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The Long-Term Earnings' Effects of a Credit Market Disruption

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The Long-term Earnings' Effects of a Credit Market Disruption*

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Abstract

This paper studies the long-term consequences on firms and workers of the credit crunch triggered by the 2007-2008 global financial crisis. Relying on a unique matched bank-employer-employee administrative dataset, we construct a firm-specific credit supply shock and examine firms' and workers' outcomes for 11 years after the crisis. We find that highly-exposed firms shrink permanently and invest less; these effects are larger for high capital-intensive firms. The impact on workers' earnings is also long-lasting, especially for high skilled workers, who are more complementary to capital. Displaced workers reallocate mostly to low capital-intensive firms, experiencing persistent wage losses.

JEL Codes: E24, E44, G21, J21, J31, J63
Keywords: credit crunch, employment, wages, long term effects, linked bank-employer-employee panel data, capital-skill complementarity.

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1 Introduction

Since the global financial crisis (GFC) of 2007-2008, questions regarding the real effects of financial shocks have generated vast academic and policy debates. The economic literature has extensively investigated the short-term consequences of that credit shock on firms' size, labor costs and propensity to invest, as well as on workers' employment probabilities (see e.g., Chodorow-Reich, 2014; Greenstone et al., 2020; Siemer, 2019 for the US; Bentolila et al., 2018; Berton et al., 2018; Huber, 2018 for Europe; Gertler and Gilchrist, 2018 for a more general overview). However, less is known about the longer-term consequences of credit shocks and about their distributional impact on different types of firms and workers.

Negative credit shocks may lead firms to adjust employment and wages for several compelling reasons. First, these shocks negatively affect capital expenditure (see for instance Cingano et al., 2016; Bentolila et al., 2018). The impact on employment and wages will thus hinge on the degree of complementarity between labor and capital. Second, firms hit by lower availability of external finance face more stringent liquidity constraints, hindering their ability to finance working capital and meet wage obligations. Consequently, such firms may resort to layoffs as a means to reduce cash outflows, with the outcome contingent on which workers are more cost-effective or easier to terminate (see for instance Caggese et al., 2019). In addition, credit constraints may affect employment when labor is not a fully variable factor of production but has a quasi-fixed component, such as in the presence of hiring and firing frictions, indispensable training investments, or wage rigidities (Benmelech et al., 2021). In the longer term, the intensity of the shock can lead firms to change their production technologies and force some to abandon the market, potentially leading to enduring effects on labor demand.

This paper studies how the credit crunch that occurred during the 2007-2008 GFC affected firms' trajectories and individuals' working histories in Italy, and whether it translated into permanent changes in labor demand and in the distribution of labor earnings. Moreover, it sheds light on the mechanism through which a credit shock affects the labor market, and on what are the consequences for workers with different skills.

Our unique data allow us to analyze the effects on firms and to track the career trajectories of workers within and between firms for up to 11 years after the shock first impacted the economy. Italy serves as an ideal context for identifying the labor market impact of the 2007-2008 credit crunch. The crisis originated in the US housing market and was unrelated to developments in the Italian economy. In addition, while Italy shares labor market institutions similar to those of most major countries in Southern and Continental Europe, it did not

experience a housing bubble during that period (which may have indirectly affected the labor market). Moreover, Italian banks had only minimal exposure to US housing-related assets (Cingano et al., 2016).

To identify a plausibly exogenous measure of credit supply shock at the firm-level, we rely on a unique dataset obtained by matching four administrative data sources. These include banks' balance sheet data from Supervisory Reports, bank-firm level credit relationships from the Italian Credit Register, longitudinal matched employer-employee data from the Italian Social Security database (INPS) and fourth, firms' balance sheet data from the firm register (CERVED). Following the existing literature (for instance, Iyer et al., 2013 and Cingano et al., 2016) our identification strategy is based on the sudden liquidity drought that took place in the interbank market in 2007-2008, stemming from the US subprime mortgage crisis and the default of Lehman Brothers. Banks that relied more heavily on interbank borrowing before the crisis went on to restrict credit more than banks that relied on other liquidity sources. Our measure of firms' credit supply shock is then obtained as a credit-share weighted average of the pre-2007 interbank funding-to-assets ratio of all banks lending to the firm within the year prior to the onset of the crisis. We conduct a battery of tests to support the hypothesis that our measure of firm exposure to the credit crunch is unrelated to other firm-specific trends and that there was no strategic firm-bank sorting before the shock impacted the economy. Moreover, we document that our shock is not systematically correlated with other labor market developments at the sector-year or province-year level, including the European sovereign debt crisis, starting in the summer of 2011.

We first present firm-level evidence on the effect of credit restrictions on firms' survival probability, size growth, and investment. We find that, compared to less affected firms, those with limited access to credit face a higher probability of exiting the market, grow less and disinvest. Additionally, we find that these effects last for at least 11 years after the shock to credit. Further analysis using firms' loan applications shows that firms, following their decision to disinvest, permanently reduce their demand for credit. This suggests that the initial credit supply contraction created a permanent change in firms' production technology, modifying their demand for capital and labor in the long term. Consistent with the hypothesis that a negative credit shock increases the cost of capital financing, we document that the persistent reductions in the surviving probability, size growth and investment are concentrated among more exposed firms that are capital intensive. This is not driven by differences in leverage or liquidity between high and low capital-intensive firms, which we explicitly account for in our empirical specification.

Naturally, our diff-in-diff estimates should be interpreted as relative rather than aggre-

gate effects –see Herreño (2021) for a discussion. To understand the relevance of general equilibrium effects, we study spillovers on firm size growth following the methodology proposed by Huber (2022). We detect significant spillovers on firm size growth of the same sign and of similar magnitude as the direct effect. Overall, considering both direct and spillover effects, we estimate that the credit supply shock accounts for approximately one-third of the average drop in firm size growth that took place in the period 2007-2018.

Next, we analyze the effect on workers. In particular, we compare the working histories of individuals employed before the crisis in firms differently exposed to the credit restrictions, up to 11 years after the shock first impacted the economy. We distinguish between workers who remain in the same firm by which they were employed in 2006 and those who move to another firm, and we study the effects on the total yearly labor earnings, the number of days worked per year and daily wages.

We find evidence of persistent earnings losses among workers who in 2006 were employed by firms that were more exposed to the credit shock. A worker employed in a firm 10pp more exposed to the shock (which corresponds to the difference between the 90^{th} and the 10^{th} percentiles of the shock distribution and to a drop in credit growth at the firm level of about 2 pp) experiences a statistically significant reduction of around 1% in average yearly labor earnings. If we solely focus on displaced workers, the long-term reduction in earnings is about 15%, in line with the findings of the literature on mass layoffs (Lachowska et al., 2020; Schmieder et al., 2023). Labor earnings show the first signs of recovery in 2016 at the earliest; that is nine years after the credit shock impacted the economy.

Moreover, we find that the effects are entirely driven by workers who were employed in 2006 at exposed firms with high capital intensity, which is consistent with the firm-level findings. The drop in labor earnings is predominantly due to job losses in the short term and wage losses in the medium/long term, as some of the displaced workers manage to find a new job in another firm but on a lower wage trajectory.

Next, we explore the distributional effects of the credit shock across workers. We focus on workers' skills, especially in relation to their degree of complementarity with capital. To this end, we distinguish between workers with high and low pre-crisis wages and between production and non-production workers (blue versus white-collar workers). These exercises allow us to assess whether the credit shock had a stronger impact on high-skilled workers, who tend to be more complementary to capital (Fonseca and Doornik, 2022; Acemoglu and Autor, 2011; Goldin and Katz, 1998). We document that high-wage/white-collar workers are much more likely to experience separations from the firm by which they were employed in 2006 if that firm was high capital-intensive. Subsequently, these workers face challenges in

finding new jobs, also because of the previously documented changes in labor demand: they tend to reallocate towards low capital-intensive firms, and eventually accept lower wages. Our results are in line with occupational downgrading among workers who reallocate during recessions (Huckfeldt, 2022).

Finally, we look at whether the effects on employment depend on reduced bargaining power among workers (Carneiro et al., 2012), and we document that the adverse effects of the shock are stronger in areas where the unemployment rate is higher, pointing to the importance of the cyclical conditions of local labor markets in shaping the adjustment following major shocks (Schmieder et al., 2023).

Taken together, our results suggest that credit restrictions can have very long-lasting real effects on workers and firms. The main channel appears to be a permanent reduction in capital, which affects employment through capital-skill complementarities. More specifically, capital-intensive firms tend to persistently reduce investments and employment of high-skilled workers, who are more likely to be complementary to firms' technology. The negative effects on the labor earnings of these workers are persistent, as the permanent change in labor demand hinders their reallocation towards a new firm and results in long non-employment spells and in lower wages in the long run.

Related literature. Our work speaks to different strands of literature. First, it contributes to the studies on the real effects of credit supply shocks (Acabbi et al., 2019; Amiti and Weinstein, 2018; Cingano et al., 2016; Paravisini et al., 2015). More specifically, we extend the literature that examines the impact of credit shocks on employment using data at the firm or worker level (Acharya et al., 2018; Benmelech et al., 2019, 2021; Bentolila et al., 2018; Berton et al., 2018; Chodorow-Reich, 2014; Giroud and Mueller, 2017; Greenstone et al., 2020; Popov and Rocholl, 2016) in two key aspects. First, we do not only look at the employment status of individual workers but we also study workers' wages and labor earnings, which is crucial in order to understand the overall labor market effects. Second, we focus on the long-term impact of the shock. This distinguishes us from two recent studies (Moser et al., 2020; Aristizábal-Ramírez and Posso, 2021) who analyze the impact of credit shocks on the distribution of workers' earnings, with a short-term perspective only.

Our work also relates to the literature on the long-term consequences of industry-level shocks, such as trade liberalizations (e.g., Autor et al., 2014; Utar, 2018; Dauth et al., 2021) or mass layoffs (e.g., Jacobson et al., 1993 and more recently Davis and Von Wachter, 2011; Gathmann et al., 2020; Ku et al., 2020; Lachowska et al., 2020; Schmieder et al., 2023, among others). Our contribution to this literature is threefold. First, given the different nature of the shock, the impact of credit restrictions on workers may differ substantially from that of

previously studied shocks. More specifically, trade shocks mostly affect low-skilled workers, who can be replaced by cheap imported goods, whereas we show that credit shocks tend to impact high-wage workers in high capital-intensive firms. Second, our setting allows us to study both workers who are displaced and those who stay, so as to assess whether or not some form of insurance within the firm takes place. This distinguishes us from the studies on the long-term earnings effects of mass layoffs, which focus on displaced workers only. Third, since our measure of the shock is at the firm level rather than at the industry or local labor market level, we can examine how it interacts with external conditions and, in particular, with different unemployment rates in local labor markets.

Finally, our paper contributes to the literature that studies the extent to which shocks to firms' performance are transmitted to their employees' labor income (for instance, Blanchflower et al., 1996; Guiso et al., 2005; Card et al., 2015, 2014; Macis and Schivardi, 2016; Juhn et al., 2018; Schoefer, 2021). We add to this literature by showing that employees who separate from the original firm bear a much larger cost than those who stay in the firm, both in the short and in the long term.

This paper is organized as follows. Section 2 describes the data and the construction of our sample. We describe the empirical strategy and present supporting evidence on its validity in Section 3. The main results at the firm and at the worker level are presented in Sections 4 and 5 respectively, where we also explore the possible mechanisms behind the employment and wage losses. Finally, Section 6 concludes.

2 The data

We rely on a unique dataset combining data from several different sources. The first is the employer-employee matched dataset, provided by the Italian Social Security Institute (INPS). This includes a random and representative 6.5% sample of the Italian workforce, drawn from the universe of private non-farm employees. The data contain information on the main demographic characteristics (age, gender, country of birth), on all employment spells (daily wages, occupation, type of contract, i.e., permanent or temporary and full-time or part-time, length of the spell) and on the unique firm tax identifier, which allows us to match firms' characteristics to the worker sample.

At the firm level, we use two data sources. The Italian Social Security Institute (INPS) provides data on some firm characteristics (size, average monthly wage, sector, and location of businesses) for all private non-farm sector firms with at least one employee. We match this dataset with the register of incorporated firms, CERVED, which collects balance sheet

information from the Italian Chambers of Commerce.

To construct our measure of credit shock, we obtain information on bank-firm credit relationships from the Italian Credit Register administered by the Bank of Italy, which includes all credit commitments above 75,000 euros (30,000 since 2009) by banks operating in Italy. For each firm-bank pair, we recover the end-of-year total granted credit. We match these data using the unique bank identifier, and then use the unique firm tax identifier to match them with the social security data and the firm's balance sheets. This allows us to obtain a high-quality measure of firms' exposure to the credit crunch, matched with rich information at the firm and worker level for five years before and 11 years after the onset of the GFC.

In the firm-level analysis, our sample covers the universe of non-farm private sector corporations active and with an outstanding credit relationship, as detailed in the Italian Credit Register, in 2006. We consider five main outcomes: the growth in credit granted to each firm every year, which we use to estimate the impact of interbank exposure on firms' ability to obtain credit; a dummy that takes the value 0 in all years when the firms operate and the value 1 in the first year the firm exits the market; a variable that measures the growth of the firm's yearly average number of employees; a variable measuring the growth of the average monthly wages of all employees in the firm; and, finally, a variable measuring investments, defined as the growth rate of total fixed assets, i.e., of total assets excluding immediate and short-term liquidity.

We construct our worker sample as follows. We consider individuals who in 2006 were between 25 and 50 years old and were employed in corporations with outstanding credit relationships. We drop workers younger than age 25, who may still be pursuing education. We also drop workers older than age 50 (i.e., older than 62 in 2018, the last year of the period of our analysis), to avoid our results being influenced by retirement choices from 2007 to 2018. Moreover, we restrict attention to employees with a strong labor market attachment, who had at least three years of tenure in 2006 (had worked in the 2006 firm for at least 600 days in the period 2003-2005). As a result, our sample mainly includes permanent workers.[1] We impose a minimum tenure requirement for two main reasons. First, this restriction largely follows the existing literature, allowing us to better compare our results to those in the literature on mass layoffs (see, e.g., Lachowska et al., 2020; Schmieder et al., 2023) and on the long term effects of trade shocks (Autor et al., 2014). Second, differently from temporary workers, permanent workers in Italy are protected by employment protection rules that are similar to those in place in other countries (i.e., more stringent with firms' size and workers'

[1] Permanent workers account for more than 80% of total employees in Italy (Source: Eurostat).

tenure, see Bentolila et al., 2020 for a review and Sestito and Viviano, 2018 for an assessment of the role of firing costs in firms' firing and hiring decisions in Italy), making our results easier to generalize and interpret. Nonetheless, in a robustness test, we relax the minimum tenure requirement during the 3-year period before 2006 to at least 100 days instead of 600 days and obtain similar results to the benchmark estimates.

Our three worker-level outcomes of interest are defined as follows: total earnings, which consist of the sum of all labor earnings obtained by an individual from all his/her employers in the considered year (0 if he/she is not employed) as reported to INPS (i.e., net of employers' social security contributions and before income taxes); the number of days, which is the total number of days worked in the year (including paid holidays but excluding Sundays); and finally, daily wages, computed as the ratio between total labor earnings and the number of days worked (normalized to 1 in 2006). We use nominal daily wages.[2] Our measure of wages includes the base-fixed component and overtime pay, but excludes premia and bonuses (as well as any type of government or public subsidy). On average, about 20% of Italian workers' wages are individually negotiated with the employers and consist of a flexible part, mainly composed of premia and bonuses (see, for instance, Adamopoulou et al., 2016). The remaining part of the wages is centrally negotiated through nationwide collective agreements, which set minimum wages at the sector level for different occupation classes. These contracts are typically renewed by the main social partners every three years (prior to 2009, it used to be every two years). In the period we consider, nominal increases of the base (minimum) negotiated wages were usually benchmarked to an independent three-year-ahead forecast of inflation net of imported energetic goods, which was always positive. Similar forms of collective bargaining are present in many other European countries, for example, France, Spain, Portugal, etc. (see Adamopoulou and Villanueva, 2022).

3 Empirical strategy

3.1 Conceptual framework

The first part of our analysis shows how firms respond to credit shocks by adjusting investment, employment and wages in both the short and long term. The second part is a worker-level analysis that looks at the career trajectories of employees working in firms more and less exposed to credit restrictions.

There are several channels through which negative credit shocks can have adverse effects

[2] All our regressions include year fixed effects and thus account for changes in average inflation over time.

on firms' size, wages and investment as well as on workers' individual wages and employment trajectories (Chodorow-Reich, 2014; Benmelech et al., 2021; Bentolila et al., 2020; Berton et al., 2018). First, negative credit shocks increase the cost of capital financing. As a consequence, capital expenditure will decrease. The impact on employment and wages will therefore depend on the elasticity of substitution between capital and labor. In particular, high-skilled workers, who are more likely to be complementary to capital (Krusell et al., 2000; Dolado et al., 2021), may suffer the greatest losses. Second, firms hit by lower availability of external finance may face liquidity constraints. As a consequence, they will struggle to finance working capital expenditures and therefore to pay wages. In this case, they will fire workers to reduce cash outlays.

Under certain circumstances, these short-term consequences may persist for several years. At the firm level, the duration of the effects will depend on the firm's ability to secure alternative sources of financing. If firms are able to quickly resort to other forms of financing, the impact of the credit shock will be short-lived. Instead, if firms need to adjust their production technology to cope with the credit shock and subsequently lower their demand for credit, the impact can be long-lasting. At the worker level, persistent earnings losses are likely to occur because of the difficulties of laid-off workers in finding new jobs on comparable wage trajectories, as documented by the literature on mass layoffs for instance.

Additional mechanisms may intensify these effects. For example, when the credit shock is large enough to modify labor demand at the aggregate level (local labor market), there can be an amplification mechanism, as workers may have further reallocation difficulties; the effect will be larger depending on the tightness of the local labor market. Second, the negative impact on more affected firms may spillover towards less affected companies, due to general equilibrium effects. This may happen, for instance, if the reduced income among households with unemployed members lowers the demand for certain types of produced goods.

In the analysis that follows we provide direct evidence in support of the capital-skill complementarity channel, which generated persistent changes in the labor demand of more affected firms. This, in turn, had long-term consequences for labor earnings, especially among high-skilled workers. We show instead that reduced firm liquidity is unlikely to drive our results. Finally, we quantify spillovers and discuss the role of firms' demand for credit.

3.2 Measuring the exposure of firms to the credit crunch

Our first step is to identify plausibly exogenous variation in firms' exposure to the credit crunch generated by the GFC. The Italian banking system was severely impacted by the

2007-2008 financial crisis. The shock was arguably exogenous with respect to the conditions of Italian banks: the GFC originated in the U.S. subprime mortgage market, a small market segment to which Italian banks were not exposed (Panetta and Signoretti, 2010). Italian banks were instead largely impacted by the liquidity drought in interbank markets that started in August 2007 (Brunnermeier, 2009). This shock was heterogeneous across banks, depending on their exposure to interbank (wholesale) funding. This is asserted in the existing literature (Iyer et al., 2013; Cingano et al., 2016), showing that banks' reliance on interbank funding is a good proxy for their exposure to the 2007-2008 financial crisis and the extent to which they restricted credit supply. We refer to these works for further details on the transmission mechanism from tensions in interbank funding markets to lending.

We measure the average exposure to interbank funding for each bank operating in Italy using the balance sheet data contained in the Supervisory Reports. For each bank b, we calculate the interbank funding (deposits plus repurchase agreements) to total assets ratio averaged over the period from 2003 to 2006.[3] We label this variable $Interbank_{b,06}$, and this is our measure of banks' exposure to the GFC.[4] Importantly, we find that the interbank funding to total assets ratio is not correlated with key bank characteristics, which could drive banks' lending policies or the quality of banks' loans. In particular, it shows no statistically significant correlation with capital, profitability, bad loans ratio, average interest rates charged on the different asset classes at the bank level, or bank size (see Table A.1 in Appendix A). The interbank funding ratio is negatively correlated with the ratio of retail deposits to total assets and with liquid assets. This is reassuring because both retail deposits and liquid assets are substitutes for interbank funding.

Since firms have multiple relationships with banks, for each firm-bank relationship we define the variable $Interbank^{f}_{b,06}$ equal to the exposure to the interbank market of bank b lending to firm f in 2006.[5] We calculate our measure of firm's f specific risk of credit crunch by averaging bank exposure $Interbank^{f}_{b,06}$ over b. For each firm, $Interbank^{f}_{b,06}$ is weighted by the share of loans granted to firm f by bank b as of end-2006 ($credit_{f,b,06}$) over total loans

[3]Data on bank balance sheet variables are observable at a semi-annual frequency, thus the average comprises eight dates from June 2003 to December 2006. The data are consolidated for all banks belonging to a banking group (to net out the flows of funds among banks within the same banking group) and exclude ECB's refinancing.

[4]We also experimented with a net interbank exposure measure (interbank liabilities-interbank assets)/total assets and all results hold.

[5]Firms in our sample have on average four bank relationships (this is in line with existing evidence for Italy –see Detragiache et al., 2000; Sette and Gobbi, 2015). Bank-firm relationships are long-lasting. While our data start in 1999 and therefore the duration of relationships we can compute is truncated, bank-firm relationships last on average eight years (the median is seven years, the 75^{th} percentile is 12 years, the 25^{th} percentile is four years).

granted to firm f in 2006, $credit_{f,06}$.

Formally:

$$Interbank_{f,06} = \Sigma_b Interbank^f_{b,06} \times \frac{credit_{f,b,06}}{credit_{f,06}}. \quad (1)$$

In our final sample, the exposure to the credit shock ($Interbank_{f,06}$) is 14%, on average, with a standard deviation of 6%. This firm-level exposure measure we adopt (analogous to those used by Iyer et al. (2013) and Cingano et al. (2016) for instance) follows the same logic as Chodorow-Reich (2014), who exploits different proxies of banks' exposure to the crisis.

For this to be a good measure by which to identify firms' exposure to the credit crunch, two conditions need to be met. First, we should exclude any possible sorting of firms into banks relying more on the interbank market. Section 3.3 describes differences in characteristics of firms more and less exposed to banks highly dependent on interbank funding and presents our identification strategy, which accounts for possible sorting. Importantly, Table A.2 in Appendix A shows that banks more reliant on interbank funding in the period before the crisis were not systematically expanding credit to firms that needed it.[6]

Second, the interbank shock had to be unforeseen. This is the case as far as we assume that Italian firms in 2006 were unable to predict both the abrupt and sudden stop in the interbank market that occurred since 2007 (which worsened after the Lehman Brothers default in 2008) and their bank's exposure to it. This is indeed a reasonable and widely shared assumption. Additionally, we always check for the absence of differential pre-trends in all our estimates, which ensures that the evolution of firms' loans and bank interbank funding does not depend on $Interbank_{f,06}$ before 2007.

A last point to note is that Italy was impacted by a second shock in the summer of 2011, that being the European sovereign debt crisis, after private sector agents were involved in the restructuring of Greek debt in late June 2011 (Bofondi et al., 2017; Correa et al., 2021). Italy found itself entangled in this crisis due to its substantial sovereign debt burden. We argue that this subsequent shock did not differentially impact banks depending on their reliance on interbank funding before the GFC. Therefore, it does not pose a threat to the identification of our effects in the long term. In other words, we can claim that the long-term effects we estimate are driven by the credit supply shock that took place during the GFC, and not by other correlated shocks that occurred afterwards.[7]

[6] In the spirit of Khwaja and Mian (2008), we regress at the bank-firm level the log change in credit in each bank-firm relationship between 2000 and 2005 on the bank's exposure to the interbank market in that period, $Interb_b$. The regressions include firm fixed effects and thus control for all time-invariant firm characteristics.

[7] The presence of another shock could affect the external validity of our long-term results. However, in the case of Italy, the contraction in GDP was exceptional in 2009, right after the GFC (-4.9%), while subsequent

We support this point based on several results. First, in Appendix A we correlate the banks' interbank funding ratio measured before the GFC, $Interb_b$, with other key bank characteristics as of 2010-2011, finding no correlation with other bank characteristics like capital and profitability, and in fact a negative correlation with the share of government bonds to assets, which could be considered a proxy for the impact of the sovereign debt crisis on Italian banks (Table A.3). Moreover, our measure of the shock, $Interb_b$, is positively correlated with the change in banks' average cost of funding between 2007 and 2010, but not between 2011 and 2015 (Table A.4). Second, existing evidence shows that the drop in credit during the sovereign debt crisis has been rather homogeneous across banks. For instance, Bofondi et al. (2017) show that the contraction in credit supply after the sovereign debt crisis was independent of banks' characteristics, including the funding structure, and was instead driven by the nationality of the bank's holding company. Taken together, all of this evidence suggests that the interbank funding ratio as measured before the GFC is a good proxy for the impact of the post-Lehman Brothers shock on banks, but not for that of the European sovereign debt crisis. Also our firm-level results on the timing of the reduction in credit growth between 2007 and 2018 displayed in Section 4 support this conclusion.

A final concern is that firms' exposure to the credit shock may be systematically correlated with other labor market and economic outcomes at the province-year level. Figure A.1 in Appendix A plots the provincial yearly unemployment rate against the share of firms highly exposed to the interbank market. The graph clearly shows that there is a large degree of heterogeneity across provinces and that the firm-level exposure to the interbank shock is not correlated with the cross-sectional variability in the provincial unemployment rate.

3.3 Sample characteristics and model specification

Tables 1 and 2 summarize the pre-shock characteristics of our firm- and worker-level sample, distinguished by the intensity of the shock: top 33-percentile of exposure (column 1) and rest of the sample (column 2).[8] Table 1 indicates that more-treated firms are on average larger and pay higher wages than less-treated firms.[9] This occurs because smaller firms tend to be customers of smaller banks, that are less exposed to the interbank market. Table 2 reports summary statistics for workers. Workers employed in firms more exposed to the credit shock

recessions were milder and broadly similar in size to previous episodes.

[8]This is purely for expositional purposes; in the regression analysis we use a continuous measure of exposure to the interbank shock.

[9]Our sample includes a much larger fraction of small firms than the sample used in Cingano et al., 2016, in which exposure to the interbank market was balanced across firms' characteristics.

are more likely to be of a higher occupational level (white collars or managers) and tend to earn higher daily wages on average than the other workers.

Our empirical analysis accounts for these differences at the firm and worker level in several ways. First, we adopt a difference-in-differences strategy. Therefore, for our identification to hold, there can be heterogeneity in the type of firms and workers that are more exposed to the credit supply shock, as long as trends in the outcomes of treated and control units would have been parallel absent the shock. In the regression analysis, we therefore always check that trends were parallel before the crisis.

Second, for our strategy to identify the effect of the credit shock only, we need to ensure that more and less treated firms (and their workers) were comparable in terms of the impact of the other, non-necessarily credit-related, negative shocks that followed the GFC and that may have impacted differently the demand for their products. To this aim, first of all we saturate the model by including province×year and sector×year fixed effects. We therefore absorb any time-varying shock that occurs at the province and sector level.

Moreover, we rely on a propensity score matching procedure to obtain a balanced sample of workers and firms, that are therefore more likely to have experienced similar shocks after the GFC. In particular, we use a step matching estimator in the spirit of Schmieder et al., 2023 and Dauth et al., 2021, and we match firms and workers within 1-digit industries based on a number of matching variables measured before the credit crunch.[10] We thus estimate within each 1-digit industry the propensity of a firm (or worker) belonging to the top 33 percentile of the distribution of exposure to the interbank market.[11] The matching variables at the firm level include firms' size, age, average wage per employee, geographical distribution, credit score and additional balance sheet information (e.g., net revenues, credit-to-asset ratio, leverage, current ratio, capital intensity). At the worker level, the matching variables are the following: gender, age (linear and squared), full-time contract, tenure within the firm (less than 2 years, 2-5 years, 6-9 years, 10 years or more), average (log) daily wage (linear, squared and cubic) and earnings in 2006 (linear, squared and cubic), firms' leverage (if firms' debt-to-asset ratio is above the 66^{th} percentile), firms' capital intensity, firms' age (linear and squared), firms' size, and firms' average monthly wage. Columns 4 and 5 of Tables 1 and 2 display the pre-crisis average characteristics of more and less exposed firms and workers with a weighting for the propensity score. This procedure allows us to obtain a highly balanced sample both at the firm and worker level, as displayed in column 6 of Tables

[10] At the firm level, since the sample is smaller and balance sheet characteristics are less stable, we use the average observed between 2002 and 2006; at the worker level, we use the value observed in 2006.

[11] The results are robust to the use of different thresholds (namely, the top 25) and matching variables.

1 and 2.

At the firm level, we then estimate the following regression model:

$$y_{f,t} = \sum \gamma_t \times Interbank_{f,06} \times 1(year = t) + \delta_f + \delta_{pt} + \delta_{st} + u_{f,t}, \quad (2)$$

where $y_{f,t}$ is the firm f outcome in year t, as defined in Section 2, $interbank_{f,06}$ is firm's f exposure to the credit shock, as defined in Section 3.2, δ_f are firm fixed effects and δ_{pt} and δ_{st} are province×year and sector×year fixed effects. Standard errors are clustered at the firm level and at the level of the bank that was lending more money to the firm before the GFC (main bank).[12]

At the worker level, we estimate the following specification:

$$y_{i,f,t} = \sum \beta_t \times Interbank_{f06} \times 1(year = t) + \alpha_i + \alpha_{pt} + \alpha_{st} + \epsilon_{i,f,t}, \quad (3)$$

where $y_{i,f,t}$ is the outcome variable of worker i in year t employed by firm f, and $interbank_{f06}$ is the exposure to the credit shock of firm $f06$ that employed the worker i in 2006, as defined in Section 3.2. The term α_i indicates worker fixed effects (and implicitly also controls for firm $f06$ fixed effects) and α_{pt} and α_{st} are province×year and sector×year fixed effects, where s refers to the sector of activity of firm $f06$ and p to the province of firm $f06$. Standard errors are clustered at the province level, the level of the firm by which workers were employed in 2006, prior to the shock, and at the level of the main 2006 bank of that firm.

A potentially important issue is how to treat individuals who lose their jobs and who move from one firm to another. In this case, we track workers across firms and attribute to them the interbank exposure of the firm by which they were employed in 2006, as any successive movement may be part of the endogenous response to the shock. This choice, aimed at identifying the long-term effects for workers of the credit shock experienced by the 2006 firm, implies that in our worker-level regressions, we can only estimate the intention to treat.

[12] In Appendix B we also present 2SLS estimates instrumenting credit growth with interbank exposure. However, these results should be taken with caution, as the exclusion restriction hypothesis may be violated if other factors (e.g., higher requests for collateral) make credit conditions stricter for firms more exposed to affected banks. Although in Table A.5 of Appendix A we show that more exposed banks did not increase the interest rates charged to firms (consistently with previous evidence Cingano et al., 2016; Rodano et al., 2018), these estimates are subject to sample selection bias, as we can observe changes in interest rates only for existing relationships (and we know that the amount of existing banking relationships could have changed after the shock). For these reasons, we report the IV estimates only in the Appendix and not as the main specification.

Importantly, to better understand the mechanisms behind our results, we distinguish workers between "movers" and "stayers" (for whom we use observations only for the years they remained in the same firm by which they were employed in 2006) and between the number of days worked per year in any firm during the period 2000-2018 and in the same firm workers were employed by in 2006. This allows us to fully assess the impact of the credit shock: if workers were laid off but could easily find a new job, the impact of the credit crunch on earnings would be short-lived. It could still be sizable if workers had to accept a lower wage in their new jobs. The richness of our data allows us to perform these tests.

4 Firm-level effects

4.1 Overall effects on firms

Figure 1 reports the estimated coefficients γ_t of equation 2 and unfolds the effects of the credit shock on firms' outcomes year-by-year. Panel a reports the estimated effects on credit growth. Relative to the omitted year (2005), before 2006 the elasticity of firm credit growth to firm exposure to the shock ($interbank_{f,06}$) is small, positive, and not statistically different from zero. Afterwards, it becomes negative and significant, signaling a structural break in 2007. After 2007, a 10-pp higher firm exposure to the shock (which corresponds to the difference between the 90^{th} and the 10^{th} percentile of the shock distribution) implies a 2 to 3-pp reduction per year in credit growth at the firm level. The effect is almost constant in the post-2006 period, and the elasticity remains stable after the onset of the sovereign debt crisis in mid-2011. This evidence supports our strategy that identifies firms more affected by the credit crunch as those that borrowed relatively more from banks that ex-ante used to rely more on interbank funding.

Panels b to e of Figure 1 display the estimated effects on firms' probability of exiting the market (equal to 1 if in year t the firm ceases operations, zero otherwise, and missing after year t), firm size growth, average monthly wage growth per employee, and investments.[13] All estimates confirm the absence of significant pre-trends for all outcomes. Moreover, they reveal that firms more exposed to the credit shock face an increased probability of exiting in 2009 and 2010 compared to less affected firms (panel b) but then the effect dissipates. Instead, the negative effects on size growth (panel c) and investments (panel e) are highly persistent. Finally, wages responded only in 2009 (panel d), probably because of downward

[13] Investments are defined as the growth rate of total fixed assets, i.e., of total assets excluding immediate and short-term liquidity.

wage rigidities. However, they do not show any sign of recovery in the subsequent years.

Regarding the timing of the impact, the drop in credit growth and investment in panels a and e of Figure 1 is almost immediate, while the effects on exit and firm size in panels b and c of Figure 1 take a couple of years to materialize. This is not surprising as the process of shutting down a business can be lengthy and there are several firing frictions in the Italian labor market (see Section 2).

In Table 3 we report the effects averaged over the period 2007-2018, relative to the 2002-2006 period (obtained by interacting a dummy equal to one for the years 2007–2018 with the shock, $interbank_{f,06}$×post2006). Overall, our results are perfectly consistent with the evidence presented in Figure 1 and imply that a 10-pp higher exposure to the shock (which corresponds to the difference between the 90^{th} and the 10^{th} percentile of the shock distribution) leads to a 2.0 pp reduction per year in credit growth at the firm level, an almost 1-pp reduction in firm size growth per year and a 0.7-pp reduction in firm-level investments per year. The average effect on the exit probability and on average wage growth in the entire post-period is not statistically significant, as the impact is concentrated only in a few years.[14]

All firm-level results, moreover, are robust to the inclusion of different sets of controls, like 2-digit sector×year and province×year fixed effects or sector×year×province fixed effects – see Table B.2 in Appendix B.

4.2 Mechanisms

4.2.1 The persistent effect on credit growth

A relevant question to draw policy implications concerns the nature of the estimated long-term effects on credit growth among firms more exposed to interbank-funded banks. In other words, whether the persistent drop in credit growth was due to a permanent contraction in the credit supply of more exposed firms or to the fact that the initial credit supply shock created a permanent reduction in the demand for credit.

To this aim, we study whether and how much firms differentially exposed to the credit supply shock resorted to new banks to counterbalance the drop in credit growth in the pre-existing bank-firm relationships (see also Crouzet, 2018). In the case of Italy, we look at bank credit only, since it is the only source of external finance for the majority of firms.[15]

[14] All results are confirmed if we run 2SLS regressions at the firm level using interbank exposure as an instrument for credit growth–see Table B.1 in Appendix B.

[15] The share of bank debt over total financial debt in our sample of Italian corporations (incorporated

Specifically, we make use of an additional unique dataset on loan applications, obtained from the Italian Credit Register.[16]

We select only bank-firm pairs that did not have a pre-existing credit relationship and focus on the period 2002-2018 as in the rest of our analysis. We then estimate a regression at the firm level, where the dependent variable is a dummy that takes the value 1 if the firm made at least one loan application towards a new bank in the considered year and 0 otherwise. We look at the coefficients of the firm-level exposure to the interbank market between 2002 and 2006, interacted with year dummies. The regression also includes year and firm fixed effects and clusters standard errors at the firm level. We restrict the sample to surviving firms to avoid a mechanical effect due to exiting firms, which would stop making loan applications when they are not active anymore.

As Figure 2 shows, firms more exposed to the credit shock sharply increased the probability of requesting credit from new banks in 2008 and 2009, i.e., in the years immediately after the credit crunch took place, relatively to less exposed firms. However, this effect was rather transitory; after a few years, credit applications of more and less exposed firms started again to behave very similarly. This suggests that the temporary reduction in credit supply had long-lasting labor market consequences mainly through changes in the demand for credit, probably following some disinvestment decisions. In the absence of changes in the demand for credit, we would expect more exposed firms to increase loan applications so as to compensate for the initial drop in credit supply and recover their pre-crisis level of credit growth. Instead, we observe that in the long run more exposed firms do not look for new banking relationships more than less exposed firms, while credit growth permanently decreases.

4.2.2 Interpreting the effects on firm-level outcomes: capital-skill complementarities

To explore the mechanisms through which the credit shock affects firm-level outcomes, we first focus on the capital-skill complementarity channel (see the discussion in Section 3.1). Indeed, Table 3 (column 5) and Figure 1 (panel e) show a significant and persistent adjustment in terms of investment flows among firms that experience a credit supply shock. To

companies from CERVED observed between 2000 and 2016) is on average 83%, and the median is 100%. Bond issuance is concentrated among a few very large issuers, while retained earnings are unlikely to have served as a buffer given that profits decreased significantly during the period of our analysis.

[16]The literature uses the term "loan applications" –see e.g., Jiménez et al. (2012), as we do here, but to be precise these are inquiries made by banks to the credit register about (new or existing) borrowers applying for credit. Therefore, these data can be considered as a close approximation of loan applications.

further corroborate the relevance of this channel, we look at the heterogeneity of the effects by firms' capital intensity before the GFC. Specifically, we classify firms as high capital-intensive if their average capital-to-labor ratio between 2002 and 2006 lies above the 66^{th} percentile of its distribution and interact the high capital intensity indicator with firms' exposure to the interbank shock and year dummies. If capital-skill complementarity is the underlying channel, we expect the effect to be driven by high capital-intensive firms, which reduce investments and employment more than the rest of the firms as a result of the credit shock.

Before presenting these results, we briefly discuss how other potential mechanisms may confound the heterogeneity by capital intensity, if for instance the latter is correlated with other firm-level characteristics. Reassuringly, Table B.3 in Appendix B shows that firms with higher capital intensity are quite comparable to the other firms, and importantly that the two groups of firms did not have a different ex-ante exposure to interbank-funded banks.[17]

However, the table shows that high capital-intensive firms were ex-ante more illiquid (had a lower current ratio in 2002-2006) than the rest of the firms.[18] This implies that we may overstate the role of capital-skill complementarities, i.e., that our results on capital intensity may be driven by differences in liquidity between firms with high and low K/L ratios. Indeed, as outlined in Section 3.1, liquidity is the main competing channel behind our firm-level effects, since credit-constrained firms may face a lack of liquidity and therefore difficulties in paying wages and financing working capital.

We conclude that liquidity does not play a large role in our results, based on two sets of evidence. First, when estimating equation 2 with the current ratio as an outcome variable we find no evidence that liquidity deteriorated as a result of the credit shock (Figure 1-panel f). Second, our tests of capital-skill complementarity always include among the controls an indicator for whether the firm had low liquidity (average current ratio in 2002-2006 below the 33^{th} percentile) interacted with the post-2006 indicator and with the degree of exposure to the interbank market in 2002-2006 (and all the corresponding controls).

Finally, in our regressions, we also control for heterogeneity depending on the degree of pre-GFC level of indebtedness (average leverage in 2002-2006), as it may be a relevant channel of heterogeneity and may be correlated with capital intensity (even though Table

[17] The key difference between low and high capital-intensive firms is size, as the latter tend to be larger. However, to the extent that larger firms can better cope with credit shocks and are less financially constrained than smaller firms, the difference in size makes it more difficult to obtain the result that high capital-intensive firms and their workforce suffer the greatest consequences as a result of the credit shock.

[18] We measure firms' liquidity using the current ratio. This is equal to $\frac{\text{Balance sheet cash}_{f,t}+\text{Short term credit}_{f,t}}{\text{Short term debt}_{f,t}}$ and is a standard measure of firms' liquidity, widely used in the literature (e.g., Demiroglu and James, 2010).

B.3 in Appendix B shows small differences in terms of indebtedness among high and low capital intensive firms).[19]

The results by firms' capital intensity are shown in Figure 3. Exposure to the interbank shock leads to lower credit growth both for high and low capital-intensive firms; the effect in 2009 is marginally larger among the former but the difference is far from reaching statistical significance.[20] By contrast, we detect an increase in the probability of exit and a sharp drop in investments only for high capital-intensive firms. Moreover, consistent with the complementarity between capital and labor, we find that the contraction in employment is much larger among high capital-intensive firms.[21]

Next, Figure B.1 in Appendix B explores the heterogeneity of the effect of the credit shock by the degree of capital intensity at the firm level, by changing progressively the threshold that defines low and high capital-intensity firms. The results show that the effect of the credit shock on the probability of exit, size growth and investment is larger (in absolute value), the higher the K/L ratio at the firm level. Moreover, the largest effect is concentrated above the 66^{th} percentile of the distribution, which is how we define high capital-intensive firms throughout the analysis.

All in all, our results suggest that firms respond to a reduction in credit supply mainly by persistently lowering investments and that this has long-term implications for employment through capital-labor complementarities. This indicates that the credit shock potentially changes the demand for labor, and in particular for skilled workers who are mainly employed by high capital-intensive firms and are considered complementary to capital (Fonseca and Doornik, 2022 and Acemoglu and Autor, 2011). We test for this hypothesis in our worker-level analysis.

[19] In particular, we control for whether the firm was highly indebted (average leverage in 2002-2006 above the 66^{th} percentile) interacted with the post-2006 indicator and with the degree of exposure to the interbank market in 2002-2006 (and all the corresponding controls).

[20] We obtain similar results if we conduct the analysis at the loan rather than at the firm level. More specifically, we estimate a Khwaja and Mian (2008) type of regression at the loan level, with log(credit) as the dependent variable, including different combinations of firm, year and bank fixed effects. As Table B.4 in Appendix B shows, again we find a significant drop in credit growth due to the exposure to the interbank shock but the effect is homogeneous among high and low capital-intensive firms.

[21] When running 2SLS regressions at the firm level using interbank exposure and interbank exposure interacted with high capital intensity as instruments for credit growth and credit growth interacted with high capital intensity, we find that the effect of a change in credit growth on size growth is more than double for high capital-intensive firms (Table B.5, column 2 in Appendix B). The effect on investments is also three times larger for high capital-intensive firms (Table B.5, column 4 in Appendix B).

4.2.3 Spillovers and aggregate effects

Although in our analysis we use the universe of private sector firms, our diff-in-diff estimates should be interpreted as relative rather than aggregate effects, i.e., as the impact on more exposed firms relative to less exposed ones, as Herreño (2021) shows. If the credit shock also affects less exposed firms, because of some general equilibrium responses, this would not be captured by our diff-in-diff estimates. Spillovers could arise for instance because firms substitute across banks or between different forms of external finance. While the latter channel should be minimal because Italian firms are mainly bank-dependent, the analysis of loan applications showed that the degree of bank substitutability was rather small as well.[22]

Moreover, in the case of a large-scale shock like the one we analyze, the effects of credit restrictions could spill over to other firms, which are not (or are minimally) directly exposed to interbank-funded banks but are located in the same local labor market as more exposed firms. The spillover effects on firms' size growth may arise in general equilibrium because of the changes in the local labor market conditions (tighter labor markets) or because of the lower demand for the goods produced (due to reduced income among households with unemployed members). To understand the size of possible spillovers among firms, we follow Huber (2022) and estimate the direct and spillover effect of the credit shock on size growth at the 2-digit sector-province level using the universe of private sector firms. We define spillovers for each firm f as the "leave-out mean", $\overline{interbank}_{sp(f)06}$, i.e., the average exposure to the interbank market of all other firms in the same 2-digit sector s and province p (excluding the exposure of firm f). We then run a regression like in Table 3, column 3 including as an additional regressor the leave-out mean.[23] The coefficient of $\overline{interbank}_{sp(f)06}\times$post2006 is the estimate of the spillovers while the coefficient of $interbank_{f,06}\times$post2006 is the direct effect as in the rest of the analysis.

Table B.6 reports the results. We find spillovers of the same sign and of equal magnitude as the direct effect.[24] This suggests that our partial equilibrium results underestimate the aggregate effects. According to our estimates, a 10-pp higher exposure to the shock (which corresponds to the difference between the 90^{th} and the 10^{th} percentile of the shock distribution) reduces firm size growth by 1.0 pp per year due to direct exposure and by an additional 1.3 pp per year due to spillovers. Given that firm size growth in our sample dropped on av-

[22] Access to market finance by Italian firms is low, also because of their small average size. In our sample, the mean firm size is around 30 employees, see Table 1.

[23] As the spillovers are defined at the 2-digit sector-province level, this regression includes firm, 2-digit-sector, province and year fixed effects.

[24] Huber (2022) also finds spillovers of similar size as the direct effect in the case of a credit shock in Germany.

erage by 7 pp per year in the period 2007-2018, the credit supply shock accounts for 33% of this drop (14% direct effect and 19% through spillovers).

5 Worker-level effects

In this section, we study the effects of the credit shock at the worker level. First, we analyze the effects on workers' career trajectories in the medium-long run, distinguishing between stayers and movers. We then test whether employment opportunities have deteriorated more for some groups of workers than for others, and the resulting distributional consequences. Specifically, we look at workers with different skills and examine how they relocate across firms with high or low capital intensity. Finally, we assess how earnings losses depend on local labor market tightness.

5.1 Overall effect on workers

Figure 4 and Table 4 display the effects of being employed in 2006 by firms borrowing from banks that used to be more exposed to the interbank market (using as a control group workers employed in less exposed firms). We estimate the impact on: total labor earnings (Figure 4, panel a and Table 4, column 1); the yearly number of days worked in any firm (Figure 4, panel c and Table 4, column 3); and daily wages in any firm (Figure 4, panel e and Table 4, column 4; normalized to 1 in 2006). To understand whether the shock was borne mostly by workers who remained employed in the same firm as in 2006 ("stayers") or by individuals who were forced or preferred to change firms ("movers"), we also run estimates looking only at the number of days worked in the 2006 firm (Figure 4, panel b and Table 4, column 2) and at wages for stayers only (Figure 4, panel d and Table 4, column 5).

Panel a of Figure 4 shows that labor earnings are persistently lower for workers who were employed prior to the crisis by firms more exposed to the credit shock. The earnings' losses persist until at least 2016 and are mainly due to a drop in the number of days worked in the original, pre-crisis, firm (panel b). By comparing panel b with panel c, we deduce that some of these workers manage to find new jobs in other firms but –compared with workers in less exposed firms– the number of days worked did not fully recover by 2018 (in line with Yagan (2019), who documents employment hysteresis after the GFC in the US). We do not detect any statistically significant effect on daily wages among stayers (panel d), while for movers we find some downward wage adjustment in certain years (panel e). The results in Table 4 for the entire post-period confirm the year-by-year estimates.

All estimates are robust to the inclusion of 2-digit sector×year and province×year fixed effects or sector×year×province fixed effects–see Table C.1, panels a and b in Appendix C. Moreover, we obtain similar estimates, of slightly smaller size, if we relax the workers' minimum tenure requirement during the 3-year-period before 2006 to at least 100 days instead of 600 days –see Table C.1, panel c in Appendix C.

Overall, we find that a worker employed in a firm 10-pp more exposed to the credit shock (which corresponds to the difference between the 10^{th} and the 90^{th} percentiles of exposure and to a 2 pp reduction in yearly credit growth at the firm level) experiences a drop of around 1% in average yearly labor earnings over the period 2007-2018. This amounts to around 250 euros per year. However, these are average effects on all workers, not only on displaced workers. If we focus solely on displaced workers, the reduction in earnings is about 15%, around 3,950 euros per year, which lies within the range of earnings' losses typically found in the literature on mass layoffs (e.g., Lachowska et al., 2020; Schmieder et al., 2023).

5.2 Evidence of capital-skill complementarities at the worker level

The discussion in Section 4.2.2 points to capital-skill complementarities as the main mechanism underlying our results. In what follows, we run further tests at the worker level that support this hypothesis. First, we study whether workers employed by high capital-intensive firms in 2006 were more severely affected. Then, we examine whether the impact of the credit shock and its interaction with the firms' capital intensity is heterogeneous among workers with different skills, as proxied by their pre-crisis wage or occupation, and among workers in different local labor markets.

5.2.1 Firms' capital intensity and worker level outcomes

Figure 5 investigates whether workers from high capital-intensive firms suffered the largest consequences of the credit shock.[25] It shows indeed that the decrease in labor earnings (panel a) and the employment losses (panel b) were concentrated among those workers. Additionally, workers who separated from high capital-intensive firms encountered major difficulties in finding new jobs (panel c) and had to accept jobs on lower wage trajectories in the medium to long term (panel e).

[25] Specifically, in line with the firm level estimates displayed in Figure 3, we estimate equation 3 separately on the sample of workers employed by high and low capital-intensive firms in 2006. Moreover, to ensure that capital intensity does not reflect differences in liquidity or indebtedness, we include the controls discussed in Section 4.2.2.

To assess the relative contribution of days worked and daily wages for the overall effect on labor earnings of workers employed by high-capital intensive firms, we decompose in Appendix D the effect on earnings into three components: first, changes in days worked per year; second, changes in daily wages; and third, their interaction, using an approach similar to that proposed in Schmieder et al. (2023). Figure D.1 shows that changes in days worked account for the largest share of the effect on earnings in the short term (2009-2011). In the long term, the contribution of wages becomes more relevant, as workers start to find new jobs but are on lower wage trajectories.

Figure C.1 in Appendix C further explores the heterogeneity of the effect of the credit shock by the degree of capital intensity of the firms where these workers were employed in 2006. To do so, we change progressively the threshold that defines low and high capital-intensive firms. The results again show that the effect of the credit shock becomes stronger, the higher the K/L ratio at the firm level before 2006.

We then analyze the role of labor adjustments along the intensive and extensive margins, distinguishing between workers who were formerly employed by more and less capital-intensive firms. Panels a, b and c of Figure C.2 in Appendix C show the results on the extensive margin; that is on the probability of being employed by the original or by any firm for at least one day in the considered year and on the probability of permanently exiting the labor market (i.e., not appearing in the Social Security data anymore).[26] Panels d and e report the effects on the intensive margin; that is, on the number of days worked per year if employed and on the incidence of part-time work among employees. We find that workers from more exposed firms are less likely to be employed (both by any and by the 2006 firm), and have a significantly higher probability of permanently exiting the labor market relative to the other workers. Moreover, the effect is almost entirely concentrated among individuals employed in high capital-intensive firms (blue line). By contrast, the adjustment at the intensive margin seems small and rather transitory both among workers employed by high and low capital-intensive firms.

5.2.2 Heterogeneous effects by workers' skills and local labor market conditions

As discussed in Section 3.1, if firms' responses are driven by capital-skills complementarities, high-skilled workers –who are more likely to be complementary to capital– should experience more severe earnings losses and face greater difficulties in finding new jobs. We thus use the

[26] This could occur either because workers exit the labor force, retire, become self-employed or migrate to another country.

pre-GFC wage (in 2006) as a proxy for workers' skills and run separate regressions for high-wage and low-wage workers employed by high and low capital-intensive firms in 2006.

Table 5 and Figure C.3 in Appendix C present the results. Table 5, column 1, shows that the credit shock generated the largest earnings losses among high-wage workers who were employed in 2006 by high capital-intensive firms (compare panels a and b). In particular, these workers have an increased likelihood of separation from the 2006 firm (column 2), consistent with the notion that high capital-intensive firms fire workers complementary to capital. A similar pattern emerges when we distinguish between white-collar and blue-collar workers (Table 5, panels c and d). Since wage and occupation can both be considered as a proxy for skills, these findings further support the capital-skill complementarity channel. Moreover, these results point out an important specificity of credit shocks, whose labor market effects differ significantly from those of trade shocks for instance, that are concentrated among low-skilled workers who are substituted for low-cost imported goods (see Autor et al., 2014; Utar, 2018; and Dauth et al., 2021).

Regarding the persistence of the effects, Panel b of Figure C.3 in Appendix C shows that the negative impact on labor earnings among high-wage workers is long lasting. Indeed, displaced high-wage workers encounter greater difficulties in finding new jobs (panel f) and experience significant wage penalties in the new jobs (panel h), especially in the long run. Figure D.2 in Appendix D decomposes the effect on earnings of low-wage (panel a) and high-wage workers (panel b). The two panels show that wage losses contribute to a large share of earnings losses only among high-wage workers.

To further evaluate the allocation process of displaced workers to other firms after the shock, we look at the characteristics of the new firms employing workers who find new employment and at their capital intensity in particular. Our working hypothesis is that displaced workers may face different labor markets after the credit shock. Indeed, –as shown in Section 4– firms have become on average less capital intensive (and therefore less willing to hire high-wage workers). This could force workers either to accept lower wages or to remain unemployed. The literature on mass layoffs has widely investigated the role of the quality of the new firm in explaining the size of the earnings' losses borne by displaced workers, finding mixed results (e.g., Lachowska et al., 2020; Schmieder et al., 2023; Gulyas and Pytka, 2019).

To analyze reallocation, in the spirit of Utar (2018) and Dauth et al. (2021), we decompose the total effect on the number of days worked (reported in column 1 of Table 6) into three components: first, the number of days lost in the original firm (column 2); second, the number of days recovered because displaced workers found jobs in a new firm of higher capital intensity than the 2006 firm (column 3); and third, the number of days recovered

because displaced workers found jobs in a new firm of equal or lower capital intensity than the 2006 firm (column 4). Panel a confirms that workers employed in 2006 by firms more exposed to the shock are less likely to stay with the 2006 firm (column 2). By comparing columns 3 and 4, we see that some workers manage to reallocate, but mainly towards firms with capital-to-labor ratio below that of the firm they were employed by in 2006; these effects, again, are concentrated on employees who were employed by high capital-intensive firms in 2006 (compare panels b and c).[27]

Finally, we document how our worker-level effects differ depending on the cyclical conditions of the labor markets within which the firms and workers are located. The existing literature finds that the costs of job displacement are largely cyclical (Davis and Von Wachter, 2011; Farber, 2017; Schmieder et al., 2023), with workers who are displaced during recessions bearing twice as large earnings' losses than those displaced during economic booms. Moreover, the existing evidence shows that the characteristics of the pool of unemployed workers vary over the business cycle (Mueller, 2017), implying heterogeneous employment prospects among workers along the cycle. Evidence of the cyclicality of the observed earnings' losses can guide future government interventions: if the drop in demand also depends on the economic cycle, these workers should also be assisted through the use of counter-cyclical social safety nets; if instead it only depends on a structural change (as the previously documented permanent shifts in labor demand), it will be necessary to intervene mainly through structural measures (such as specific job training programs). Our shock measure is particularly suitable for this test because it varies at the firm level rather than at the local level and is spread across geographical areas in a way that is uncorrelated with the local average unemployment rate (Figure A.1 in Appendix A). It is therefore straightforward to compare workers employed by similarly hit firms, located in local labor markets that face heterogeneous economic conditions.

More specifically, we interact the credit shock with the yearly unemployment rate in the province of the firm where each worker was employed in 2006, prior to the shock. Table C.3 shows that a high local unemployment rate in conjunction with the exposure to the credit shock exacerbates earnings losses (panel a, column 1). Moreover, while overall there is a limited amount of insurance within the firm (panel a, column 5, first row), wages of stayers significantly adjust downwards in high unemployment regions (panel a, column 5, second row). This suggests that wages of incumbents, which are typically thought to be rigid, do in fact react to labor market slack and to the reduced outside option for workers under high

[27] We reach similar conclusions if we decompose labor earnings instead of the number of days worked –see Table C.2 in Appendix C.

unemployment conditions. When distinguishing between workers who were employed before the shock by high and low capital-intensive firms (panels b and c), we find that employment losses are larger among more exposed workers in high capital-intensive firms located in areas with higher local unemployment rates.

Overall, our results point to a demand-side mechanism behind the persistent employment and earnings losses of high-wage workers. The credit shock affected all firms exposed to interbank-funded banks, but its impact was amplified for those with a high capital-to-labor ratio before the shock. These firms persistently reduce their labor demand, with particularly negative consequences for white-collar and high-wage workers. Some of the displaced high-skilled workers move to less capital-intensive firms and accept flatter wage trajectories, while others permanently exit the labor market pointing to a feedback effect of this channel on a reduction in labor supply. Finally, these effects are exacerbated when the local unemployment rate is higher and therefore workers have lower bargaining power.

6 Conclusions

More than a decade after the 2007-2008 global financial crisis, it is now possible to analyze whether and to what extent this remarkable event has had persistent effects on firms and their employees. To answer this question, we use a unique matched bank-employer-employee dataset that enables us to construct a firm-specific shock to credit supply in order to study the effect of credit restrictions on labor market outcomes up to 11 years after the shock first impacted the economy.

Our results indicate substantial effects of credit restrictions on firms and workers, which tend to persist in the long run. Thus, an analysis confined to the short-run effect would only provide a partial picture of the overall effect of credit shocks on labor earnings and on the workers' reallocation process. Indeed, we find that firms that experience a restriction to credit supply face on average a persistently higher probability of exiting the market, permanently shrink in size, and disinvest. Moreover, workers who were formerly employed by these firms experience a significant reduction in labor earnings, compared to those employed by less exposed firms. The effect on earnings is sizeable and persistent over time. The earnings of workers employed in firms at the 90^{th} percentile of the distribution of our firm-level measure of exposure to the shock were (and remained so at the end of the sample) around 1% lower per year than those of workers employed in firms at the 10^{th} percentile of the shock distribution: this loss amounts to approximately 15% if we only consider displaced workers. In the short run, this permanent loss in earnings is mainly caused by a reduction in days worked by more

exposed individuals; in the medium-long run, it is largely driven by lower wage growth among previously displaced employees who find new jobs in firms with weaker career prospects.

Furthermore, we shed light on the mechanisms behind the observed employment and earnings losses. Our findings point to a specificity in the way credit shocks affect workers, relative to other shocks such as those to international trade. In line with the hypothesis that credit restrictions increase the cost of capital financing, we document that the effects at the firm level are larger for more capital-intensive firms, which then reduce labor demand permanently. Moreover, we show that high-skilled workers suffer the largest earnings losses both in the short and in the long term. This is mainly explained by a demand-side mechanism. As the credit shock reduces investments, firms (especially if high capital intensive) lay off employees who are complementary to capital; that is, high-wage and white-collar workers. Subsequently, these workers have considerable difficulty in finding new employment and, when they do so, it is mostly in firms with lower capital intensity that offer flatter wage trajectories in the medium/long term.

More broadly, our paper speaks to the debate about how financial shocks affect the dispersion of labor income through its heterogeneous effects on workers' wages and employment prospects. This topic has gathered high attention from policy-makers and academics, in light of the substantial increase in inequality observed in the last decades, in particular after the outbreak of the GFC (Hoynes et al., 2012; Coibion et al., 2017; Mumtaz and Theophilopoulou, 2017). We show that the credit shock significantly affected the earnings distribution of workers, that the effects were persistent over time and that they depended on the complementarity of workers' skills with capital.

Our results provide valuable insights to policymakers. They indicate the importance of immediate policy responses to any shock that leads to a halt in corporate financing. Indeed, the effects of even short-term shocks to credit supply can be permanent due to potentially persistent shifts in labor demand. Immediate action can avert the enduring consequences of persistent capital reductions by firms and the risk of workers falling into prolonged unemployment with stagnant wage growth. Moreover, we document that the brunt of credit supply shocks is disproportionately borne by high-skilled workers who were previously employed by capital-intensive firms. It is therefore crucial, following credit shocks, to augment traditional social safety nets, primarily crafted to protect low-skilled individuals, with targeted measures tailored to high-skilled workers, aimed for instance at preventing human capital depreciation.

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Tables and Figures

Table 1: Summary statistics - firm level

	Unweighted			Weighted (PSM)		
	Most treated top 33^{th} exp. [1]	Least treated others [2]	Diff [3]	Most treated top 33^{th} exp. [4]	Least treated others [5]	Diff [6]
Firm level variables (characteristics in 2002-2006)						
Interb.	0.174	0.091	-0.083***	0.167	0.098	-0.070***
	(0.075)	(0.037)	(-218.47)	(0.064)	(0.031)	(-150.33)
Credit score > 6	0.245	0.254	0.009**	0.240	0.242	0.002
	(0.430)	(0.435)	(3.03)	(0.427)	(0.428))	(0.54)
Year of foundation	1985.629	1986.292	0.663***	1986.010	1985.924	-0.087
	(10.280)	(9.885)	(11.17)	(10.008)	(10.047)	(-0.83)
North	0.615	0.639	0.024***	0.626	0.628	0.002
	(0.487)	(0.480)	(8.53)	(0.484)	(0.483)	(0.37)
South	0.187	0.172	-0.014***	0.167	0.164	-0.003
	(0.390)	(0.378)	(-6.39)	(0.373)	(0.371)	(-0.73)
Manufacturing	0.434	0.407	-0.028***	0.490	0.490	0.000
	(0.496)	(0.491)	(-9.52)	(0.500)	(0.500)	(0.00)
Size	30.298	22.796	-7.502***	33.876	34.184	0.308
	(44.116)	(34.706)	(-30.90)	(44.072)	(44.463)	(0.63)
Av. wage	1596.390	1485.414	-110.976***	1675.339	1676.806	1.467
	(550.885)	(486.180)	(-35.63)	(528.981)	(528.557)	(0.26)
Net revenues	8271.531	6495.578	-1775.953***	7697.530	7753.822	56.292
	(14334.200)	(12149.951)	(-18.28)	(12615.342)	(12999.190)	(0.39)
Credit/assets	52.128	52.970	0.842***	53.299	53.505	0.206
	(30.435)	(31.081)	(3.86)	(30.403)	(31.020)	(0.65)
K/L	58.344	57.296	-1.048	56.008	56.106	0.099
	(81.160)	(80.110)	(-1.81)	(76.891)	(73.511)	(0.13)
Current ratio	0.557	0.651	0.093***	0.352	0.357	0.006
	(0.549)	(0.567)	(28.79)	(0.531)	(0.537)	(1.07)
Leverage	0.783	0.793	0.011***	0.782	0.781	-0.001
	(0.175)	(0.178)	(8.46)	(0.174)	(0.179)	(-0.48)
Observations	42945	92208	135153	26823	18760	45583

Note: Standard deviation in parentheses (columns 1, 2, 4, 5); t-statistics (columns 3 and 6). Most treated are firms in the top 33^{th} percentile of exposure to the interbank market in 2006. Columns 4, 5 and 6 show summary statistics after having matched the most exposed firms with similar ones that are less exposed. The variable interb. is the firm's exposure to the interbank market as defined in equation 1.

Table 2: Summary statistics - worker level

	Unweighted			Weighted (PSM)		
	Most treated top 33^{th} exp. [1]	Least treated others [2]	Diff. [3]	Most treated top 33^{th} exp. [4]	Least treated others [5]	Diff. [6]
Firm level variables (characteristics in 2006 of 2006 firms)						
Interb.	0.171	0.108	-0.063***	0.172	0.110	-0.062***
	(0.060)	(0.028)	(-58.21)	(0.061)	(0.027)	(-53.34)
Size	3010.152	1277.525	-1732.627	926.053	1207.868	281.816
	(10953.587)	(4095.735)	(0.90)	(2381.615)	(3353.831)	(1.09)
Av. wage	2221.274	2031.739	-189.535***	2206.480	2171.424	-35.057
	(847.638)	(727.351)	(-5.61)	(821.568)	(799.593)	(-1.08)
Firm age	21.022	22.149	1.128**	21.467	21.963	0.496
	(13.183)	(12.957)	(1.85)	(13.093)	(14.122)	(0.87)
Manufacturing	0.561	0.552	-0.008	0.591	0.593	0.002
	(0.496)	(0.497)	(-0.35)	(0.492)	(0.491)	(0.14)
Worker level variables (in 2006)						
Age	43.548	43.411	-0.137	43.484	43.503	-0.019
	(7.010)	(7.022)	(-1.48)	(7.019)	(6.998)	(-0.24)
Female	0.305	0.318	0.012	0.302	0.298	0.004
	(0.461)	(0.466)	(1.54)	(0.459)	(0.457)	(0.46)
Blue Collar	0.531	0.588	0.056***	0.551	0.555	0.004
	(0.499)	(0.492)	(2.78)	(0.497)	(0.497)	(0.29)
High-wage worker	0.554	0.473	-0.081***	0.544	0.531	-0.013
	(0.497)	(0.499)	(5.08)	(0.498)	(0.499)	(1.23)
Tenure $<$ 6 years	0.417	0.434	0.017	0.433	0.431	0.001
	(0.493)	(0.496)	(1.15)	(0.495)	(0.495)	(0.11)
Daily wage	95.411	88.026	-7.385***	94.735	95.708	-0.973
	(80.010)	(59.019)	(-6.98)	(79.980)	(77.187)	(-0.51)
Days worked	298.514	297.493	-1.021**	298.522	298.056	-0.466
	(42.867)	(43.975)	(-2.05)	(42.912)	(43.515)	(-0.89)
Labor earnings	28204	25972	-2232***	27988	28280	-293
	(18379)	(15163)	(-6.52)	(17737)	(20689)	(-0.51)
Observations	1108539	2250934	3359473	980763	673988	1654751

Note: Standard deviation in parentheses (columns 1, 2, 4, 5); t-statistics (columns 3 and 6). Most treated are firms in the top 33^{th} percentile of exposure to the interbank market in 2006. Columns 4, 5 and 6 show summary statistics after having matched the workers employed in the most exposed firms with similar workers working in the least exposed firms (all other firms). The variable interb. is the 2006 firm's exposure to the interbank market as defined in equation 1. High-wage workers are workers whose wage in 2006 was above the median.

Table 3: Firm level evidence

Dep var:	Credit growth [1]	1=Exit [2]	Size growth [3]	Wage growth [4]	Investment [5]
interb.×post2006	-0.201***	-0.005	-0.097***	-0.010	-0.069***
	(0.056)	(0.008)	(0.022)	(0.007)	(0.022)
N	519704	609266	645388	641072	596471
Firm FE	Yes	Yes	Yes	Yes	Yes
st FE	Yes	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes	Yes

Note: Firm level analysis. The dummy exit is a dummy equal to 0 for all the years a firm operates in the market and 1 for the first year the firm exits the market. Sample column [1]: only years when receiving credit; sample column [2]: only years when the firm operates in the market and the first year after the firm exits; sample columns [3] and [4]: only years the firm operates in the market; sample column [5]: only years when balance sheet information is available. The variable interb. is the firm's exposure to the interbank market as defined in equation 1. The regressions include firm, province×year and sector×year fixed effects. Standard errors clustered at the firm level and at the level of the main 2006 bank identifier in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Worker level evidence

Dep var:	Earnings	N days empl		Daily wage (2006=1)	
		2006 firm (0 if moving)	any firm	any firm	if they stay (. if moving)
	[1]	[2]	[3]	[4]	[5]
interb.×post2006	-2452.159**	-47.490***	-24.229***	-0.036	-0.011
	(984.804)	(13.288)	(7.155)	(0.026)	(0.025)
N	1654751	1654751	1654751	1471086	1135590
$\overline{y}$	26163.439	203.219	257.985	1.160	1.133
Worker FE	Yes	Yes	Yes	Yes	Yes
st FE	Yes	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes	Yes

Note: Worker level analysis. The variable interb. is the 2006 firm's exposure to the interbank market as defined in equation 1. The regressions include worker, sector (of the 2006 firm) × year and province (of the 2006 firm) × year fixed effects. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of those firms. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Worker level evidence - heterogeneity by workers' wage and occupation

Dep var:	Earnings	N days empl		Daily wage (2006=1)	
		2006 firm (0 if moving)	any firm	any firm	if they stay (. if moving)
	[1]	[2]	[3]	[4]	[5]
		Panel a: *High wage*			
interb.×post2006	-1212.908	-3.260	-28.746**	0.010	0.003
	(1519.013)	(17.886)	(13.411)	(0.028)	(0.032)
interb.×post2006×high K/L	-10390.631*	-128.110**	-36.998	-0.127**	-0.052
	(5731.215)	(52.176)	(29.592)	(0.063)	(0.063)
N	823646	823646	823646	752724	590411
		Panel b: *Low wage*			
interb.×post2006	-1280.067	-33.594***	-17.339	-0.025	-0.016
	(789.678)	(10.829)	(10.491)	(0.072)	(0.068)
interb.×post2006×high K/L	-1309.264	-32.003	-5.921	-0.055	-0.015
	(1744.531)	(63.627)	(23.790)	(0.067)	(0.083)
N	749015	749015	749015	644529	489612
		Panel c: *White collars and Managers*			
interb.×post2006	1495.990	4.096	-0.444	-0.057	-0.059
	(2204.309)	(13.372)	(13.349)	(0.039)	(0.049)
interb.×post2006 × high K/L	-6774.664	-114.608***	-14.952	-0.135*	-0.097
	(6387.514)	(32.879)	(25.589)	(0.071)	(0.089)
N	683266	683266	683266	611610	468385
		Panel d: *Blue collars*			
interb.×post2006	-2866.798***	-32.207**	-32.333***	0.010	0.004
	(897.401)	(12.561)	(8.685)	(0.061)	(0.056)
interb.×post2006×high K/L	-3349.118	-46.584	-18.195	-0.029	0.017
	(2254.758)	(47.455)	(18.422)	(0.046)	(0.056)
N	889412	889412	889412	785681	611690
Worker FE	Yes	Yes	Yes	Yes	Yes
st FE	Yes	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes	Yes

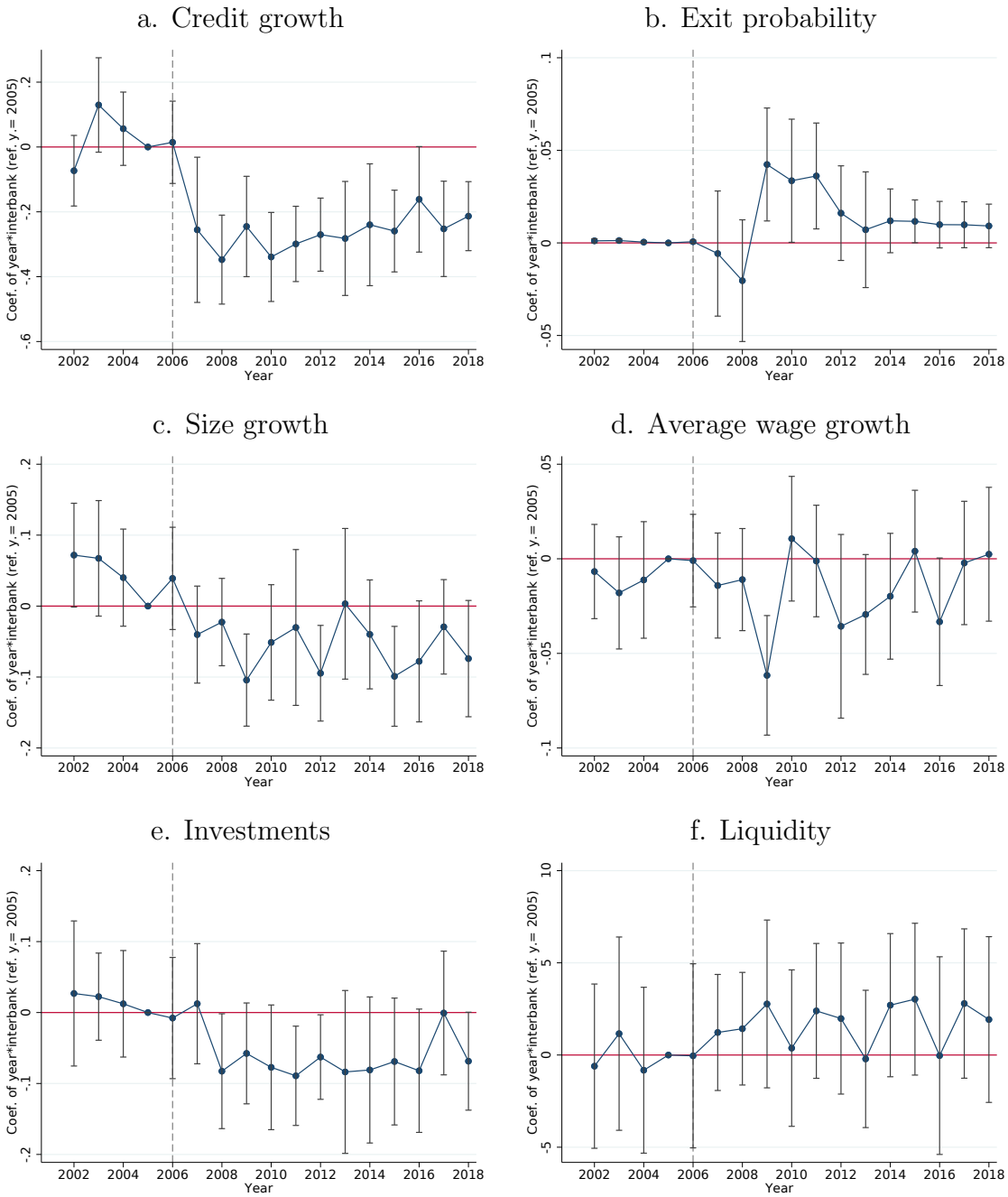
Note: Worker level analysis. High-wage workers are workers whose wage in 2006 was above the median. High K/L if the firm lies in the top tercile of the distribution of the average K/L between 2002 and 2006. The variable interb. is the 2006 firm's exposure to the interbank market as defined in equation 1. Additional controls: worker fixed effects; sector (of the 2006 firm) × year and province (of the 2006 firm) × year fixed effects, interacted with a dummy indicating whether the firm was high K/L; dummies indicating high leverage and low liquidity firms, interacted with interbank exposure × post and with year fixed effects. High leverage is a dummy indicating whether the firm where the workers were employed in 2006 lies in the top tercile of the distribution of the average leverage level between 2002 and 2006; low liquidity is a dummy indicating whether the firm lies in the bottom tercile of the distribution of the average liquidity level between 2002 and 2006. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of these firms. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Allocation after the shock - Days worked decomposition by K/L, all workers

	Overall		Stayers		Movers	
	Any firm		2006 firm		higher K/L	lower K/L
	[1]	=	[2]	+	[3]	+ [4]
			Panel a: *All*			
interb.×post2006	-24.716**		-47.512***		-0.605	23.412**
	(9.477)		(17.382)		(8.917)	(8.982)
N	1525155		1525155		1525155	1525155
			Panel b: *from high* K/L			
interb.×post2006	-66.677**		-128.172***		-3.634	65.143**
	(25.658)		(41.464)		(18.787)	(32.841)
N	518022		518022		518022	518022
			Panel c: *from low* K/L			
interb.×post2006	-17.670		-7.682		-23.634*	13.651
	(10.931)		(22.889)		(13.577)	(10.034)
N	1007086		1007086		1007086	1007086
Worker FE	Yes		Yes		Yes	Yes
st FE	Yes		Yes		Yes	Yes
pt FE	Yes		Yes		Yes	Yes

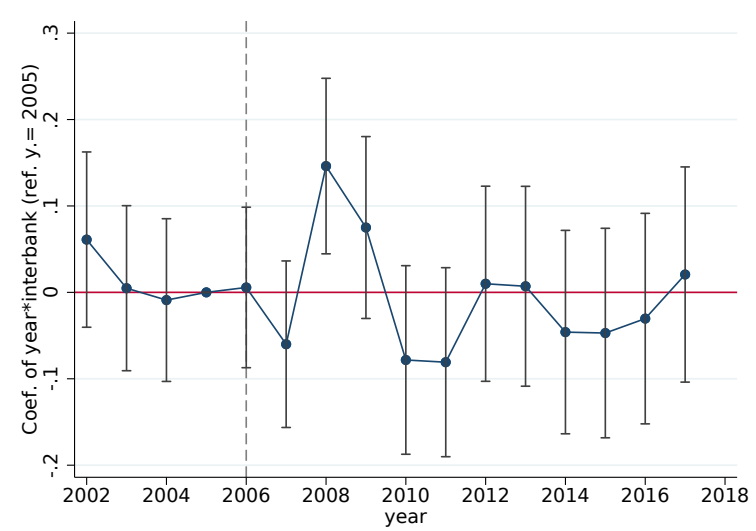
Note: Worker level analysis. The sum of the coefficients of columns 2, 3 and 4 gives the coefficient displayed in column 1. The table displays coefficients of regressions similar to the ones reported in Table 4, where the dependent variable is in column 3 the number of days worked in firms with higher K/L relative to the 2006 firm (and 0 otherwise); in column 4 the number of days worked in firms with lower K/L relative to the 2006 firm (and 0 otherwise). Interbank is the 2006 firm's exposure to the interbank market as defined in equation 1. The regressions include worker, sector (of the 2006 firm) × year fixed effects and province (of the 2006 firm) × year fixed effects. In panels b and c, the regressions also interact all fixed effects by whether the 2006 firm was high K/L (its average K/L in 2002-2006 lies above the 66^{th} percentile). Additional controls: dummies indicating high leverage and low liquidity firms, interacted with interbank exposure × post and with year fixed effects. High leverage is a dummy indicating whether the firm where the workers were employed in 2006 lies in the top tercile of the distribution of the average leverage level between 2002 and 2006; low liquidity is a dummy indicating whether the firm lies in the bottom tercile of the distribution of the average liquidity level between 2002 and 2006. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of those firms. The number of observations (and the coefficient) of column 1 panel a is not exactly the same as that reported in column 2 of Table 4 because we exclude less than 8% of observations referring to individuals who were re-employed in firms with missing values of K/L. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: Effect on credit growth, exit probability, firms' size growth, average wage growth per employee, investments and liquidity growth



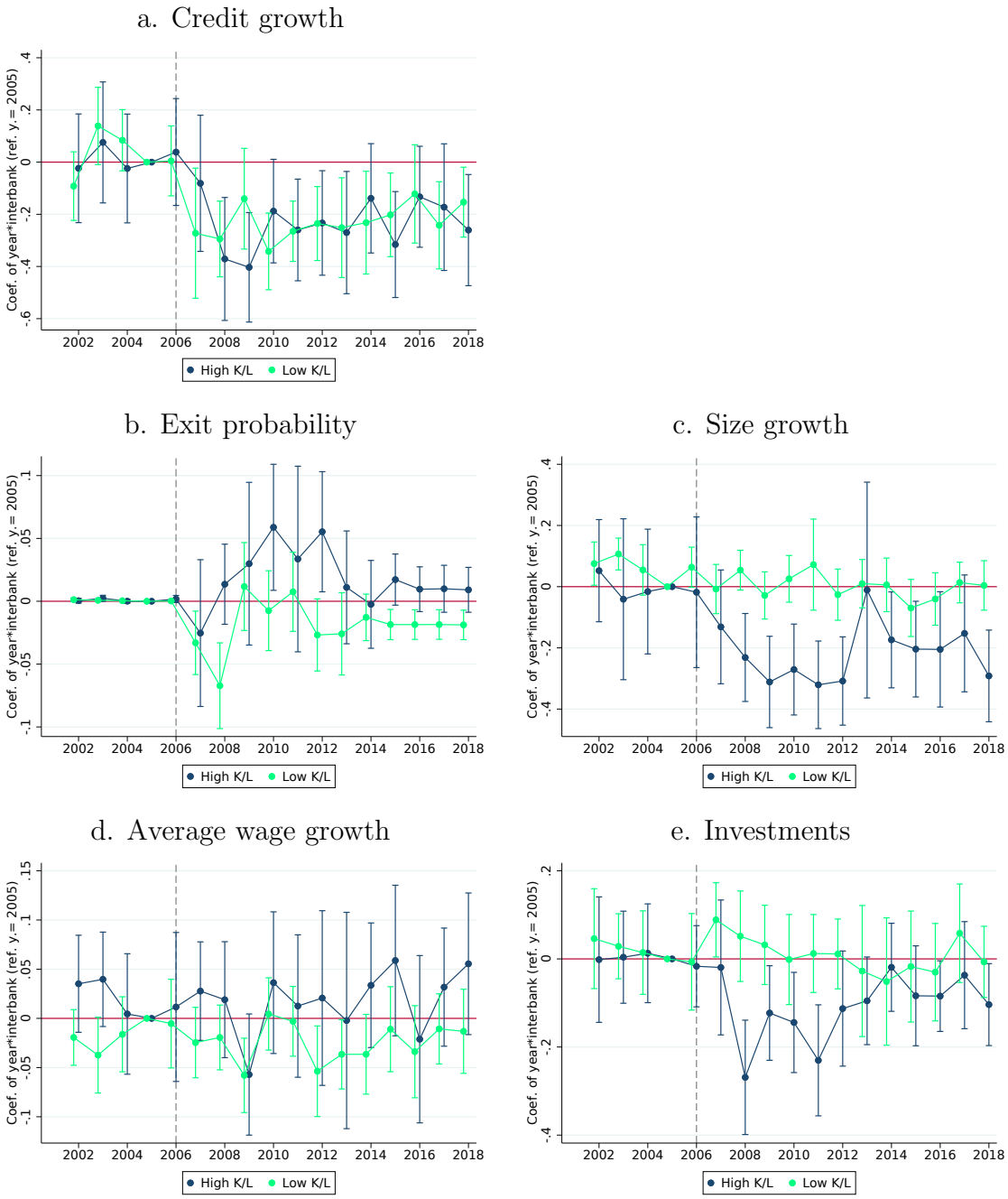
Note: Firm level analysis. The graph displays coefficients of the interactions of firms' exposure to the interbank market with year dummies (γ_t in equation 2). Vertical bars represent 95% confidence intervals. Interbank is defined in equation 1. The regressions include firm, province×year and sector×year fixed effects. Standard errors clustered at the firm level and at the level of the main bank identifier in parentheses.

Figure 2: Effect on the probability of requesting credit from new banks



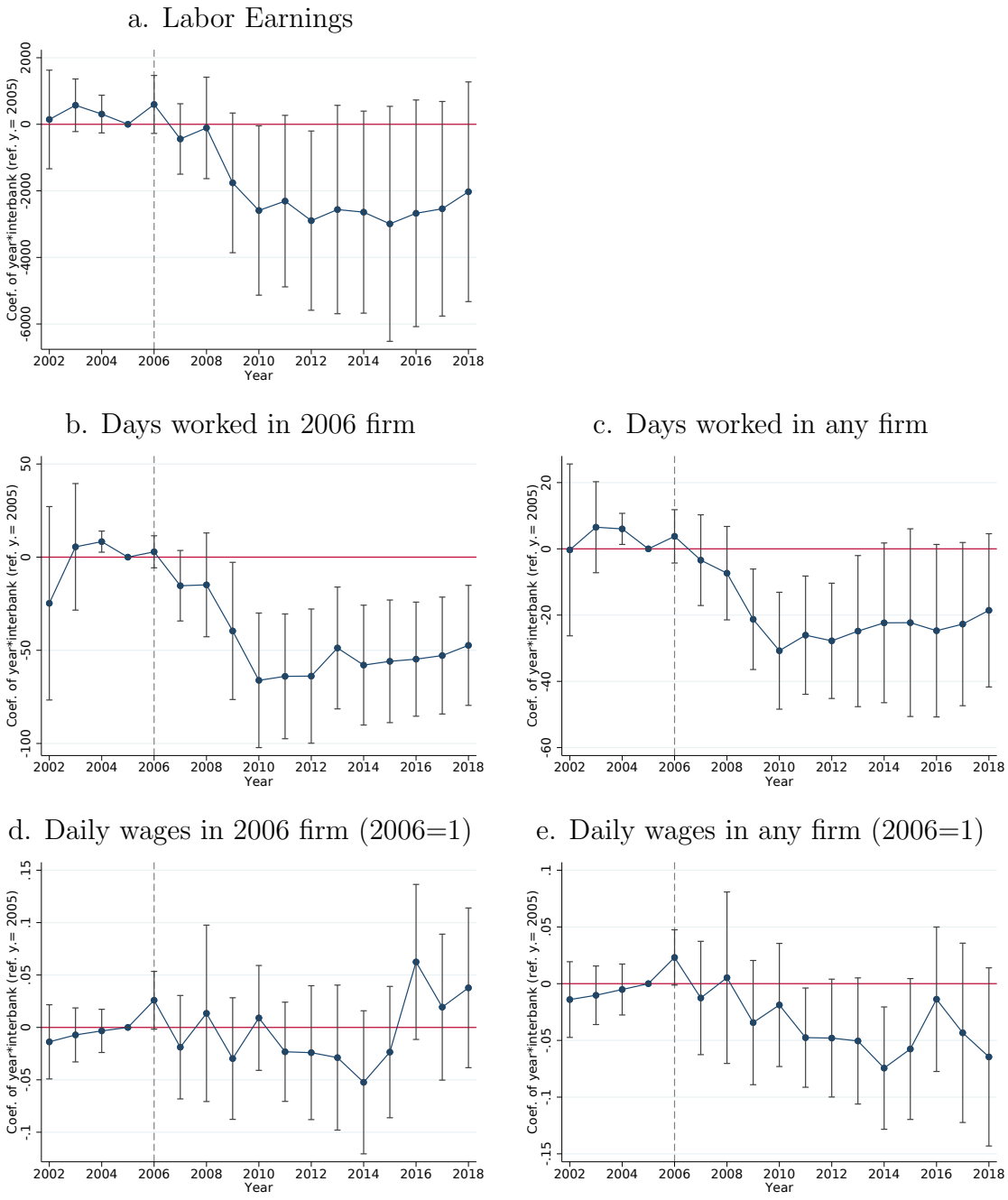
Note: Firm level analysis. Loan application data. The graph displays coefficients of the interactions of firms' exposure to the interbank market with year dummies. Vertical bars represent 95% confidence intervals. Interbank is defined in equation 1. Standard errors clustered at the firm level. Additional controls: firm and year fixed effects.

Figure 3: Effect on credit growth, exit probability, firms' size growth, average wage growth per employee and investment by K/L



Note: Firm level analysis. The graph displays coefficients of the interactions of firms' exposure to the interbank market with year dummies (γ_t in equation 2) for high and low K/L firms. Vertical bars represent 95% confidence intervals. Interbank is defined in equation 1. High K/L if the firm's average K/L in 2002-2006 is above the 66^{th} percentile. The regressions include firm, province×year and sector×year fixed effects. Moreover, they control for an indicator for whether the firm was highly indebted (average leverage in 2002-2006 above the 66^{th} percentile) × the post-2006 indicator, its interaction with the degree of exposure to the interbank market in 2002-2006, an indicator for whether the firm had low liquidity (average current ratio in 2002-2006 below the 33^{th} percentile) × the post-2006 indicator, and its interaction with the degree of exposure to the interbank market in 2002-2006. Standard errors are clustered at the firm level and at the level of the main bank identifier in parentheses.

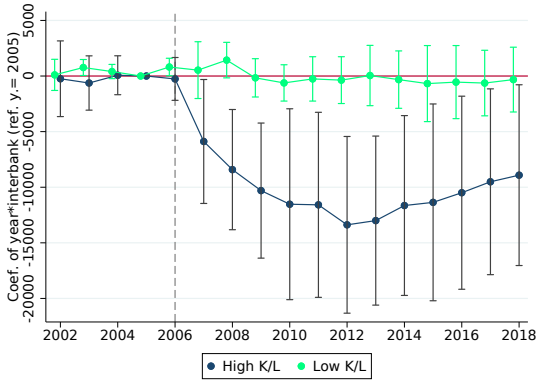
Figure 4: Effect on workers' earnings, days worked and daily wages



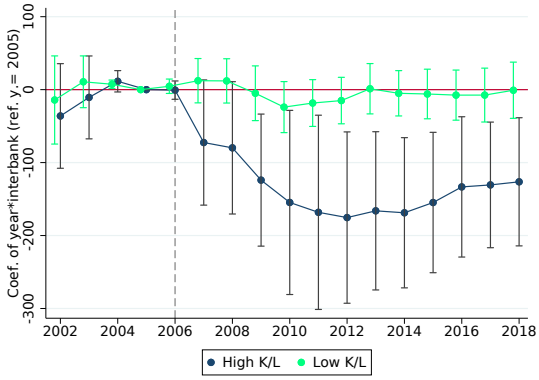
Note: Worker level analysis. The graph displays coefficients of the interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies (β_t in equation 3). Vertical bars represent 95% confidence intervals. Interbank is defined in equation 1. The regressions control for worker, sector (of the 2006 firm) $\times$ year and province (of the 2006 firm) $\times$ year fixed effects. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of those firms.

Figure 5: Effect on workers' earnings, days worked and daily wages by K/L

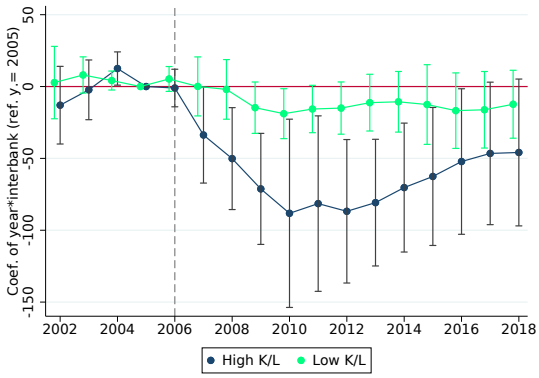
a. Labor Earnings



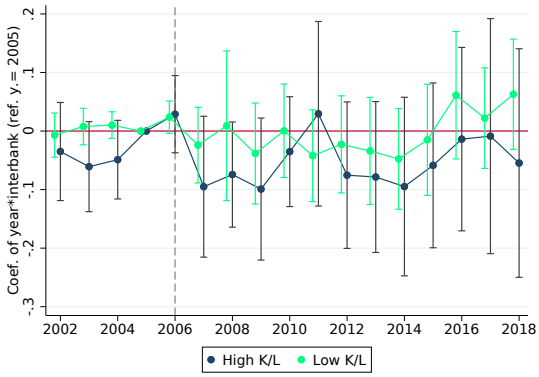
b. Days worked in 2006 firm



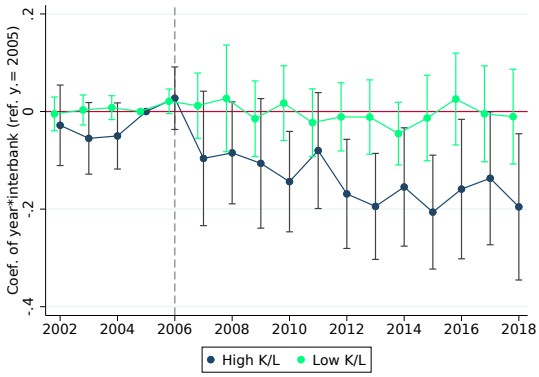
c. Days worked in any firm



d. Daily wages in 2006 firm (2006=1)



e. Daily wages in any firm (2006=1)



Note: Worker level analysis. The graph displays coefficients of the interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies (β_t in equation 3) coming from two separate regressions estimated on the sample of high and low K/L firms. High K/L if the 2006 firm's average K/L in 2002-2006 was above the 66^{th} percentile. Vertical bars represent 95% confidence intervals. Interbank is defined in equation 1. The regressions control for worker, sector (of the 2006 firm) $\times$ year, province (of the 2006 firm) $\times$ year fixed effects, an indicator for whether the 2006 firm was highly indebted (average leverage in 2002-2006 above the 66^{th} percentile) $\times$ the post-2006 indicator, its interaction with the degree of exposure to the interbank market in 2002-2006, an indicator for whether the 2006 firm had low liquidity (average current ratio in 2002-2006 below the 33^{th} percentile) $\times$ the post-2006 indicator, and its interaction with the degree of exposure to the interbank market in 2002-2006. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of those firms.

The Long-term Earnings Effects of a Credit Market Disruption: Online Appendix

A Appendix A - Robustness checks for the identification strategy

Figure A.1: Province level dispersion of interbank exposure

Note: Unemployment rate at the province level (average 2002-2016) and share of firms highly exposed to the interbank market (above the 66^{th} percentile in 2006) in the same province.

Table A.1: Correlation between interbank funding ratio and bank characteristics

Dep var:	Interbank/Assets		
	[1]	[2]	[3]
capital ratio	-0.00753	-0.0122	-0.0116
	(0.0129)	(0.0138)	(0.0120)
bank roa	0.725	0.732	0.643
	(0.917)	(0.906)	(0.834)
liquidity ratio	-0.0904**	-0.0900**	-0.0729**
	(0.0355)	(0.0378)	(0.0350)
retail deposits/assets	-0.208***	-0.204***	-0.203***
	(0.0436)	(0.0435)	(0.0435)
bad loans/assets	0.312	0.342	0.122
	(0.214)	(0.221)	(0.219)
interest rate on assets	0.000433	0.000332	
	(0.000442)	(0.000502)	
log(bank assets)	0.176		0.413
	(0.387)		(0.404)
2^{nd} size decile		0.102	
		(1.075)	
3^{rd} size decile		-0.712	
		(1.058)	
4^{th} size decile		-2.005**	
		(0.824)	
5^{th} size decile		-0.838	
		(1.041)	
6^{th} size decile		-2.764***	
		(0.986)	
7^{th} size decile		-2.266**	
		(1.013)	
8^{th} size decile		-1.234	
		(1.140)	
9^{th} size decile		1.398	
		(1.852)	
10^{th} size decile		0.394	
		(3.293)	
2^{nd} interest rate decile			-2.287
			(2.030)
3^{rd} interest rate decile			0.935
			(2.659)
4^{th} interest rate decile			-1.958
			(1.999)
5^{th} interest rate decile			-2.466
			(1.957)
6^{th} interest rate decile			-2.840
			(1.963)
7^{th} interest rate decile			-2.629
			(2.279)
8^{th} interest rate decile			-2.455
			(1.976)
9^{th} interest rate decile			-0.949
			(2.232)
10^{th} interest rate decile			3.199
			(3.118)
Constant	12.89***	14.56***	12.64***
	(4.058)	(2.721)	(4.229)
Observations	463	463	463
R^2	0.282	0.297	0.318

Note: Regression at the bank level of the interbank funding ratio on bank characteristics. Data are from bank balance sheet data from the Supervisory reports (average 2003-2006). Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table A.2: Share of firm-level credit from banks more exposed to the interbank market in 2006

Dep var:	Delta % credit 2005-2000	
	[1]	[2]
interb.$_b$	0.001	0.001
	(0.000)	(0.003)
% credit 2000		-1.009***
		(0.006)
Observations	538169	538169
Firm FE	Yes	Yes

Note: Regressions at the bank-firm level. They show whether the change in the pre-crises share of credit of different banks lending to firm f is correlated to the banks' exposure to interbank markets (average interbank funding to total assets in 2003-2006, denoted as interb.$_b$). Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table A.3: Correlation between bank characteristics as of 2010-2011 and interbank exposure as of 2006 at the bank level

	capital/assets	tier1/assets	capital/rwa	roa	govt bonds/assets
	[1]	[2]	[3]	[4]	[5]
interb.$_b$	-0.0221	-0.0116	-0.0217	-0.000242	-0.162***
	(0.0169)	(0.0173)	(0.0388)	(0.00467)	(0.0509)
Observations	469	469	469	469	469
R^2	0.192	0.252	0.132	0.017	0.151

Note: Regressions at the bank level. They show correlations between banks' exposure to interbank markets (average interbank funding to total assets in 2003-2006, denoted as interb.$_b$) and measures of capital, profitability, and exposure to the sovereign debt crisis (averages between June 2010 and June 2011). All regressions include dummies for deciles of bank assets. Data are from the Supervisory Reports. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4: Change in bank's average cost of funding

Dep var:	Change in average cost of funding	
	2006-2010	2011-2015
	[1]	[2]
interb.$_b$	0.0484**	0.000735
	(0.0238)	(0.0130)
initial cost of funding (level)	-1.285**	-0.388**
	(0.521)	(0.166)
Observations	448	443
R^2	0.119	0.085

Note: Regressions at the bank level. They show correlations between banks' exposure to interbank markets (average interbank funding to total assets 2003-2006, denoted as interb.$_b$) and the change in the average cost of funding between 2006 and 2010 in column 1, and 2011-2015 in column 2. All regressions include dummies for deciles of bank assets. Data are from the Supervisory Reports. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.5: Effects on interest rates - loan level regressions

Dep. var:	Interest rate		
	[1]	[2]	[3]
interb.	0.131***		
	(0.022)		
interb.×post2006	-0.005	0.009	-0.011
	(0.019)	(0.018)	(0.010)
Observations	948,469	948,467	909,051
R^2	0.596	0.608	0.772
Firm-year FE	Yes	Yes	Yes
Bank FE	No	Yes	No
Firm-bank FE	No	No	Yes

Note: Regressions at the loan level. They show that banks did not transmit the shock to interest rates. The regression in column [1] includes firm-year fixed effects, in column [2] firm-year and bank fixed effects, and in column [3] firm-year and firm-bank fixed effects. The variable interb. is the firm's exposure to the interbank market as defined in equation 1. In line with existing studies (Cingano et al., 2016; Rodano et al., 2018; Sette and Gobbi, 2015), the Table considers interest rates on overdraft loans, as these are a homogeneous type of loans, very common among firms, with no pre-specified maturity, as they are revolving facilities and typically uncollateralized. Note that these tests have some data limitations because of limited information on the maturity of the loan (only available in coarse categories, i.e. below 1 year, between 1 and 5 years, above 5 years) or on the value of the collateral (we only observe whether the loan is backed by real collateral or not, and in this case the minimum between the value of the loan and the value of the collateral, so we cannot compute a loan to value ratio). Robust standard errors clustered at the banking group level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B Appendix B - Robustness checks and additional results for the firm level analysis

Table B.1: Firm level evidence - 2SLS

Dep var:	1=Exit	Size growth	Wage growth	Investment
	[1]	[2]	[3]	[4]
Credit growth	-0.105***	0.409***	0.084***	0.578***
	(0.004)	(0.012)	(0.003)	(0.016)
Observations	585391	580172	576534	567943
Firm FE	Yes	Yes	Yes	Yes
st FE	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes

Note: Firm level analysis. Sample columns [1], [2] and [3]: firms-years for which the first stage is defined; sample column [4]: firms-years for which the first stage is defined and there is available balance sheet information. The regressions include firm, province×year and sector×year fixed effects. Kleibergen-Paap rk Wald F statistic of the first stage: 363.51. Standard errors clustered at the firm level and at the level of the main 2006 bank identifier in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B.2: Robustness - firm level evidence

Dep var:	Credit growth	1=Exit	Size growth	Wage growth	Investments
	[1]	[2]	[3]	[4]	[5]
	Panel a: Sector 2d×Year FE, Province×Year FE				
interb.×post2006	-0.298***	0.013	-0.096***	-0.009	-0.069***
	(0.055)	(0.009)	(0.023)	(0.007)	(0.022)
Observations	583922	699680	645372	641056	596455
	Panel b: Sector×Year×Province FE				
interb.×post2006	-0.289***	0.013	-0.092***	-0.010	-0.069***
	(0.060)	(0.009)	(0.022)	(0.007)	(0.023)
Observations	581925	697693	643499	639207	594489
Firm FE	Yes	Yes	Yes	Yes	Yes

Note: Firm level analysis. The dummy exit is a dummy equal to 0 for all the years a firm operates in the market and 1 for the first year the firm exits the market. Sample column [1]: only years when receiving credit; sample column [2]: only years when the firm operates in the market and the first after the firm exits; sample column [3] and [4]: only years the firm operates in the market; sample column [5]: only years when balance sheet information is available. The variable interb. is the firm's exposure to the interbank market as defined in equation 1. Standard errors clustered at the firm level and at the level of the main 2006 bank identifier in parentheses. The table reports non-singleton observations. *** p<0.01, ** p<0.05, * p<0.1.

Table B.3: Summary statistics by K intensity - firm level

	High K/L [1]	others [2]
Firm level variables (characteristics in 2002-2006)		
Interb.	0.131	0.133
	(0.056)	(0.063)
Credit score > 6	0.256	0.234
	(0.436)	(0.424)
Year of foundation	1984.569	1986.594
	(10.444)	(9.770)
North	0.607	0.636
	(0.489)	(0.481)
South	0.204	0.148
	(0.403)	(0.356)
Manufacturing	0.516	0.479
	(0.500)	(0.500)
Size	37.750	32.362
	(49.398)	(41.656)
Av. wage	1734.355	1649.936
	(543.507)	(519.908)
Net revenues	11056.316	6232.072
	(16609.625)	(10330.366)
Credit/assets	53.446	53.383
	(29.238)	(31.352)
Current ratio	0.243	0.404
	(0.431)	(0.567)
Leverage	0.735	0.803
	(0.187)	(0.167)
Observations	13970	31613

Note: Standard deviation in parentheses. High K/L are firms above the 66^{th} percentile of the distribution of the average K/L ratio between 2002 and 2006. The variable interb. is the firm's exposure to the interbank market as defined in equation 1.

Table B.4: Effects on credit - loan level regressions

Dep. var:	Log(Credit)			
	[1]	[2]	[3]	[4]
interb.×high K/L	-0.185	-0.122	-0.092	
	(0.208)	(0.227)	(0.239)	
interb.×post2006	-0.863***	-0.583**		
	(0.238)	(0.265)		
interb.×post2006×high K/L	0.0217	-0.0360	-0.0632	-0.0274
	(0.140)	(0.158)	(0.167)	(0.0893)
Observations	2225717	2225717	2225510	2173809
R^2	0.655	0.688	0.691	0.913
Firm-year FE	Yes	Yes	Yes	Yes
Bank FE	No	Yes	No	No
Bank-year FE	No	No	Yes	Yes
Firm-bank FE	No	No	No	Yes

Note: Regressions at the loan level. They show that the effect on credit is homogeneous among firms of different capital intensity. The regression in column [1] includes firm-year fixed effects, in column [2] firm-year and bank fixed effects, in column [3] firm-year and bank-year fixed effects, and in column [4] firm-year, bank-year and firm-bank fixed effects. The variable interb. is the firm's exposure to the interbank market as defined in equation 1. Robust standard errors clustered at the bank level in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table B.5: Firm level evidence - heterogeneity by high and low K/L with 2SLS

Dep var:	1=Exit	Size growth	Wage growth	Investment
	[1]	[2]	[3]	[4]
Credit growth	0.011	0.202***	0.044**	0.111
	(0.019)	(0.052)	(0.019)	(0.075)
Credit growth×high K/L	-0.095***	0.332***	-0.083*	0.324***
	(0.028)	(0.110)	(0.042)	(0.108)
Observations	583901	578747	575099	566519
Firm FE	Yes	Yes	Yes	Yes
st FE	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes

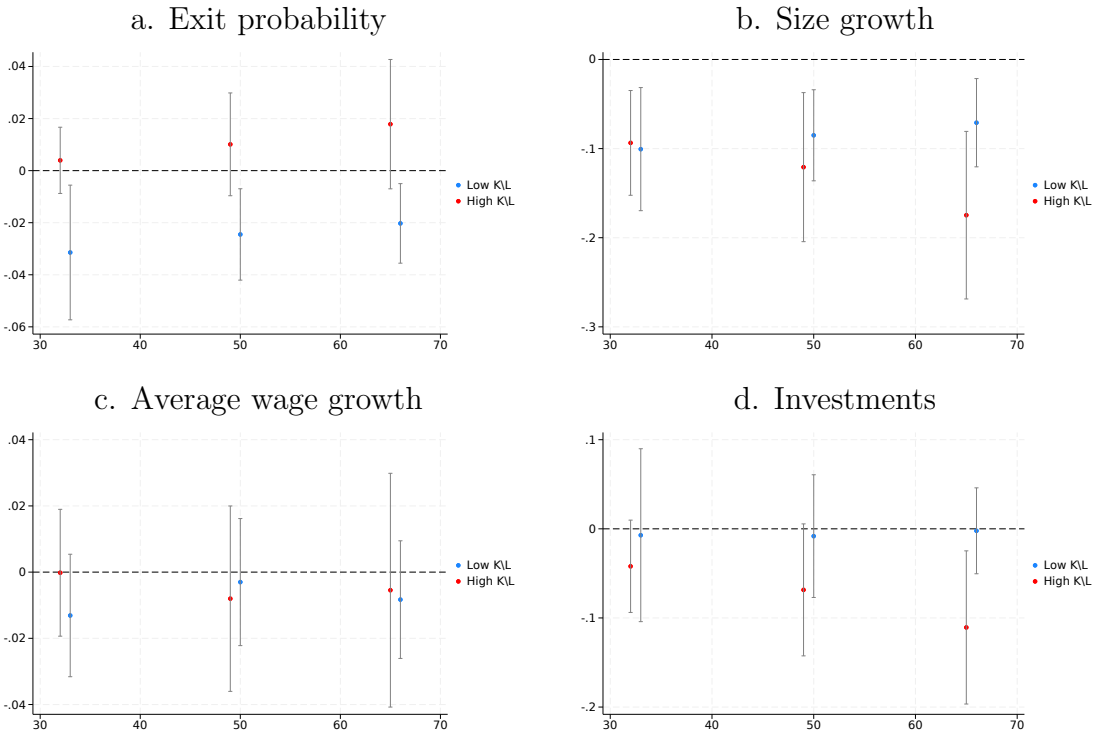
Note: Firm level analysis. Sample columns [1], [2] and [3]: firms-years for which the first stage is defined; sample column [4]: firms-years for which the first stage is defined and there is available balance sheet information. High K/L if the firm lied above the 66^{th} percentile of the distribution of the average K/L between 2002 and 2006. The regressions include firm, province×year, sector×year fixed effects and an indicator for whether the firm was high K/L × the post 2006 indicator. Moreover, they control for an indicator for whether the firm was highly indebted in 2002-2006 (leverage above the 66^{th} percentile) × the post 2006 indicator and an indicator for whether the firm had low liquidity in 2002-2006 (credit ratio below the 33^{th} percentile) × the post 2006 indicator Kleibergen-Paap rk Wald F statistic of the first stage: 12.65. Standard errors clustered at the firm level and at the level of the main 2006 bank identifier in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B.6: Direct and spillover effects

Dep. var:	Size growth [1]
Direct effect	
$interb_f \times$post2006	-0.099***
	(0.028)
Spillover effect	
$\overline{interb}_{sp(f)} \times$post2006	-0.130***
	(0.038)
Observations	632,701
Firm FE	Yes
s FE	Yes
p FE	Yes
t FE	Yes

Note: Firm level analysis. The sample includes only years the firm operates in the market and for which the leave-out mean $\overline{interb}_{sp(f)}$ can be computed. The variable interb. is firm's f exposure to the interbank market as defined in equation 1. The leave-out mean is the average exposure to the interbank market of all other firms in the same province-2 digit sector as firm f (excluding the exposure of firm f). The regressions include firm, 2-digit sector, province, and year fixed effects. Standard errors clustered at the firm level and at the level of the main 2006 bank identifier in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure B.1: Heterogeneity by capital intensity, firm level



Note: Firm level analysis. The figure plots the coefficients of the main effect (interb.×post2006) for high and low K/L firms obtained by estimating separate firm level regressions. Each regression uses a different decile of the distribution of K/L variable to define high K/L firms (as indicated in the x axis). The variable interb. is the firm's exposure to the interbank market as defined in equation 1.

C Appendix C - Robustness checks and additional results for the worker level analysis

Table C.1: Robustness - worker level evidence

Dep var:	Earnings	N days empl		Daily wage (2006=1)	
		2006 firm (0 if moving)	anyfirm	any firm	if they stay (. if moving)
	[1]	[2]	[3]	[4]	[5]
Panel a: Sector 2d×Year FE, Province×Year FE					
interb.×post2006	-2421.789***	-47.819***	-24.543***	-0.029	-0.004
	(847.602)	(12.505)	(5.825)	(0.028)	(0.028)
Observations	1654751	1654751	1654751	1471086	1135590
Panel b: Sector×Year×Province FE					
interb.×post2006	-2279.579*	-37.776***	-21.965**	-0.038	-0.021
	(1309.280)	(14.197)	(8.602)	(0.025)	(0.023)
Observations	1653942	1653942	1653942	1470176	1134520
Panel c: All workers in the 2006 firm for at least 100 days between 2003 and 2005					
interb.×post2006	-1666.339*	-28.008*	-20.188**	-0.008	-0.001
	(933.489)	(16.274)	(8.165)	(0.026)	(0.026)
Observations	2467211	2467211	2467211	2069155	1439470
Worker FE	Yes	Yes	Yes	Yes	Yes

Note: Worker level analysis. The regressions include worker fixed effects. Panel a includes firm, province×year, sector (2 digit)×year fixed effects; panel b includes firm, sector (1 digit)×province×year fixed effects; panel c includes province×year, sector (1 digit)×year fixed effects (as in the baseline regressions) and enlarges the sample to all workers employed by the 2006 firm for at least 100 days in the 3 years previous to the shock (instead of 600 days). The variable interb. is the 2006 firm's exposure to the interbank market as defined in equation 1. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of those firms. *** p<0.01, ** p<0.05, * p<0.1.

Table C.2: Allocation after the shock - Earnings decomposition by K/L, all workers

	Overall		Stayers		Movers	
	Any firm		2006 firm		higher K/L	lower K/L
	[1]	=	[2]	+	[3]	+ [4]
			Panel a: *All*			
interb.×post2006	-2435.840*		-4137.683**		-272.489	1974.332**
	(1308.235)		(1736.766)		(1018.301)	(758.142)
N	1525155		1525155		1525155	1525155
			Panel b: *from high* K/L			
interb.×post2006	-10294.734**		-13361.107***		-2426.621	5492.993**
	(4395.204)		(4487.704)		(2309.555)	(2248.216)
N	518022		518022		518022	518022
			Panel c: *from low* K/L			
interb.×post2006	-804.517		28.739		-2104.517	1271.261
	(1327.633)		(2248.786)		(1598.104)	(891.098)
N	1007086		1007086		1007086	1007086
Worker FE	Yes		Yes		Yes	Yes
st FE	Yes		Yes		Yes	Yes
pt FE	Yes		Yes		Yes	Yes

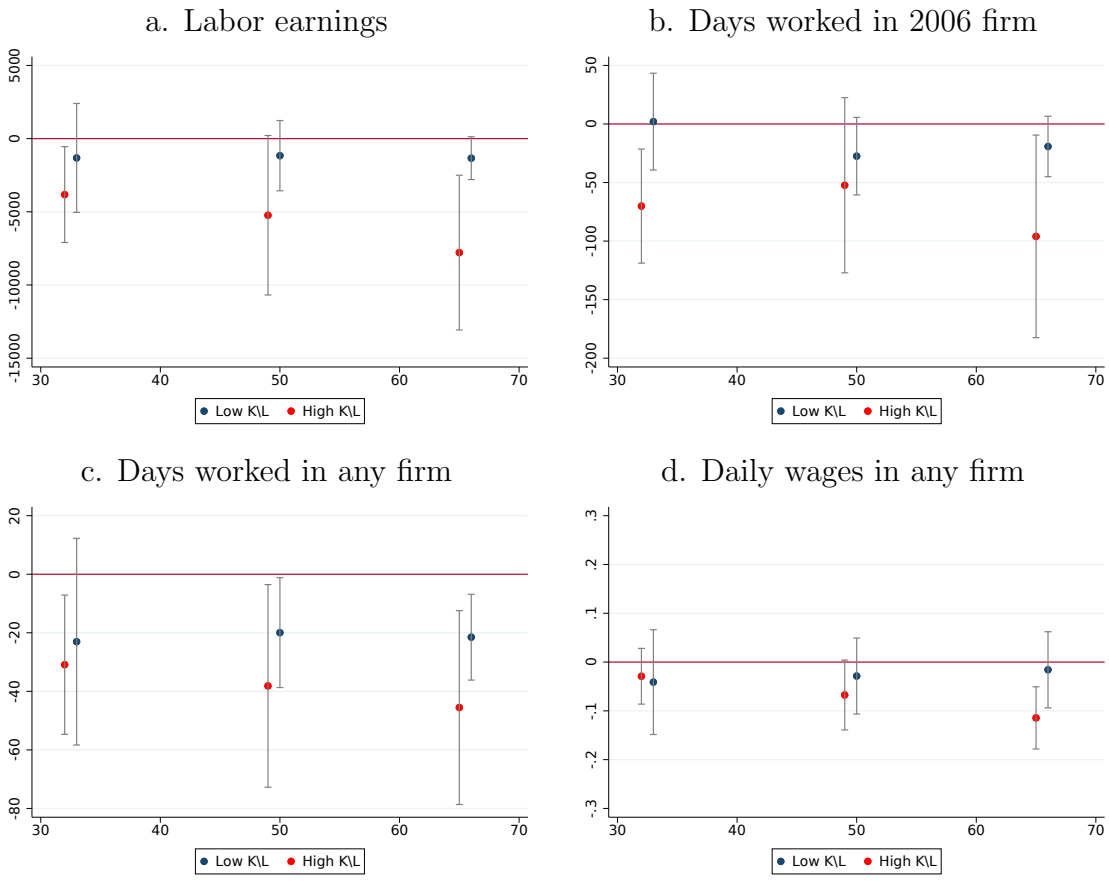
Note: Worker level analysis. The sum of the coefficients of columns [2], [3] and [4] gives the coefficient displayed in column [1]. The table displays coefficients of regressions similar to the ones reported in Table 4, where the dependent variable is in column [3] labor earnings in firms with higher K/L relative to the 2006 firm (and 0 otherwise); in column [4] labor earnings in firms with lower K/L relative to the 2006 firm (and 0 otherwise). The variable interb. is the 2006 firm's exposure to the interbank market as defined in equation 1. The regressions include worker, sector (of the 2006 firm) × year, province (of the 2006 firm) × year fixed effects. In panels b and c, the regressions also interact all fixed effects by whether the firm was high K/L. High K/L if the 2006 firm was highly capital intensive (average K/L in 2002-2006 above the 66^{th} percentile). Additional controls in panels b and c: an indicator for whether the 2006 firm was highly indebted (average leverage in 2002-2006 above the 66^{th} percentile) × the post-2006 indicator, its interaction with the degree of exposure to the interbank market in 2002-2006, an indicator for whether the 2006 firm had low liquidity (average credit ratio in 2002-2006 below the 33^{th} percentile) × the post 2006 indicator, and its interaction with the degree of exposure to the interbank market in 2002-2006. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of those firms. The number of observations (and the coefficient) of column 1 panel a is not exactly the same as that reported in column 1 of Table 4 because we exclude less than 8% of observations referring to individuals who were re-employed in firms with missing values of K/L. *** p<0.01, ** p<0.05, * p<0.1.

Table C.3: Worker level evidence - heterogeneity by local unemployment rate

Dep var:	Earnings	N days empl		Daily wage (2006=1)	
		2006 firm (0 if moving)	anyfirm	any firm	if they stay (. if moving)
	[1]	[2]	[3]	[4]	[5]
		Panel a: *All*			
interb.×post2006	-1852.198*	-31.666**	-19.511**	-0.021	-0.019
	(939.681)	(14.730)	(7.457)	(0.027)	(0.025)
interb.×post2006×UR	-1417.392***	-20.263*	-8.137	-0.025	-0.034*
	(482.568)	(12.112)	(5.779)	(0.016)	(0.020)
N	1653942	1653942	1653942	1471086	1134520
		Panel b: *from high K/L firms*			
interb.×post2006	-9936.484**	-99.333***	-55.390**	-0.097*	-0.034
	(4590.352)	(30.735)	(26.204)	(0.049)	(0.057)
interb.×post2006×UR	-2692.382**	-57.587***	-22.960**	-0.057*	-0.020
	(1290.320)	(10.378)	(10.269)	(0.031)	(0.049)
N	532006	532006	532006	481868	383839
		Panel c: *from low K/L firms*			
interb.×post2006	14.414	2.322	-11.902	-0.007	-0.029
	(1111.978)	(20.898)	(9.171)	(0.048)	(0.047)
interb.×post2006×UR	-959.674	-5.799	-3.583	-0.021	-0.036*
	(626.077)	(13.048)	(7.219)	(0.017)	(0.021)
N	1037935	1037935	1037935	912456	693116
Worker FE	Yes	Yes	Yes	Yes	Yes
st FE	Yes	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes	Yes

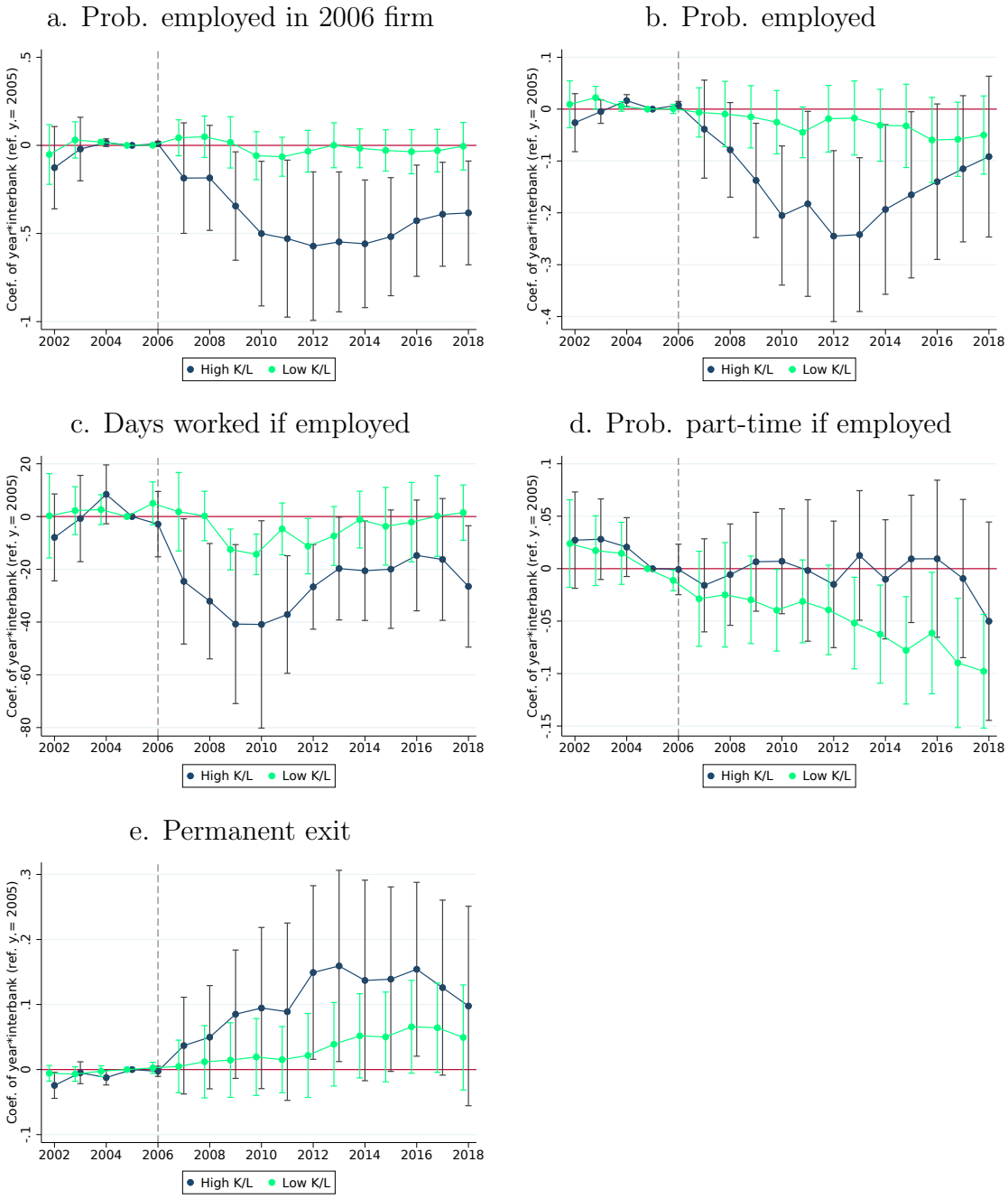
Note: Worker level analysis. The unemployment rate (UR) has been standardized to have mean 0 and standard deviation 1. High K/L if the 2006 firm was highly capital intensive (average K/L in 2002-2006 above the 66^{th} percentile). The variable interb. is the 2006 firm's exposure to the interbank market as defined in equation 1. The regressions include worker, sector (of the 2006 firm) × year and province (of the 2006 firm) × year fixed effects. In panels b and c, additional controls: an indicator for whether the 2006 firm was highly indebted (average leverage in 2002-2006 above the 66^{th} percentile) × the post 2006 indicator, its interaction with the degree of exposure to the interbank market in 2002-2006, an indicator for whether the 2006 firm had low liquidity (average credit ratio in 2002-2006 below the 33^{th} percentile) × the post 2006 indicator, and its interaction with the degree of exposure to the interbank market in 2002-2006. Standard errors are clustered at the province level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure C.1: Heterogeneity by capital intensity, worker level



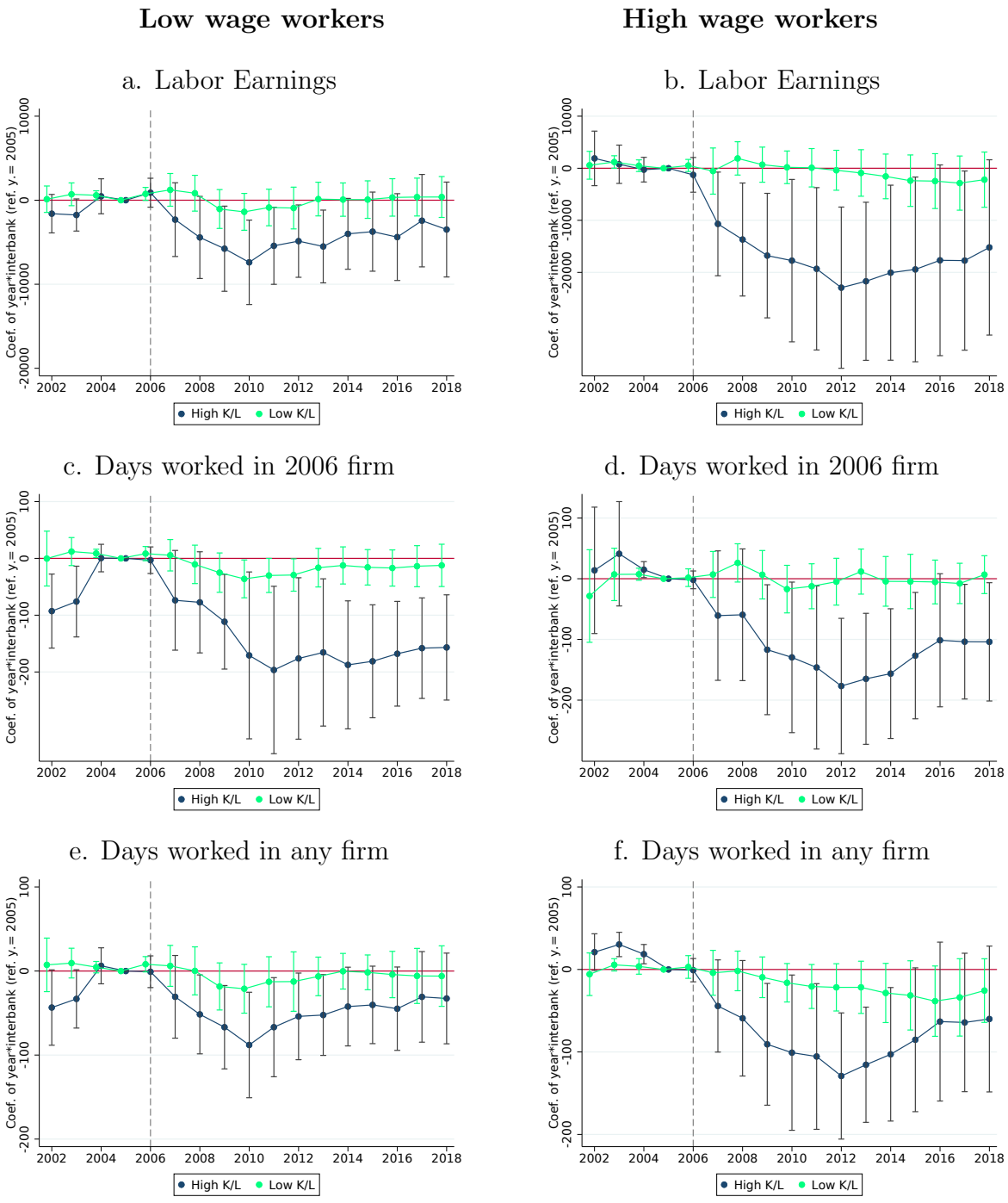
Note: Worker level analysis. The figure plots the coefficients of the main effect (interb.×post2006) for high and low K/L firms obtained by estimating separate worker level regressions. Each regression uses a different decile of the distribution of K/L variable to define high K/L firms (as indicated in the x axis). The variable interb. is the 2006 firm's exposure to the interbank market as defined in equation 1.

Figure C.2: Intesive and extensive margin adjustments, by K/L

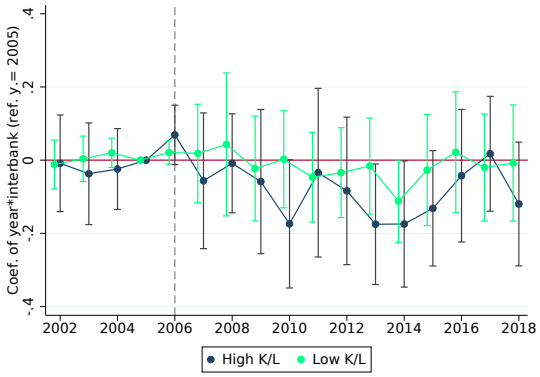


Note: Worker level analysis. The graph displays coefficients of the interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies (β_t in equation 3) coming from two separate regressions estimated on the sample of high and low K/L firms. High K/L if the 2006 firm was highly capital intensive (average K/L in 2002-2006 above the 66^{th} percentile). Interbank is defined in equation 1. Vertical bars represent 95% confidence intervals. The regressions control for worker, sector (of the 2006 firm) $\times$ year, province (of the 2006 firm) $\times$ year fixed effects, an indicator for whether the 2006 firm was highly indebted (average leverage in 2002-2006 above the 66^{th} percentile) $\times$ the post 2006 indicator, its interaction with the degree of exposure to the interbank market in 2002-2006, an indicator for whether the 2006 firm had low liquidity (average credit ratio in 2002-2006 below the 33^{th} percentile) $\times$ the post 2006 indicator, and its interaction with the degree of exposure to the interbank market in 2002-2006. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of those firms.

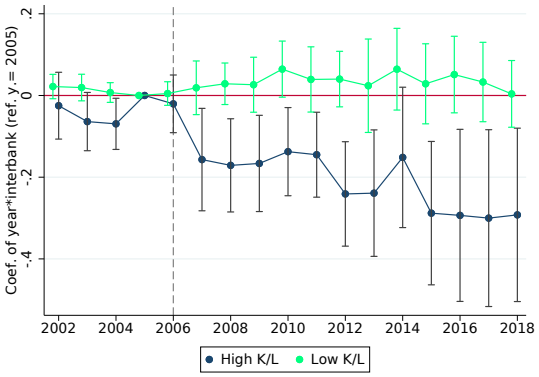
Figure C.3: Effect by workers' wage - high and low K/L firms in 2006



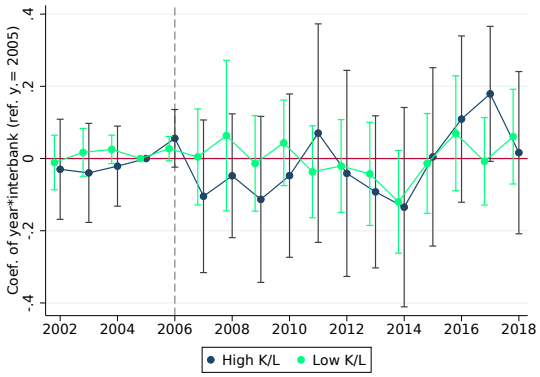
g. Daily wages in any firm (2006=1)



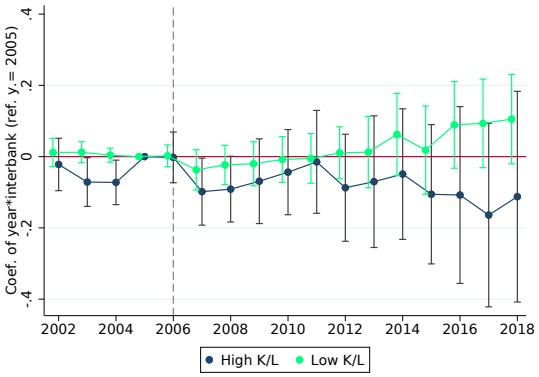
h. Daily wages in any firm (2006=1)



i. Daily wages in 2006 firm (2006=1)



j. Daily wages in 2006 firm (2006=1)



Note: Worker level analysis. The graph displays coefficients of the interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies (β_t in equation 3) coming from two separate regressions estimated on the sample of high and low K/L firms. High K/L if the 2006 firm was highly capital intensive (average K/L in 2002-2006 above the 66^{th} percentile). Vertical bars represent 95% confidence intervals. Interbank is defined in equation 1. The regressions control for worker, sector (of the 2006 firm) $\times$ year, province (of the 2006 firm) $\times$ year fixed effects, an indicator for whether the 2006 firm was highly indebted (average leverage in 2002-2006 above the 66^{th} percentile) $\times$ the post 2006 indicator, its interaction with the degree of exposure to the interbank market in 2002-2006, an indicator for whether the 2006 firm had low liquidity (average credit ratio in 2002-2006 below the 33^{th} percentile) $\times$ the post 2006 indicator, and its interaction with the degree of exposure to the interbank market in 2002-2006. High-wage workers are workers whose wage in 2006 was above the median. Standard errors are clustered at the province level, at the level of the 2006 firm identifier and at the level of the main 2006 bank of those firms.

D Appendix D - Decomposing earnings losses

To assess how much of the drop in yearly earnings is due to a reduction in the number of days worked per year or a reduction in daily wages (for those who work), we perform a decomposition in the spirit of Schmieder et al. (2023).

The change in earnings between year t and the base year (2006) $\Delta E_t = E_t - E_{06}$ can be written as:

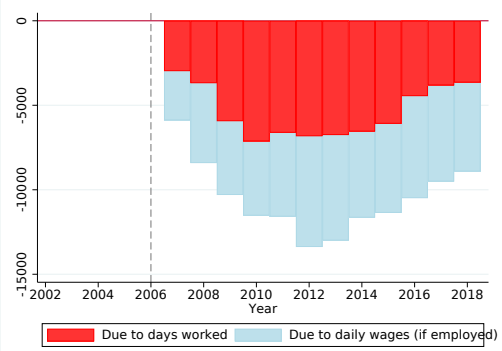
$$\Delta E_t = \Delta L_t * w_{06} + \Delta w_t * L_{06} + \Delta L_t \Delta w_t. \tag{D.1}$$

The first term denotes the contribution of changes in days worked per year, keeping the daily wage fixed at the 2006 level; the second term denotes the role of changes in daily wages (estimated only on those who have a job in year t) keeping working days fixed at the 2006 level. The third term is an interaction term, which describes whether those who experience greater losses in days worked also experience greater losses in daily wages. A negative value of the interaction term suggests that workers who experience larger losses in days worked per year experience smaller losses in daily wages.

Figure D.1 applies this decomposition to our difference-in-differences framework, for the sample of workers who experience the largest losses, i.e., those employed in high k/L firms in 2006. It plots the overall effect and the contribution of days worked and of the wage and interaction effect (collapsed together). From the graph it is clear that days worked contribute to about half of the loss in labor earnings for the first years after the shock. In the longer term the contribution of changes in daily wages becomes larger, as workers tend to find another job but experience persistent losses in their wage trajectories.

Figure D.2 decomposes the effect for different types of workers. From the figure we deduce that the earnings losses of high wage workers are determined by wage losses much more than for low wage workers.

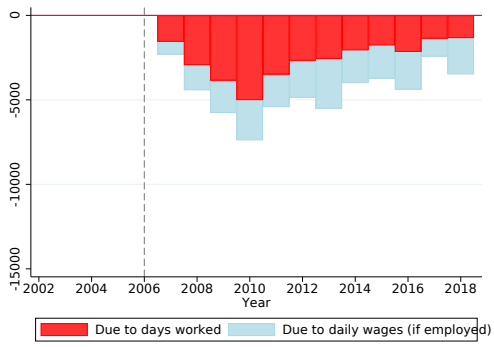
Figure D.1: Decomposing earnings losses



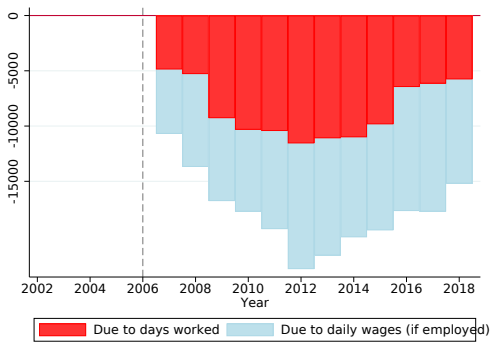
Note: Worker level analysis. Interactions of 2006 exposure to interbank of the firms where the worker was employed in 2006 with year dummies. The overall size of the bars is the earnings loss of workers in high K/L firms. The red bar uses as dependent variable $L_t w_{06}$ and displays the effect of changes in days worked (L_t) keeping wage fixed (w_{06}); the light blue bar indicates the difference between the overall effect and the effect due to days worked (wage effect and interaction/selection effect). Usual controls.

Figure D.2: Decomposing earnings losses, worker heterogeneity

a. Low wage



b. High wage



Note: Worker level analysis. Interactions of 2006 exposure to interbank of the firms where the worker was employed in 2006 with year dummies. The overall size of the bars is the earning loss of workers in high K/L firms. The red bar uses as dependent variable $L_t w_{06}$ and displays the effect of changes in days worked (L_t) keeping wage fixed (w_{06}); the light blue bar indicates the difference between the overall effect and the effect due to days worked (wage effect and interaction/selection effect). High-wage workers are workers whose wage in 2006 was above the median.

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Schmieder, J., T. von Wachter, and J. Heining (2023). The Costs of Job Displacement over the Business Cycle and its Sources: Evidence from Germany. *American Economic Review*, *113*(5): 1208-54.

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