significant role the public banks play in the German banking system, making up nearly 38 percent of the total bank assets in the German economy over the sample period from 1997 through 2011 and comprise roughly 29 percent of all banks.

The German Savings Bank Association (Deutscher Sparkassen- und Giroverband) describes the structure and operational procedures of the local savings banks to follow five constitutive elements: a public mandate, the regional principle, municipal trusteeship, its legal status and ownership, and its decentralized group nature (Deutscher Sparkassen- und Giroverband 2012). First, the public mandate requires the savings banks to practice a "sustainable business philosophy" focusing on the "appropriate and adequate provision of credit" to all customers, including private customers, regardless of personal income and current financial situation, and for a "sustainable commitment to the development of local businesses." The public mandate is issued by law and is the foundation for the savings banks' primary mission: to serve and promote economic and business development within the region. Further, the public mandate allows the savings banks to extend credit to customers that otherwise would not receive credit from other financial institutions.

Second, the regional principle stipulates that the savings banks are authorized to operate only within their region and "that their loan activities should focus on that region" alone. The regional principle therefore prohibits savings banks from lending outside of their region and searching out or accepting customers in more economically viable regions. Further, the savings banks are required by mandate to turn down any loan requests from customers outside of their respective regions. Thus, the regional principle creates an environment of narrow banking by turning "local deposits into local loans."[2] While German savings banks are locally specialized, they are diversified across sectors (OECD 2014).

Third, the municipal trusteeship element of the savings banks attempts to ensure that locally anchored savings banks remain legally and financially independent. A municipality is "the re-

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[2]See Kobayakawa and Nakamura (2000) for a survey of narrow banking.

sponsible pubic body of a savings bank – but not its owner", where a municipality may refer to a city, town, district, or an "association of local authority for the purpose of jointly running a savings bank". However, a savings bank is not an asset of the municipality, the municipality owns no shares of the savings bank, and the municipality cannot sell the savings banks for revenue generation. A supervisory board, consisting of local council representatives and employees within the region, ensures that the savings banks satisfy their public mandate. However, the supervisory board has no direct impact on day-to-day operations of the savings banks.

Fourth, the legal status and ownership are structured to prevent savings banks from being taken over by private institutions with the primary goal to maximize profits. The savings banks "are incorporated as institutions under public law" that are "legally and financially independent" and have no owners. Their legal form aims to ensure that region's population is "adequately represented", as the supervisory board consists of city council officials and local citizens. However, the management board runs the banks' day-to-day operations and consists of banking professionals–and not local politicians–to ensure impartial behavior.

A fifth feature of German savings banks is their decentralized network. Since individual savings banks are relatively small entities alone, the formation of savings bank groups allows for the diversification of risk. Savings banks may only form associations with other savings banks from close local regions (and within the same federal state), and members of these associations share the same common name, typically "Sparkasse".

It is through these regional associations that the savings banks construct their ownership (either minority or majority ownership) in the Landesbanks. Federal law requires the local savings bank associations to legally support and maintain liability for the Landesbanks (Moody's 2004). Therefore, Landesbanks may rely on the savings banks for support, and shocks to the equity of a Landesbank directly transmit to the savings banks' balance sheets in its region, and further, local savings banks provide funds to the regional Landesbanks in response to a shock to the equity of the Landesbank.

In addition, there are significant costs to firms associated with switching from the local savings bank to a different bank. As a result, a shock to the capital of a Landesbank that is entirely unrelated to the local economy can have consequences for the provision of credit to local businesses, and properly identifying an exogenous shock to a Landesbank's capital potentially allows for the measure of the effect of an exogenous shock to the banking system on economic outcomes. Further, identifying an exogenous shock that affects only some of the Landesbanks rather than all would allow for the credible exploitation of regional variation in economic outcomes due to the contained, regional nature of the German banking system.

2.2 Identification of Bank Shocks

Figure 1 shows a the regional distribution of the German Landesbanks and the federal states each Landesbank covers as of 2007 and prior to the crisis. In 2007, 10 Landesbanks covered the 16 German federal states. Each Landesbank served as the central bank in typically one federal state, with the Helba and Nord/LB Landesbanks covering three federal states each.

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 with total assets of €68 billion in 2007, 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 direct involvement in subprime mortgages approached €500 million[3], whereas the German newspaper *S´uddeutsche Zeitung* reported Sachsen LB had as much as €65 billion in five funds at Ormund Quay. State officials announced on August 26, 2007, that Sachsen LB would be sold to Landesbank Baden-Württemberg (LBBW), the central clearing house for the savings banks located in Baden-Württemberg 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-Württemberg, Rheinland-Palatinate, and Saxony.[4]

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. 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

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

[4]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.

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.

WestLB, the Landesbank of the federal state North Rhine-Westphalia and central clearing house for the state's savings banks, was the next Landesbank to announce losses due to exposure to the U.S. subprime crisis on August 27, 2007, saying it had nearly €1.25 billion of direct exposure to U.S. mortgage-backed securities (Clark 2007). WestLB was the third largest Landesbank at the time, with total assets of €285 billion in 2007. Its exposure stemmed from five subsidiaries which borrowed money by selling short-term commercial paper and investing those funds in securities backed by U.S. mortgages. In an attempt to limit the bank fallout from the 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 received a €5 billion rescue package from the state of North Rhine-Westphalia and the two local savings banks associations (Rheinischer Sparkassen- und Giroverband and Westfálisch-Lippischer Sparkassen- und Giroverband). Losses of up to €2 million were to be absorbed by the owners of WestLB according to the respective ownership stakes in the bank, of which the two savings bank associations of North-Rhineland-Westpahlia owned more than 50 percent (Puri et al., 2011). On April 2, 2008, West LB reported a net loss of €1.6 billion for 2007, directly citing exposure to U.S. mortgage-backed securities.

In addition to the 5 billion euro rescue package in February 2008, WestLB announced the creation of a bad bank called Erste Abwicklungsanstalt (EAA), and €85 billion in toxic assets were transferred from WestLB to EAA in November 2009. While referred to as a bad bank, EAA is not a bank as it does not hold a banking license nor attempts to generate new business. EAA was established as a specialty agency with the mission to wind up a financial portfolio of toxic assets responsibly and sustainably.[5] Therefore, EAA was viewed as serving a public function. On December 20, 2011, the European Commission approved a liquidation plan for WestLB submitted

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[5]For more information on EAA's specific functions, please see https://www.aa1.de/en/about-us/faq/general-questions/.

by the German government. After June 30, 2012, WestLB stopped taking new banking business (Lienemeyer and Magnus, 2011) and was dissolved.[6]

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 million, whereas the two owners of Bayern LB, the state of Bavaria and the savings bank association, Sparkassenverband Bayern, would be responsible for €2.4 million 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.[7] 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.[8] 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-Württemberg (LBBW), with total assets in 2007 of €443 billion and an ownership structure of 40.5 percent by the State of Baden-Württemberg, 40.5 percent by the savings bank associations of Baden-Württemberg and

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[6]At this point, what remained of WestLB began to operate as Portigon Financial Services AG. EAA and the Landesbank of Hessian and Thuringia, Helba, handled the bankruptcy and carried on with the core functions of the former WestLB.

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

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

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-Württemberg, Rheinland-Palatinate, and Saxony.[9] While LBBW remained bullish on its operating business in early 2008, due to its strong market position in the core businesses of Baden-Württemberg and Rheinland Palatinate, LBBW announced in November 2008 that it faced €800 million of write-downs and €1.1 billion of losses, citing 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-Württemberg, the city of Stuttgart, and the regional savings bank associations of Baden-Württemberg 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.

Panel b of table 1 summarizes the identified Landesbanks exposed to the U.S. subprime crisis, the date each bank announced its first losses, the time period when each bank was expected to experience its first losses due to the crisis, and the resulting affected federal states and savings banks where each Landesbank served as the central bank. The approach reveals exposure to the U.S. subprime crisis by five Landesbanks–SachsenLB, HSH Nordbank, WestLB, BayernLB, and LBBW–that serve as the central bank for savings banks in seven of the sixteen German federal states–Saxony, Schleswig-Holstein, Hamburg, North Rhine-Westphalia, Bavaria, Baden-Württemberg, and Rheinland-Palatinate. SachsenLB, HSH Nordbank, and WestLB all announced first losses due to exposure to the U.S. subprime crisis within ten days of each other in August 2007. Further, while BayernLB did not announce its first losses until February 2008, there is considerable evidence that BayernLB experienced its first losses in the third quarter of 2007, a similar time to that of SachsenLB, HSH Nordbank, and WestLB. Thus, the narrative suggests that four Landesbanks were in crisis due to exposure to the U.S. subprime crisis 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, affecting the savings banks of Württemberg and Rheinland-Palatinate. Accordingly, 2007 marks the beginning of the crisis for the remainder of the study.

Figure 2 shows a map of the affected and unaffected German federal states. The map shows significant geographical dispersion in affected states, as there are affected states located in the

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[9]While always serving as the central bank for the saving banks of Baden-Württemberg, 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.

north, east, south, and west. Further, each affected state borders an unaffected state, allowing for stark regional variation.

3 Data and Summary Statistics

Our dataset allows us to observe a large fraction of the German economy over 14 years in a stratified, linked employer-employee sample. To construct this dataset, we merge three independent data sources. First, we obtain bank-level data to identify the transmission of financial shocks and to quantify their effect on bank lending. Second, we use a novel establishment-worker dataset from German social security records that allows us to follow individual workers across establishments and firms. Third, we collect data on regional economic variables to provide evidence on the aggregate welfare and macroeconomic effects. This section describes these data and discusses summary statistics.

3.1 Banks and Financial Shocks

Bank-level data come from Bankscope, a dataset compiled by Bureau van Dijk, which covers the universe of German banks over our sample period of 1997-2010. The data include three sets of bank characteristics: (1) financials (e.g., loans, deposits, securities, capital, etc.), (2) bank type (e.g., savings bank, cooperative bank, investment bank, etc.), and (3) descriptive information (e.g., physical address, registration, etc.). These characteristics allow us to identify the savings banks exposed to the U.S. subprime crisis via their ownership in the respective Landesbanks and to delineate these banks' geographic domains affected by the financial shock.

Columns 1 and 2 of table 2 show the summary statistics for the aggregate, state-level bank balance sheets from 1997 to 2010 (column 1) and from 2007 to 2010 (column 2). All monetary figures here and henceforth are expressed in 2005-Euros. Comparing the values of total average assets and total average loans during the crisis period (2007-2010) and over the entire sample shows that the value of assets and loans were, on average, larger during the crisis than earlier in the sample.[10] This observation is attributed to trend growth for both variables in our sample period. Comparing the average annual growth rates in total assets and total loans during the crisis and over the entire sample shows a clear, yet small, 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, whereas loan growth is only 1.93 percentage points lower. The average annual growth rate and standard deviation for total loans are on par with those of total assets, indicating

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[10]The category of total assets consists for total loans, other earning assets such as advances to banks, derivatives, and securities, and fixed assets, whereas the category of total loans consists of mortgage loans, consumer and retail loans, and corporate and commercial loans.

that fluctuations in total loans drive fluctuations in total assets over the sample period and during the crisis.

Columns 3 and 4 of table 2 compare the state-level bank balance sheets between the federal states affected and unaffected by their Landesbanks' exposure to the U.S. subprime crisis. In the unaffected states (column 3), total asset growth and loan growth remain robust during the crisis, averaging 4.72 percent and 4.62 percent, respectively. In contrast, the affected states (column 4) experience a significant contraction in both asset growth and loan growth during the crisis. In the affected states, the total asset growth and loan growth during the crisis average -10.48 and -8.02 percent, respectively. Comparing to the unaffected states, 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.

3.2   Workers, Establishments, and Firms

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. 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 and expanded to East-German states in 1996. The sample includes all West German establishments that completed a survey in at least one year from 1997 to 2010 and identified themselves as part of a privately-held partnership, a limited liability company, or a publicly-traded capital corporation. An establishment in this sample refers to a local unit of a firm–that is, a specific plant or building. We match establishments to firms via a crosswalk provided by the FDZ 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 15,392 establishments.

We obtain complete worker-level histories for every worker who was employed and liable to social security at any establishment in our sample for at least one day in 1997-2010. 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 worker 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.

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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. 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 Minister of Labor, it yields a high response rate of about 80 percent among the establishments that stay in the panel Janik and Kohaut (2012). The survey provides information about an establishment's total investment in plant, property, and equipment, the fraction of investment financed through a particular financing channel (e.g., internal cash flow, bank loans, and government subsidies), and 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 and provide additional qualitative evidence.

Table 3, panel a, shows the establishment-level descriptive statistics, where the unit of analysis is the establishment-year. The mean (median) establishment employs 283 (55) workers. The sample-wide average establishment-year net hire rate is -0.9 percent. The establishment's net hire rate is the difference between total number of employee inflows and outflows, expressed as a fraction of total employment as of the start of the year. The median net hire rate is -0.2 percent, and the standard deviation is 27.0 percent, indicating substantial variation in net employment flows across establishment-years. The slightly negative average establishment net hire rate matches the macro-level employment statistics and reflects the stable decline in Germany's working age population and the effect of multiple recessions in our sample period. Worker inflow and outflow rates, however, are substantially larger over the sample period, indicating significant worker movement across establishments. The mean (median) value of investment per employee is €12,822 (6,651) per establishment-year, and the standard deviation is €55,053.

Table 3, panel b, shows a summary of the employment level, net hire rate, and investment per employee statistics broken down by establishments of privately-held and publicly-listed firms. The statistics suggest a clear distinction between these groups. As expected, the median number of employees is much lower for publicly-listed firms (278 employees) than for privately-held firms

(48 employees). The summary statistics on employment levels also indicate large within-group variation in size both for establishments of privately-held and publicly-listed firms. However, the average net hire rates over the entire sample paint more similar picture between establishments of privately-held firms and those of publicly-traded firms and are on par with the sample average presented in panel a of table 3.

Investment per employee differs noticeably between the establishments of privately-held and publicly-traded firms. The mean (median) investment per employee for the privately-held establishments amounts to €10,829 (5,068), significantly below the mean (median) investment of €15,741 (9,185) at the publicly listed firms. The standard deviation of investment per employee is also significantly larger for the publicly-listed firms at €76,359 compared to €33,314 for the privately-held firms.

Table 4 shows the establishments' responses to survey questions related to financing channels and the financial crisis. These responses suggest 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. Further, the privately-held firms in affected states reported being more strongly affected by the crisis than publicly-listed firms and their privately-held counterparts in unaffected states.

3.3 Macroeconomic Variables

We obtain state-level macro statistics from the German statistical agency. These statistics include the 2005 consumer price index, state-level output, household income, total employment levels, full-time and part-time employment levels, and unemployment rates. As discussed earlier, we use the 2005 CPI to deflate all nominal, euro-valued variables to the real basis.

Table 5 presents the summary statistics for key state-level macroeconomic variables in 1997-2010. These statistics are shown separately for the entire sample (column 1), the 2001-2004 recession (column 2), and the 2007-2010 financial crisis (column 3). The unit of observation is a state-year, and all statistics are weighted by the square root of the state's population in a given year to provide a better indication of the economy-wide performance. Growth rates are calculated as the percent change in the federal state from year $t-1$ to year t.

Average real output growth at the state level over the 14 year sample is low, a pattern attributed to the 2001- 2004 recession, followed by a slow recovery and a global financial crisis. Output growth during the 2001-2004 recession was only 0.2 percent, with a small standard deviation of 1.0 percent across observations, which indicates a relatively uniform stagnation across all federal states. Comparing these numbers to the financial crisis (2007-2010), average annual output growth

during the crisis was slightly higher at 0.4 percent. However, the standard deviation of output growth during the crisis period was 3.5 percent, noticeably larger than the standard deviation of output during the 2001-2004 recession. This distinction indicates large cross-sectional variation in growth rates across the federal states during the crisis, in stark contrast to the largely homogenous distribution of state-level growth rates during the previous recession.

Total employment growth over the sample period was 0.7 percent with a standard deviation of 1.6 percent. During the 2001-2004 recession, average total employment growth was -0.7 percent with a standard deviation of 1.2 percent. In 2007-2010, average total employment grew at an average rate of 1.1 percent, with a standard deviation of 1.1 percent. Breaking employment growth into full-time employment growth and part-time employment growth helps to explain some of the dynamics of the total employment growth. Over the entire sample, full-time employment at the state level contracted, on average, whereas part-time employment grew at a strong rate. During the 2001-2004 recession, full-time employment fell, indicating a relatively uniform contraction in growth rates across federal states, whereas part-time employment grew. In 2007-2010, the average growth rate in full-time employment remained positive but showed strong variation across federal states. Most federal states experienced strong part-time employment growth during the crisis period.

The stark differences between full-time and part-time employment growth is attributed to a series of new labor market policies in Germany introduced during our sample period. In 1999, Germany initiated the first of the Hartz Reforms, a series of reforms conducted in four waves through 2005. A second German labor market policy that helps explain the strong growth in part-time employment during the bank loan-crisis period is the institution of short-time work. While short-time work as a labor market policy had been available in Germany since the 1970s, it was only sparingly used until the crisis, when Germany experienced a spike in the number of workers on short-time, peaking at nearly 1.5 million workers at the height of the crisis. The increase in short-time work has been viewed as a success in avoiding mass layoffs, reducing the increase in unemployment during the crisis (Brenke et al., 2013) and saving nearly 500,000 jobs(Balleer et al., 2014).

The unemployment rate over the entire sample is 9.4 percent, with a standard deviation of 4.5 percent. The large standard deviation across states stems from the high unemployment rates in the East German federal states compared to the West German federal states. The average unemployment rate rose to 10.6 percent during the 2001-2004 recession but remained subdued at 7.7 percent during the financial crisis. The relatively mild unemployment during the crisis is attributed to active German labor market policies aimed at combating mass layoffs during the crisis.

4 Regression Results

This section provides the empirical results quantifying the effect of the bank capital shock on regional bank loan credit, the impact of the bank loan credit contraction on regional macroeconomic outcomes, and the differential effect of the bank loan credit shock on establishments in privately-held firms compared to establishments belonging to publicly-listed firms.

4.1 Bank Loan Credit During the Crisis

Section 2.2 documents that five Landesbanks, owned by the savings banks in seven federal states, were exposed to and experienced significant losses directly attributed to the U.S. subprime crisis starting in 2007. This leads to a key question of the analysis: did bank loan credit from savings banks significantly fall in the seven federal states with Landesbanks that experienced losses due to direct exposure to U.S. subprime asset-backed securities?

While the differences in average growth rates between the affected and unaffected states presented in table 2 are quite stark, isolating the effect and statistical significance of the crisis on the bank activity in the affected states requires a more formal analysis. The nature of the banking shock allows for the exploitation of both time-series and cross-sectional variation to isolate its impact on bank asset and loan growth, exploiting time variation through the pre-crisis and crisis periods and exploiting cross-sectional variation through the affected and unaffected states through each state's Landesbank exposure to the U.S. subprime crisis. Thus, to quantify the impact of the shock on asset and loan growth in the affected states during the crisis, the analysis relies on a the following difference-in-difference (diff-in-diff) specification:

$$
\begin{aligned}
BankActivity_{it} \;=\; & \beta_0 + \beta_1 Crisis_t + \beta_2 AffectedState_i \\
& + \beta_3 (Crisis_t \times AffectedState_i) + W'\Upsilon + \epsilon_{it}
\end{aligned} \tag{1}
$$

where $BankActivity_{it}$ is either total asset growth or total loan growth in federal state i from period $t-1$ to t, $Crisis_t$ takes a value of 1 during the crisis period from 2007 through 2010 and 0 otherwise, $AffectedState_i$ takes the value of 1 if the federal state is one of the seven states to have its Landesbank exposed to the U.S. subprime crisis and zero otherwise, $(Crisis_t \times AffectedState_i)$ takes a value of 1 for an affected state during the crisis period and zero otherwise, and W is a vector of control variables including a dummy variable for whether a federal state is in East Germany and a dummy variable that takes a value of 1 for the 2001-2004 recession and 0 otherwise.

Validity of the diff-in-diff approach relies on satisfying the parallel trend assumption. The parallel trend assumption applied to the bank activity framework in equation (1) requires that total

15

assets and total loans for both the unaffected and affected states follow the same trend in absence of the affected states' Landesbanks exposure to the U.S. subprime crisis. Figure 3 shows the time series of total real loans (in 2005 euros) aggregated for all 9 of the unaffected states and the time series of total real loans aggregated for all 7 of the affected states, both indexed to 100 in 2004. The figure appears to tell a very clear story: the trends for total loans in both the unaffected and affected states are nearly identical until 2007, when there is a clear break. Beginning in 2007 (the start of the crisis period), the total loans time series for the affected states begins a clear downward trajectory while the total loans for the unaffected states continues to grow. Therefore, the behavior of the total loans time series for the unaffected and affected states strongly suggests that the parallel trend assumption applies.

Table 6 shows the results for the estimated equation (1), with column 1 showing the results where the federal state total bank asset growth rate is the dependent variable, and column 2 showing the results where the federal state total loan growth rate is the dependent variable. The key estimated coefficient of interest for both the asset and loan growth regressions is $\hat{\beta}_3$–the coefficient on the $(Crisis_t \times AffectedState_i)$ interaction variable–which isolates the impact that exposure to the U.S. subprime crisis had on the bank asset and loan growth rates in the affected states under the diff-in-diff. The estimated coefficient on the interaction term in the asset growth rate regression takes a value of -.245 with a standard error of .077, and the estimated coefficient on the interaction term in the loan growth rate regression takes a value of -.202 with a standard error of .076. Both coefficients are statistically significant at the 99 percent confidence-level.

The interpretation of the estimated coefficients on the interaction term for both regressions is as follows: Total bank asset growth was 24.5 percentage points lower in the 7 federal states with Landesbanks exposed to the U.S. subprime crisis during the crisis period, and total loan growth was 20.2 percentage points lower in affected states compared to the unaffected states during the crisis.[11] Both estimates, however, indicate a severe and marked contraction in bank activity in the affected states during the crisis.

While the regression results in table 6 provide clear evidence of a severe contraction in bank activity in the affected states during the crisis, the question still remains as to whether the contraction is due to a reduction in the supply of available bank credit in the affected states or the reduction in the demand for bank credit. The narrative in section 2.2 suggests the exposure to

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[11]The difference between the estimated coefficients on the interaction term in the asset growth and loan growth regressions compared to the simple summary statistics from Table 2 comparing asset and loan growth in the affected and non affected states can be explained by the estimated coefficient, $\hat{\beta}_2$, on the affected state dummy. These estimated coefficients indicate that affected states have, on average, a 9.3 percentage point higher growth rate in assets and a 8.0 percentage point higher growth rate in loans over the sample period. Adding $\hat{\beta}_2$ and $\hat{\beta}_3$ in both the asset growth and loan growth regressions yields a difference of 15.2 and 12.2 percentage points, for each respective regression, when comparing the affected states versus the not affected states. These numbers are nearly identical to the differences calculated from the means in table 2.

the U.S. subprime crisis led to a marked reduction in the affected states' bank balance sheets, and thus a marked reduction in the supply of credit. A formal analysis to disentangle the supply and demand effects, however, requires analyzing whether the number of loan applications fell in the affected states during the crisis or whether the loan acceptance rate decreased in the affected states during the crisis. Unfortunately, data on the number of loan applications and the acceptance rate of loan applications is not publicly available nor is it available in the restricted access datasets made available for this study. Puri et al. (2011) use individual bank loan application data from the Bundesbank spanning the time period from the third quarter of 2006 through the second quarter of 2008 to study exactly whether the number of loan applications to the public savings banks decreased in the affected states during the crisis or whether the loan rejection rate increased. They find clear evidence that loan acceptance rates at the public savings bank fell by nearly 12.5 percentage points (from a loan acceptance rate of 97.34 percent in the third quarter of 2006 to 84.93 percent in the second quarter of 2008) in the affected states compared to no decrease in the unaffected states and that any contraction in the available credit can be attributed to a reduction in the supply of bank loans.

4.2 The Macroeconomic Impact of the Bank Loan Credit Shock

Section 4.1 provides stark evidence that bank loan credit fell drastically in the federal states with Landesbanks exposed to the U.S. subprime crisis, with loan growth rates contacting by 20 percentage points compared to loans in federal states without exposed Landesbanks. However, the question remains as to whether the bank credit crunch in the affected federal states had any impact on these states' real economy.

The following difference-in-differences empirical specification again exploits the time-series and cross-sectional variation in the bank shock to quantitatively examine the impact that a reduction in bank loan credit due to Landesbank exposure to the U.S. subprime crisis has on the macroeconomic variables at the federal state-level:

$$
\begin{aligned}
MacroVariable_{it} = & \ \delta_0 + \delta_1 Crisis_t + \delta_2 AffectedState_i \\
& + \delta_3 (Crisis_t \times AffectedState_i) + X' \Psi + \eta_{it}
\end{aligned}
\tag{2}
$$

where $MacroVariable_{it}$ is a vector including output growth, total employment growth, full-time employment growth, part-time employment growth, and the unemployment rate in federal state i and period t; $Crisis_t$ takes a value of 1 during the bank loan crisis period of 2007 to 2010; $AffectedState_i$ takes a value of 1 if one of the 5 Landesbanks exposed to the U.S. subprime crisis serves as the central bank to the savings banks of that federal state; $(Crisis_t \times AffectedState_i)$ takes a value of 1 for an affected state during the crisis and 0 otherwise; and X is a vector of control

variables including a dummy variable for whether a federal state is in East Germany; a dummy variable that takes a value of 1 for the 2001 through 2004 recession and 0 otherwise; a dummy variable that takes a value of 1 for the years 2005 and after to account for the implementation of the most significant stage of the Hartz reform; and the growth rate of the number of short-time workers in the economy to control for active German labor market policies.

The key coefficient of interest in the estimation of equation (2) is δ_3, the coefficient on the $(Crisis_t \times AffectedState_i)$ interaction term. The estimated coefficient, $\hat{\delta}_3$, quantifies the differential effect of the bank balance sheet shock on the macroeconomic variables in the affected states with exposed Landesbanks during the crisis relative to the unaffected states in which its Landesbanks were not exposed during the crisis. Therefore, the point estimate of $\hat{\delta}_3$ should isolate the impact of the negative shock to bank credit on the macroeconomic variable of choice and will be the focus of the analysis below.

Table 7, column 1 shows the results of the estimated equation (2) with real output growth serving as the dependent variable. The key estimated coefficient of interest, $\hat{\delta}_3$, on the $(Crisis_t \times AffectedState_i)$ is -.006, implying that affected states with Landesbanks exposed to the U.S. subprime crisis had a 0.6 percentage point lower output growth rate than unaffected states, on average, during the four year crisis period. The point estimate on the interaction coefficient is statistically significant. Further, the point estimate on the $Crisis_t$ variable is -0.011 and statistically significant at the 95 percent confidence level implying that all states experienced an average decline in output growth of 1.1 percentage points, on average, over the four crisis years. This fall in output growth corresponds to approximately 2.5 times the sample average output growth rate.

Columns 2 through 4 of table 7 show the results of the estimated equation (2) with total employment growth rate, full-time employment growth rate, and part-time employment growth rate as the respective dependent variables. The point estimate of $\hat{\delta}_3$ isolating the impact of the bank balance sheet shock in the affected states during the crisis is negative in all three equations, implying that an exogenous contraction in loan growth due to exposure to the U.S. subprime crisis results in a contraction in employment growth. The estimated coefficient is statistically significant at the 95 percent confidence level for both the total employment growth and the full-time employment growth regressions, whereas the estimated coefficient is statistically insignificant for the part-time employment growth regression. Economically, though, the point estimates imply that the bank loan credit shock in an affected state during the crisis resulted in a 0.9 percentage point reduction in total employment growth, a 0.8 percentage point reduction in full-time employment growth, and a 0.9 percentage point reduction in part-time employment growth relative to unaffected states during the crisis. These employment growth reductions are equivalent to 128.5, 225.0, and 28.1 percent reductions in total employment growth, full-time employment growth, and part-time employment growth relative to each respective sample average.

Table 7, column 5 shows the estimated results of the unemployment rate regression. The point estimate on the $(Crisis_t \times AffectedState_i)$ variable isolating the isolating the differential effect of the bank credit shock on the unemployment rate in affected states relative to unaffected states is large in magnitude at 0.14 and statistically significant at the 90 percent confidence level. A positive point estimate on the interaction term suggests that the bank loan contraction during the crisis increased the unemployment rate in the affected states compared to the unaffected states by 1.4 percentage points, on average, during the four crisis years. A 1.4 percentage point increase in the unemployment rate corresponds to a 14.9 percent increase in the unemployment rate relative to the 9.4 percent sample average.

Overall, the macroeconomic regressions present clear evidence that the bank credit contraction resulting from the exposure of the 5 Landesbanks covering 7 federal states had an effect on the respective federal states' real economy. Employment growth (total employment, full-time, and part-time) all fell noticeably in the affected states relative to the unaffected states during the crisis, whereas the unemployment rate in the affected states rose significantly. Further, output growth contracted significantly in all states during the crisis period.

4.3 The Impact of the Bank Credit Shock: Privately-Held versus Publicly-Listed Companies

Section 4.1 showed that federal states with a Landesbank exposed to the U.S. subprime crisis saw a significant 20.2 percentage contraction in loan growth compared to federal states without an exposed Landesbank, and section 4.2 mapped the bank credit contraction into adverse real economic outcomes in output and employment for the affected federal states. This section explores a mechanism through which exogenous shocks to bank credit work their way through the economy: Shocks to bank credit differentially affect privately-held partnerships and limited liability firms compared to publicly-listed firms. A publicly-listed company has access to a wide array of methods to finance its business activity, including access to both domestic and international equity markets, cash from an international base of customers, and private bank credit from local banks, and more typically, commercial banks with an international reach. Privately-held companies, however, rely much more heavily on access to local bank credit and do not have access to the same equity markets and international commercial banks as publicly-listed companies. Therefore, when a bank shock that leads to a contraction in the supply of local credit hits the economy, publicly-listed companies can turn to equity markets and international lenders to finance their business activities, whereas privately-held companies will be forced to reduce their business activities, thereby negatively impacting real economic outcomes. This section investigates the privately-held versus publicly-traded companies mechanism using matched employer-employee data linked with

the annual establishment-level survey data from German Federal Employment Agency.

The survey results from section 3 lend credence to the central hypothesis of the paper that establishments belonging to privately-held firms are more dependent on bank loans to finance business activities than establishments belonging to publicly-listed firms and that an exogenous shock to bank capital, reducing the supply of loans, will differentially and adversely affect the net hiring and investment at establishments in privately-held firms relative to those in publicly-listed firms. This sections turns to the comprehensive, administrative, employer-employee matched dataset to directly test the hypothesis.

The following diff-in-diff empirical specification exploits both the cross-sectional and time-series variation of the bank capital shock identified in section 2.2 to estimate the differential effect bank exposure to the U.S. subprime has on establishment-level net hiring rates and levels of investment per employee for establishments in privately-held firms in affected states during the crisis:

$$
\begin{aligned}
EstabDecision_{it} &= \alpha_0 + \alpha_1 Crisis_t + \alpha_2 AffectedState_i + \alpha_3 Private_{it} \\
&+ \alpha_4(Crisis_t \times AffectedState_i) \\
&+ \alpha_5(AffectedState_i \times Private_{it}) \\
&+ \alpha_6(Crisis_t \times Private_{it}) \\
&+ \alpha_7(Crisis_t \times AffectedState_i \times Private_{it}) \\
&+ Y'\Omega + \xi_{it}
\end{aligned}
\tag{3}
$$

where $EstabDecision_{it}$ is a vector including the net hiring rate and investment per employee, in 2005 euros, in establishment i and period t, $Crisis_t$ takes a value of 1 during the bank loan crisis period of 2007 from 2010 and 0 otherwise, $AffectedState_i$ takes a value of 1 if 1 of the 5 Landesbanks exposed to the U.S. subprime crisis serves as the central bank to the savings banks of that federal state and 0 otherwise, $Private_{it}$ takes a value of 1 if the establishment belongs to a privately-held firm and 0 if the establishment belongs to a publicly-listed firm, $(Crisis_t \times AffectedState_i)$ takes a value of the 1 for the affected states during the crisis in 0 otherwise, $(AffectedState_i \times Private_{it})$ takes a value of 1 for privately-held establishments in affected states and 0 otherwise, $(Crisis_t \times Private_{it})$ takes a value of 1 for a privately-held establishment during the crisis and 0 otherwise, $(Crisis_t \times AffectedState_i \times Private_{it})$ takes a value of 1 during the crisis for establishments belonging to privately-held firms in the affected states and 0 otherwise, and Y is a vector of control variables including a dummy variable for 1999, the year of the first wave of Hartz Reforms, a dummy variable that takes a value of 1 starting in 2005 to account for the period after all Hartz reforms were implemented, a dummy variable for establishments that have a work council, a dummy for establishments that have collectively bargained wage agreements, a

dummy variable for the 2001 through 2004 recession, controls for the establishment's occupational mix, the fraction of female employees, and the average age of the establishment's workforce.

The key coefficient of interest in the estimation of equation (3) is α_7, the coefficient on the $(Crisis_t \times AffectedState_i \times Private_{it})$ interaction term. The estimated coefficient, $\hat{\alpha}_7$, quantifies the differential affect on net hiring rate and investment per employee on privately-held establishments compared to the publicly-listed in the affected states with exposed Landesbanks during the crisis.

Table 8 show the results from the net hire rate and investment per employee regressions, where columns 1 and 2 show the net hire rate regression results, and columns 3 and 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. Columns 1 and 3 do not include dummies for these establishment-level employment measures, whereas columns 2 and 4 include the employment measure dummies. However, the results are quantitatively similar regardless of whether the employment measures are included for both the net hire rate and investment per employee regressions. Therefore, the remaining analysis focuses on the results presented in columns 2 and 4 of table 8.

For the net hire rate regression, the key estimated coefficient, $\hat{\alpha}_7$, on the triple interaction term, $(Crisis_t \times AffectedState_i \times Private_{it})$, is -0.239 and statistically significant at the 99 percent confidence level, suggesting that establishments belonging to privately-held firms in affected state had a 23.9 percentage point lower hire rate during the crisis relative to establishments belonging to publicly-listed firms in affected states during the crisis. For comparison, the regression shows that net hire rates fell by roughly 3 percentage points during the 2001 through 2004 recession, a difference of nearly 8 times.

For the investment per employee regression, the estimated coefficient, $\hat{\alpha}_7$, on the triple interaction term, $(Crisis_t \times AffectedState_i \times Private_{it})$, is -6,021 and statistically significant at the 99 percent confidence level, suggesting 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. Table 3, panel b, shows that the average level of investment per employee at establishments in privately-held firms is €10,829 over the sample, meaning that a €6,021 reduction in investment per employee corresponds to a 56 percent reduction relative to its sample average.

Overall, the establishment-level empirical results show a clear, differential, and adverse effect on net hiring at establishments belonging to privately-held firms compared to establishments belonging to publicly-listed firms in affected 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.

5 Worker-Level Effects of Bank Speculation

This section investigates the impact of the financial shocks on individual workers in establishments located in geographies affected by the shock to local bank capital. Identifying these individual-level effects presents a novel and unique contribution of this paper. Specifically, we use the rich, individual-level, administrative data with employer and employee identifiers to quantify the impact of the crisis on affected workers' wages, displacement, unemployment duration, and movements along the job ladder. The data allow us to identify which workers were employed at an affected establishment during the crisis period and then follow each of those workers' entire employment history, whether or not they continue to work in the same establishment before and after the shock. In particular, we follow each worker's employment/unemployment status, wage, and occupation.

5.1 Individual-level Wage Effects

We use the following difference-in-differences specification to identify the impact of the shock such workers' employment earnings that were employed at an affected establishment at the onset on the shock:

$$
\begin{aligned}
Earnings_{it} = {} & \gamma_0 + \gamma_1 Crisis_t + \gamma_2 AffectedState_i + \gamma_3 Private_i \\
& + \gamma_4 (Crisis_t \times AffectedState_i) \\
& + \gamma_5 (AffectedState_i \times Private_i) \\
& + \gamma_6 (Crisis_t \times Private_i) \\
& + \gamma_7 (Crisis_t \times AffectedState_i \times Private_i) \\
& + Y'\Omega + \nu_{it}
\end{aligned}
\tag{4}
$$

where $Earnings_{it}$ is worker i's total annual real earnings in 2005-chained €s from employment in calendar year t, $Crisis_t$ takes a value of 1 during the bank loan crisis period of 2007 from 2010 and 0 otherwise, $AffectedState_i$ takes a value of 1 if 1 of the 5 Landesbanks exposed to the U.S. subprime crisis serves as the central bank to the savings banks of that federal state in which the worker was employed during the onset of the crisis in 2007 and 0 otherwise, $Private_i$ takes a value of 1 if the establishment in which the worker was employed during the onset of the crisis in

2007 belongs to a privately-held firm and 0 if the establishment belongs to a publicly-listed firm, $(Crisis_t \times AffectedState_i)$ takes a value of the 1 for the affected states during the crisis in 0 otherwise, $(AffectedState_i \times Private_i)$ takes a value of 1 for privately-held establishments in affected states and 0 otherwise, $(Crisis_t \times Private_i)$ takes a value of 1 for a privately-held establishment during the crisis and 0 otherwise, $(Crisis_t \times AffectedState_i \times Private_i)$ takes a value of 1 during the crisis for establishments belonging to privately-held firms in the affected states and 0 otherwise, and Y is a vector of control variables including the worker's age and age square and dummy variables for the worker's education level, gender, and whether the job generating the worker's earnings is full-time or part-time.

The key coefficient of interest for the analysis is $\hat{\gamma}_7$, which is the coefficient on the interaction of the crisis, affected state, and private dummy variables, and it provides the estimate of how different the annual employment earnings of a worker who was employed in an affected establishment at the onset of shock are, on average, relative to a worker employed at an unaffected establishment at the onset of the shock for each year of the crisis period.

Table 9, column 1, shows the results. The average worker, whether employed in an affected or unaffected establishment, experiences an earnings loss of roughly €3,000 , on average. Additionally, workers in establishments belonging to privately-held firms earn significantly less, on average, than their publicly-traded counterparts throughout the sample period by roughly €6,000 per year. Workers employed in affected establishments at the onset of the shock experienced earnings losses roughly €918, on average, per year greater than those workers who were employed at unaffected establishments.

5.2 Worker Unemployment Duration Effects

This section focuses on the impact to affected workers' unemployment duration. The analysis uses the same difference-in-differences specification as equation (4) with the dependent variable now being the total number of days worker i spent unemployed during year t. Since the total number of days unemployed within a calendar year can only take values from 0 through 365, we employ a tobit regression. Table 9, column 2, shows the results of the unemployment duration regression.

The estimated coefficient on the crisis dummy shows that, on average, a worker who was employed at any establishment, affected or unaffected, at the onset of the crisis experienced five less days of unemployment after the onset of the crisis than before. This result initially seems counterintuitive but can be explained through Germany's active labor market policies during the financial crisis, most notably short-time work. During the crisis, the German government provided employment subsidies to establishments that, on condition of accepting the subsidies, the establishments would reduce the hours of the worker for which the subsidy was granted without

reducing the worker's take home pay or laying the worker off. Both establishments in privately-held and publicly-traded firms made use of the short-time labor market policy, thus explaining why unemployment duration fell during the crisis period.

The key coefficient of interest for the analysis, though, is once again the estimated coefficient on the interaction between the crisis, affected state, and privately-held dummy variables, providing an estimate of the differential impact on the unemployment duration of the average worker in an affected establishment relative to the average worker in an unaffected establishment. Workers in affected establishments experienced more than 15 days per year, on average, longer in unemployment relative to workers in unaffected establishments. Over the course of the post-impact period, this translates to roughly nine weeks longer in unemployment for affected workers relative to unaffected workers.

5.3   Worker Occupational Switching and Job Ladder Effects

This section examines the impact of the crisis on worker's occupational choices and the impact on a worker's position on the job ladder. The data provide detailed, three-digit occupation codes for each worker. To classify a worker's position on the job ladder, we translate the three-digit occupational codes into the International Labour Organization's International Standard Classification of Occupations (ISCO), which classifies occupations according to 88 two-digit codes and ranks occupations according to skill. Since the occupations codes provide a ranking, they are a natural starting point to examining a worker's climb along the job ladder.

To examine the impact of the shock on a worker's occupational choice, we employ the diff-in-diff specification as in equation (4). The two dependent variables of interest are whether a worker i changed occupations within year t and whether the worker moved to a more highly ranked occupation– that is, whether the worker "climbed the job ladder." Both the dependent variables of any change and moving up the job ladder are binary and take values of 1 if the change occurred and 0 otherwise. Therefore, we use a probit regression to estimate the impact.

Table 10 shows the results of the probit regression for both the any change in occupational status regression and, conditional on a change, moving up the job ladder regression. For each regression, we use the full sample of workers and then break the sample into full-time workers and part-time workers to see if there is any differential impact along the hours dimension. In the regression examining whether there was any change in a worker's occupation, the average worker in an affected establishment after the onset of the shock was 30 percent less likely to change occupations relative to the average worker in an unaffected establishment. Breaking the sample into full-time and part-time workers, full-time worker in an affected establishment after the onset of the shock had nearly a 50 percent lower probability of changing occupations relative to an

unaffected full-time worker, whereas an affected part-time worker was only 20 percent less likely to change occupations. Thus, the full-time workers were significantly driving the results in the full sample.

The regression results on whether a worker changed occupations and moved up in the occupational rankings show that a worker at an affected establishment had roughly a 30 percent lower probability of moving up in the occupational rankings after the onset of the shock relative to a worker at an unaffected establishment. As was the case for the regression of any change, breaking the sample into full-time and part-time workers shows that the result is primarily driven by the full-time workers. Taken together, this suggests that the shock impacted workers occupational choices by stalling their position on the job ladder– workers were 30 percent less likely to make an occupational change and move up– and that this effect was primarily driven by full-time workers– full-time workers were 50 percent less likely to make an occupational change and move up.

6   Related Literature

This paper complements 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., 2013). The recent financial crisis has led to renewed interest in the same 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.

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 Jiménez 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 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' 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.

7 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 and investment. A narrative approach identifies 5 German regional Landesbanks covering 7 federal states with significant trading losses from U.S. mortgage-backed securities. The local savings banks in the affected states directly absorbed their respective Landesbanks' trading losses onto their balance sheets, causing a deep economic contraction in the banks' exclusive geographic domain. 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.

Future extensions of this work will focus on identifying the individual-level costs placed on workers due to the shock to local bank capital. The rich, individual-level, administrative data allows for quantifying the impact of the crisis on affected workers' wages, displacement, and unemployment duration. Further, detailed job, industry, education, and geographical identifiers will allow for the study of whether affected workers moved to unaffected states to find new work, received further education or took part in job re-training programs in order to facilitate an occupational switch, or if the publicly-listed firms benefited from the adverse effect of the bank loan crisis on the privately-held firms through obtaining the privately-held's human capital.

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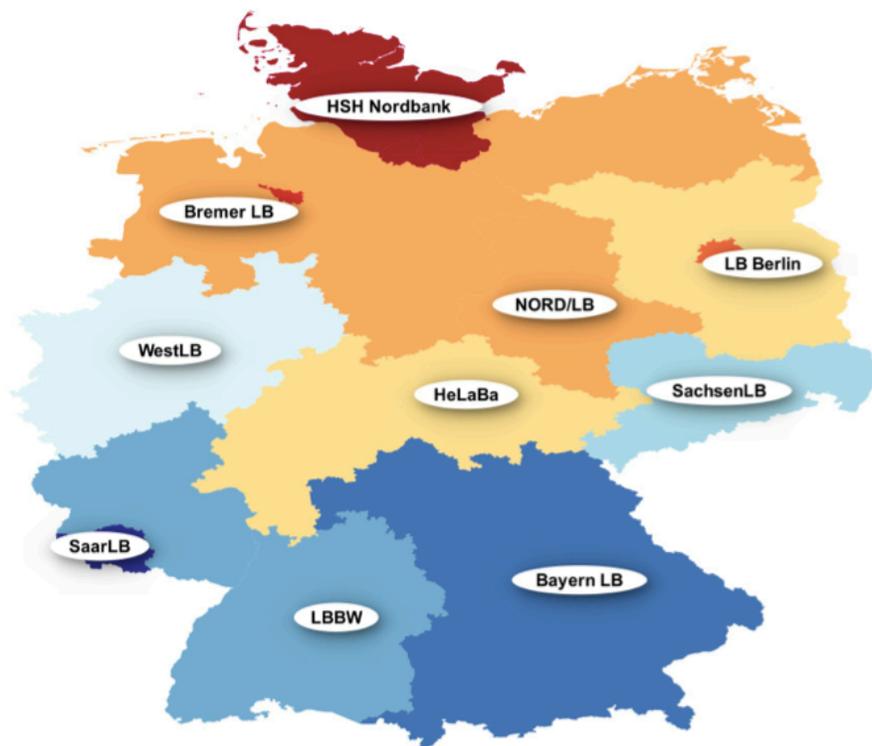
Figure 2: Affected States versus Unaffected States due to Landesbank Exposure

Figure 3: Total Real-Valued Bank Loans, Affected versus Unaffected State
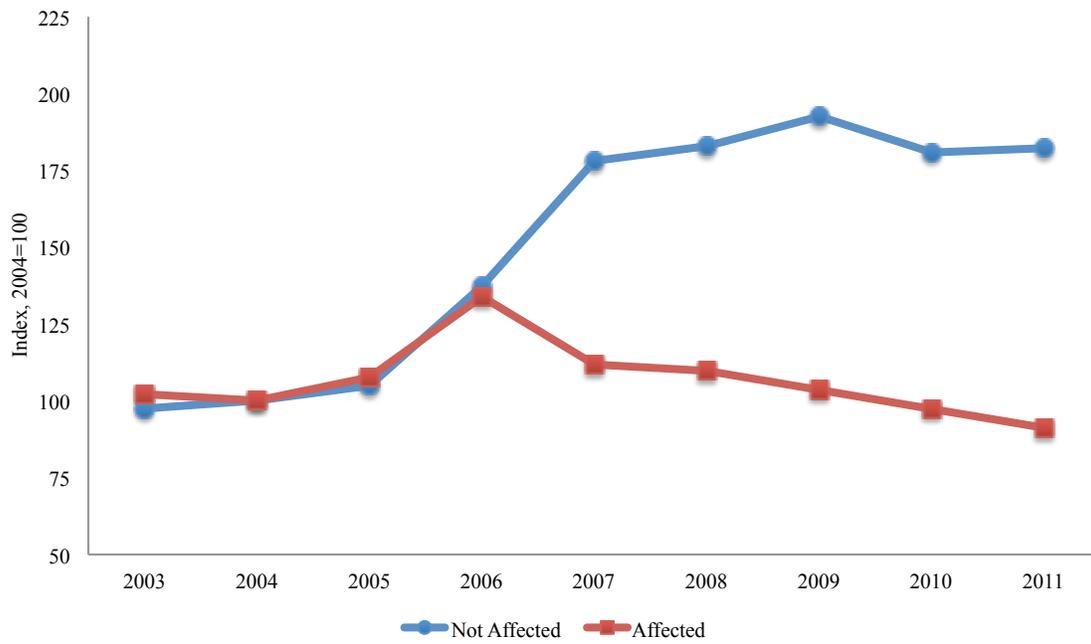
Table 1: German Banking System and Exposure to the U.S. Subprime Crisis

Panel A: German Bank Specialization, 1997-2010

| | Fraction of | |
Specialization	Total Assets (%)	Total Banks (%)
Private Banks	53.8	16.8
Cooperative Banks	8.5	54.5
Public Savings Banks	37.7	28.7

All values expressed in percent terms. The fraction of total assets is calculated on an annual basis and averaged across the years in the indicated column. Total assets for each year is calculated by aggregating the assets of all German banks. The fraction of total banks is calculated on an annual basis and averaged across the years in the indicated column. Total banks for each year is calculated by counting all German banks operating in the economy. Source: Bankscope and authors' calculations.

Panel B: German Public Banks Exposed to the U.S. Subprime Crisis

Exposed Landesbank	Date of Announced First Losses	Date of Expected First Losses	Resulting Affected Federal States
SachsenLB	August 17, 2007	2007:3	Saxony
HSH Nordbank	August 23, 2007	2007:3	Schleswig-Holstein Hamburg
West LB	August 27, 2007	2007:3	North Rhine-Westphalia
BayernLB	February 13, 2008	2007:3	Bavaria
LBBW	November 27, 2008	2008:4	Baden-Württemberg Rheinland-Palatinate Saxony

Table 2: German Federal State-Level Bank Summary Statistics

	1997-2010	2007-2010	2007-2010	
			Unaffected States	Affected States
Average Total Assets (Millions, €)	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 (Millions, €)	156,084	190,994	178,216	207,422
	(182,677)	(220,619)	(256,415)	(166,860)
Average Loan Growth (%)	1.02	-0.91	4.62	-8.02
	(25.91)	(23.58)	(25.75)	(18.55)

Standard deviations in parentheses. Unit of observation is the federal state-year. Total assets and total loans are real variables expressed in 2005 euros.

Table 3: Establishment Sample Summary Statistics

Panel A: Full Sample Summary Statistics

Key Variables	Mean	Median	Standard Deviation
Employment Level	283	55	1,257
Net Hiring Rate	-0.009	-0.002	0.270
Worker Inflow Rate	0.202	0.109	0.869
Worker Outflow Rate	0.211	0.114	0.833
Investment per Employee	12,822	6,651	55,053

Establishment Counts	Total		
Total Establishments	15,392		
Partnership Establishments	51		
Limited Liability Establishments	13,870		
Publicly Traded Establishments	1,471		

Panel B: Sample Statistics by Legal Form

Employment Level	Mean	Median	Standard Deviation
Privately Held Establishments	184	48	465
Publicly Traded Establishments	1,137	278	3,541
Net Hire Rate			
Privately Held Establishments	-0.008	0.000	0.238
Publicly Traded Establishments	-0.010	-0.004	0.309
Investment per Employee			
Privately Held Establishments	10,829	5,068	33,314
Publicly Traded Establishments	15,741	9,185	76,359

Unit of observation is the establishment-year. Net hire rates are a fraction of the establishment's employment level on January 1 of the given year. Investment per employee is a real variable expressed in 2005 euros.

Table 4: Establishment Survey Questions and Responses

In retrospect, did the economic and financial crisis of the past two years affect your establishment? This questions refers to both negative and positive effects.		*How strongly would you say your establishment was affected by the economic and financial crisis?*	
	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%
Unaffected State		Moderate	32.76
Yes	54.87%	Slight	22.41
No	35.94		
Don't Know	9.19	*Unaffected State and Private*	
No Response	0.00	Strong/Very Strong	42.34%
		Moderate	37.29
		Slight	20.37
		Unaffected State and Public	
		Strong/ Very Strong	43.06%
		Moderate	34.72
		Slight	22.22

Unit of observation for each question response is the establishment in 2010.

Table 4 (Cont.): Establishment Survey Questions and Responses

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

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

	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
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
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

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

	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
Private			
Yes	3.56%	15.41%	16.46%
No	86.95	84.02	83.54
No Response	9.49	0.57	0.00
Public			
Yes	10.79%	8.43%	8.89%
No	89.21	91.57	91.11
No Response	0.00	0.00	0.00

What fraction of your overall financing was provided by the following methods?: Unit of observation for each year is the establishment. 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... *Did you have difficulties acquiring a loan capital from private credit institutions?* The unit of observation for each year is the establishment. 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.

Table 5: German Federal State-Level Macroeconomic Summary Statistics

	1997-2010	2001-2004	2007-2010
Output Growth	0.7	0.2	0.4
	(2.1)	(1.0)	(3.5)
Household Income Growth	0.5	0.6	1.6
	(1.1)	(1.0)	(1.6)
Employment Growth, All Workers	0.7	-0.7	1.1
	(1.6)	(1.2)	(1.1)
Employment Growth, Full-Time	-0.4	-1.8	0.5
	(1.8)	(1.3)	(1.3)
Employment Growth, Part-Time	3.2	2.3	4.5
	(3.0)	(2.3)	(1.4)
Unemployment Rate	9.4	10.6	7.7
	(4.5)	(5.1)	(3.1)

All values expressed in percentage terms. Standard deviations in parentheses. Unit of observation is the federal state-year. Output and household income are real variables expressed in 2005 euros.

Table 6: German Federal State Banks Asset and Loan Growth Regressions

Dependent Variable	Asset Growth Rate	Loan Growth Rate
	(1)	(2)
Crisis	0.052	0.074
	(0.060)	(0.059)
Affected State	0.093	0.080
	(0.043)	(0.042)
Crisis x Affected State	-0.245	-0.202
	(0.077)	(0.076)
2001-2004 Recession	0.035	0.035
	(0.046)	(0.046)
East	0.001	0.010
	(0.038)	(0.038)
R-squared	0.052	0.036
N	240	240

Standard errors in parentheses. Unit of observation is a federal state-year. Bank asset growth and bank loan growth are year-over-year growth rates of the euro-value of total real bank assets and total real bank loans, respectively, aggregated at the federal-state level, both expressed in terms of 2005 euros. Crisis takes a value of 1 during the years of the financial crisis, 2007-2010. The variable Affected State takes a value of 1 for the federal states exposed to the U.S. subprime crisis: Northrine Westfalia, Baden-Württemberg, Bavaria, and Saxony. The variable (Crisis x Affected State) is the interaction between the Crisis and Affected State variables and thus takes a value of 1 for the exposed states during the years of the financial crisis. The variable East takes a value of 1 if the federal state is located in East Germany.

Table 7: German Federal State Macroeconomic Regressions

Dependent Variable	Output Growth Rate	Employment Growth Rate, All Workers	Employment Growth Rate, Full-Time Workers	Employment Growth Rate, Part-Time Workers	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 x 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	0.007	0.026	0.036	-0.044	-0.032
	(0.008)	(0.005)	(0.005)	(0.009)	(0.010)
R-squared	0.079	0.549	0.572	0.476	0.718
N	240	240	240	240	240

Standard errors in parentheses. Unit of observation is a federal state-year. Output and household income are real variables defined in terms of 2005 euros. Crisis takes a value of 1 during the years of the financial crisis, 2007-2010. The variable Affected State takes a value of 1 for the federal states exposed to the U.S. subprime crisis: Northrine Westfalia, Baden-Württemberg, Bavaria, and Saxony. The variable (Crisis x Affected State) is the interaction between the Crisis and Affected State variables and thus takes a value of 1 for the exposed states during the years of the financial crisis and zero otherwise. The variable East takes a value of 1 if the federal state is located in East Germany. All regressions include a set of labor market reform dummy variables. The labor market reform dummies consist of three variables: one variable takes a value of 1 in the year 1999 when the first wave of the Hartz reform lead to a large influx of part-time workers; a second variable takes a value of 1 after 1999 to account for a trend break due to the first Hartz reform; a third variable takes a value of 1 after 2004 to account for the final wave of the Hartz reform that changed the unemployment insurance system.

Table 8: Establishment-Level Regressions

Dependent Variable	Net Hire Rate		Investment per Employee	
	(1)	(2)	(3)	(4)
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 x Affected State	0.117	0.117	6,719	5,953
	(0.009)	(0.063)	(2,228)	(2,313)
Affected State X Private	0.152	0.152	-3,509	-3,553
	(0.040)	(0.040)	(1,392)	(1,393)
Crisis x Private	0.215	0.204	798	-350
	(0.064)	(0.066)	(2,323)	(2,401)
Crisis x Affected State x Private	-0.243	-0.239	-6,931	-6,021
	(0.078)	(0.079)	(2,793)	(2,860)
2001-2004 Recession	-0.030	-0.029	742	805
	(0.024)	(0.024)	(834)	(835)
Employment Measures	No	Yes	No	Yes
R-squared	0.021	0.021	0.021	0.021
N	56,612	56,612	40,678	40,678

Standard errors in parentheses. Unit of observation is the establishment year. The net hire rate is 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. Investment per employee is total investment in a calendar year divided by the establishment's employment level on the last day of the previous calendar year. Crisis takes a value of 1 during the years of the financial crisis, 2007-2010. The variable Affected State takes a value of 1 for the federal states exposed to the U.S. subprime crisis: North Rhine-Westphalia, Baden-Württemberg, Bavaria, Hamburg, Schleswig-Holstein, Rheinland Palatinate, and Saxony. The variable Private takes a value of 1 when the establishment is prviately held, either as a partnership or a limited liability company. The variable (Crisis x Affected State) is the interaction between the Crisis and Affected State variables and thus takes a value of 1 for the exposed states during the years of the financial crisis. The variable (Affected State x Private) is the interaction between the Affected State and Private variables and thus takes a value of 1 for the privately held establishments in exposed states. The variable (Crisis x Private) is the interaction between the Crisis and Private variables and thus takes a value of 1 for the privately held establishments during the years of the financial crisis. The variable (Crisis x Affected State x Private) is the interaction between the Crisis, Affected State, and Private variables and thus takes a value of 1 for the privately held establishments in exposed states during the years of the financial crisis. 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.

Table 9: The Effect of Bank Credit Supply Shocks on Employee Earnings and Unemployment Duration

Dependent Variable	Real Annual Employment Earnings (Euros)	Days Unemployed per Calendar Year (Tobit)
	(1)	(2)
Crisis	-3,076.60	-5.398
	(45.52)	(0.923)
Affected State	135.10	-4.034
	(33.16)	(1.115)
Private	-6033.63	67.418
	(45.52)	(1.672)
Crisis x Affected State	381.70	-12.882
	(57.44)	(1.138)
Affected State X Private	2519.66	-53.977
	(52.04)	(1.900)
Crisis x Private	1167.51	-54.685
	(56.04)	1.559
Crisis x Affected State x Private	-918.90	15.361
	(68.72)	(1.929)
Controls	Age, Age Squared, and Education, Sex, and Full-Time dummies	
N	16,113,908	16,113,908

Standard errors in parentheses and are clustered by person. Unit of observation is an individual worker in a given year. The unemployment duration regression is a tobit, where the dependent variable can take a value from 0 through 365. Crisis takes a value of 1 during the years of the financial crisis, 2007-2010. Affected State takes a value of 1 for the federal states exposed to the U.S. subprime crisis: North Rhine Westphalia, Baden Württemberg, Bavaria, Schleswig-Holstein, Hamburg, Rhineland Palatinate, and Saxony. The variable Private takes a value of 1 when the establishment is privately-held, either as a partnership or a limited liability company.

Table 10: Worker-Level Occupational Switching Probit Regressions

Dependent Variable	Any Switch			Up		
	All Workers	Full-Time	Part-Time	All Workers	Full-Time	Part-Time
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis	0.198	0.061	0.168	0.162	0.052	0.122
	(0.006)	(0.009)	(0.008)	(0.007)	(0.011)	(0.010)
Affected State	-0.206	-0.410	-0.122	-0.214	-0.429	-0.132
	(0.005)	(0.010)	(0.006)	(0.006)	(0.013)	(0.007)
Private	-0.206	-0.524	-0.054	-0.195	-0.478	-0.040
	(0.006)	(0.009)	(0.014)	(0.008)	(0.011)	(0.017)
Crisis x Affected State	0.194	0.362	0.150	0.174	0.356	0.132
	(0.007)	(0.012)	(0.009)	(0.009)	(0.016)	(0.012)
Affected State x Private	0.245	0.459	-0.086	-0.056	0.489	-0.063
	(0.008)	(0.012)	(0.017)	(0.010)	(0.016)	(0.021)
Crisis x Private	-0.062	0.112	0.100	0.259	0.084	0.094
	(0.008)	(0.011)	(0.018)	(0.010)	(0.014)	(0.021)
Crisis x Affected State x Private	-0.305	-0.486	-0.183	-0.291	-0.485	-0.176
	(0.010)	(0.015)	(0.021)	(0.013)	(0.019)	(0.026)
Controls	Age, Age Squared, and Education Dummies, and Sex dummies					
Semi-Elasticity: Crisis x Affected State x Private	-0.784	-1.221	-0.484	-0.816	-1.336	-0.507

Standard errors in parentheses and are clustered by person. Unit of observation is an individual worker in a given year. The unemployment duration regression is a tobit, where the dependent variable can take a value from 0 through 365. Crisis takes a value of 1 during the years of the financial crisis, 2007-2010. Affected State takes a value of 1 for the federal states exposed to the U.S. subprime crisis: North Rhine Westphalia, Baden Württemberg, Bavaria, Schleswig-Holstein, Hamburg, Rhineland Palatinate, and Saxony. The variable Private takes a value of 1 when the establishment is privately-held, either as a partnership or a limited liability company.