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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 pay lower wages. These effects are amplified if firms are (ex-ante) more capital-intensive. The impact on workers' earnings is also long-lasting, especially for high skilled workers, who are more complementary to capital. Displaced workers reallocate more often to less capital-intensive firms, experiencing wage losses.

JEL Codes: E24, E44, G21, J21, J31, J63

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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 employment probabilities, firms' performance and their propensity to invest, as well as on firms' size and labor costs (see e.g., Chodorow-Reich, 2014; Greenstone et al., 2020 for the US, and Bentolila et al., 2018; Berton et al., 2018; Huber, 2018 for Europe). Less is known, however, about the long term consequences of credit shocks on firms and workers.

Negative credit shocks may lead firms to adjust employment and wages for several reasons. First, negative credit shocks negatively affect capital expenditure (see for instance Cingano et al., 2016; Bentolila et al., 2018). The impact on employment and wages will depend on the degree of complementarity between labor and capital. Second, firms hit by a lower availability of external finance face tighter liquidity constraints. As a consequence, they will struggle to finance working capital and therefore to pay wages. In this case, they will fire workers to reduce cash outlays: the impact on labor will depend on which workers are cheaper or easier to fire (see for instance Caggese et al., 2019). In addition, hiring and firing frictions as well as wage rigidities make labor a quasi-fixed factor, so that negative shocks to the availability of credit may affect employment in a similar way as they affect capital (Benmelech et al., 2021). In the long term, the intensity of the shock can lead firms to change their capital-to-labor ratio and force some firms to abandon the market.

Consequently, the effects of the credit shock to firms on their workers will be highly heterogeneous. The tightness of firms' liquidity constraints and the degree of complementarity between capital and labor will increase the probability of a job separation and/or a wage cut in the short term. In the long term, the differential effect of the shock will depend on workers' characteristics, on their labor market behavior and on the evolution of 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 the distribution of labor earnings. Our setting allows us to analyse what happened to firms and to observe workers' careers within and between firms for up to 11 years after the shock first impacted the economy. Moreover, it enables us to go beyond the analysis of average aggregate effects. We can assess both which workers – whether those displaced or those who remained in the original firm – have been affected the most and the interplay between the credit shock, firm heterogeneity, and external local labor market conditions. Italy represents an ideal setting within which to identify the labor market impact of

the 2007-2008 credit crunch. The crisis originated in the US housing market and was unrelated to conditions within and developments of the Italian economy. In addition, while the Italian labor market institutions are comparable to those of most major countries in Southern and Continental Europe, Italy did not experience a housing bubble at this time (which might indirectly affect the labor market) and 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: first, banks' balance sheet data from Supervisory Reports, bank-firm level credit relationships from the Italian Credit Register; third, 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, following the US subprime mortgage crisis and the Lehman Brother's' default. 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 start of the crisis. We perform several tests to support the hypothesis that our measure of firm exposure to the credit crunch is unrelated to previously observed 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 shocks 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, and average wage. We find that, compared to less affected firms, those with limited access to credit face a higher probability of exiting the market, downsizing more and paying their employees lower wages on average. Consistent with the hypothesis that a negative credit shock increases the user cost of capital, we document that more exposed firms suffer larger effects if they are more capital-intensive. The reductions in surviving probability, employment and wages are concentrated among the latter group of firms, which appear to reduce labor demand permanently.

Next, by relying on matched employer-employee administrative panel data, 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 shock 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 three main outcomes: first, the total yearly labor earnings; second, the number of days worked per year; and third, daily wages. Given our results on firms, we also test the hypothesis that high skilled workers (who are complementary to capital) suffer the most because of the credit shock (Fonseca and Doornik, 2021; Acemoglu and Autor, 2011; Goldin and Katz, 1998), as they are more likely to get displaced.

Our findings provide insights into the long-term real effects of credit shocks. We find evidence of persistent earnings' losses, on average, among workers who were employed in firms in 2006 that were later 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 90th and the 10th percentiles of the shock distribution and to a drop in credit growth at the firm level of about 3pp) experiences (in 2016) a statistically significant drop of around 1% in average yearly labor earnings. Labor earnings show the first signs of recovery in 2016 at the earliest; that is, nine years after the credit shock impacted the economy.

Note that these are average effects on all workers. 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., 2019). Moreover, we find that the effects are entirely driven by workers who were employed in 2006 at exposed firms with higher capital intensity, which is consistent with the findings that credit restrictions mainly affect this type of firm. The drop in labor earnings is predominantly due to job losses in the short term and to wage losses in the medium/long term, as some of the displaced workers were able to find a new job in another firm but on a lower wage trajectory. We find that the aggregate number of days worked starts to recover more than a decade after the credit crunch, in line with Yagan (2019) who documents employment hysteresis after the GFC in the US.

Next, we explore the distributional effects of the credit shock across workers. First, we focus on workers' skills. In particular, 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 complementary to capital (Fonseca and Doornik, 2021). 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 highly capital-intensive. Subsequently, these workers face challenges in finding new jobs, they tend to reallocate towards less capital-intensive firms, and eventually accept lower

wages. Our results are in line with occupational downgrading among workers who reallocate during recessions (Huckfeldt, 2021). These findings point to an important specificity of credit shocks and are markedly different from those of trade shocks (Autor et al., 2014; Utar, 2018; Dauth et al., 2021), which show effects that are mainly concentrated among low skilled workers. Second, we focus on workers' tenure. Firing short tenured workers typically entails lower firing costs (Kletzer and Fairlie, 2003); thus, they can be cheaper to lay off for credit constrained firms (Caggese et al., 2019). Our results indicate that there is no heterogeneity by tenure in terms of the probability of separating from credit constrained firms. Instead, short and long tenured workers are equally likely to experience job separations, suggesting that differences in firing costs are unlikely to be an alternative mechanism.

Finally, we look at whether the effects on employment depend on reduced bargaining power among movers (Carneiro et al., 2012), and we document that the negative 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., 2019).

Taken together, our results suggest that credit frictions can have very long-lasting real effects on workers and firms. The earnings' losses of more exposed workers do not result in a fixed penalty attached to laid-off workers, but largely depend on their complementarity with the firm's technology and are amplified by the conditions of the local labor markets within which they reside (i.e., the unemployment rate and local demand in highly capital-intensive firms).

Our work speaks to different strands of economic 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 on the impact of credit shocks on employment (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 dimensions. First, we do not only look at employment status of individual workers, but we also study workers' wages and labor earnings, which is critical in order to understand the overall labor market effects. Second, we focus on the long-term effects of the shock and we study their persistence. This distinguishes us from Moser et al. (2020) who, in a contemporaneous study, analyze the impact of negative monetary policy rates on the distribution of workers' earnings, but with a short-term perspective only. Our long-term focus allows us to fully gauge the effect of the shock on the working histories of individuals. Indeed, we show that the reduction in firm size translates heterogeneously into a reduction in workers' earnings, and that different

dimensions of heterogeneity matter in the short and in the long term.

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 Lachowska et al., 2020; Schmieder et al., 2019; Davis and Von Wachter, 2011; Gathmann et al., 2020; Ku et al., 2020, among others). Our contribution to this literature is threefold. First, the impact of credit shocks on workers may differ substantially from that of previously studied shocks, since our shock affects firms and workers through very different channels, all of which are crucial to assess so as to formulate policy responses. For instance, trade shocks mostly affect low skilled workers, who may be replaced by cheap imported goods, whereas we show that credit shocks tend to impact high wage workers in highly capital-intensive firms. Second, our setting allows us to study both displaced workers and those who stay, so as to assess whether or not some form of insurance within the firm takes place (Guiso et al., 2005; Schoefer, 2021). 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, Juhn et al., 2018; Macis and Schivardi, 2016; Card et al., 2015, 2014; Guiso et al., 2005; Blanchflower et al., 1996). 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 show some supporting evidence on its validity in Section 3. The main results at the firm and at the worker level are presented in Section 4, where we also explore the possible mechanisms behind the employment and wage losses. Finally, Section 5 concludes.

2 The data

We rely on a unique dataset combining data from five different sources. The first and most important for our paper is the employer-employee matched dataset, provided by the Italian Social Security Institute (INPS). This includes a random and representative sample of 6.5%

of the Italian workforce, drawn from the universe of private employees. The data contain information on the main demographic characteristics (age, gender, country of birth) and on all employment spells (daily wages, occupation, type of contract, length of the spell). This dataset also contains the unique firm tax identifiers, which allow us to match firm characteristics to the worker sample.

At the firm level, we obtain information from two 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 sector firms with at least one employee. We match this dataset with the register of incorporated firms, CERVED, which collects balance sheet data from the Italian Chambers of Commerce. Hence, the sample includes incorporated firms for which we observe balance sheet information from the firm register (this includes between 600,000 and 700,000 firms per year).

Finally, the last two data sources are related to banks and credit relationships. 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. The banks' exposure to the interbank market is obtained from the bank balance sheet information taken from the Supervisory Reports. We compute the reliance of banks on interbank funding as the ratio between interbank deposits, including repurchase agreements (repos) and banks' total assets. In particular, we use the average bank exposure between 2003 and 2006.[1] We match these data using the unique bank identifier, and then we use the unique firm tax identifier to match them with the social security and firm balance sheet datasets. This allows us to obtain unique quality information at the worker level matched with firm-level data and a measure of firm exposure to the credit restrictions following the start of the 2007-2008 financial crisis.

We construct our worker sample as follows. We consider individuals aged between 20 and 50 in 2006, who were employed in corporations with outstanding credit relationships at that time, as detailed in the Italian Credit Register. We drop workers younger than age 15 as of 2002, since 15 is the minimum working age in Italy. We also drop workers older than age 60 at the end of the period, who may have already accessed retirement programs in Italy during the period we consider. Moreover, we restrict attention to workers with a strong labor market attachment, who had at least three years of tenure in 2006 (had worked in the 2006 firm for

[1]We use data consolidated at the bank holding company level for banking group and individual bank data from stand-alone entities. This is important in order to net out the flows of funds among banks within the same banking group.

at least 200 days per year in the period 2003-2005). As a result, our sample only includes permanent workers. We do so for two main reasons. First, these restrictions largely follow 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., 2019) and on the long term effects of trade shocks (Autor et al., 2014). Second, while firing costs in Italy are null for temporary workers, permanent workers are protected by employment protection rules that are similar to those in place in other countries (i.e., firing costs are increasing in firms' size and workers' tenure, see Bentolila et al., 2020 for a review), making our results easier to generalize and interpret.[2] Temporary workers represent only a small portion of the employees in the Italian private sector (about 12%), and their exclusion implies, if anything, that we may be underestimating the employment losses as there are no firing costs for temporary workers.[3] We then follow these individuals from 2002 until 2018. Overall, our data include around 1.9 million worker-year observations.

Our three worker-level outcomes of interest are defined as follows: first, 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); second, number of days, which is the total number of days worked (including paid holidays but excluding Sundays); and third, daily wages, computed as the ratio between total labor earnings and number of days worked (normalized to 1 in 2006).

In our analysis, we use nominal daily wages.[4] Our measure of wages includes the base-fixed component, as well as premia and bonuses that vary over time. 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 every three years (prior to 2009, it used to be every two years) by the main social partners. In the period we consider, nominal increases of the base (minimum) wage were usually benchmarked to an independent three-year-ahead forecast of inflation net of imported energetic goods, which was always positive. Similar

[2]See, for instance, Sestito and Viviano (2018) for an assessment of the role of firing costs in firms' firing and hiring decisions in Italy.

[3]Notice that our results are broadly robust, even if less precise, to the inclusion of workers with less than three years of tenure (for the vast majority, these are temporary workers). These workers tend to experience effects in line with our findings for low wage workers.

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

forms of collective bargaining are present in many other European countries, for example France, Spain, Portugal, etc. (see Villanueva, 2015).

In the firm-level analysis, we use a sample of firms that includes the same corporations as those we observe in the workers' sample. We consider four main outcomes: first, credit granted to each firm every year, which we use to estimate the impact of interbank exposure on firms' ability to obtain credit; second, a dummy that takes the value 1 when the firm exits the market and 0 otherwise; third, a variable that measures the growth of the firms' yearly average number of employees; and, fourth, a variable measuring average monthly wages of all employees in the firm (normalized to 1 in 2006).

3 Empirical strategy

3.1 Conceptual framework

The first step of our analysis consists of showing that firms respond to credit shocks by adjusting employment. The second is a worker-level analysis in which we look for long-term effects and for heterogeneous effects both across firms and workers.

There are several channels through which shocks to the availability of credit lead firms to adjust employment (Chodorow-Reich, 2014; Benmelech et al., 2021; Bentolila et al., 2020; Berton et al., 2018), and different channels provide different predictions about the type of workers more likely to be impacted.

First, negative credit shocks induce an increase in the user cost of capital. As a consequence, capital expenditure will decrease. The impact on employment and wages depends on the elasticity of substitution between capital and labor. In addition, hiring and firing frictions as well as wage rigidity make labor a quasi-fixed factor, and negative shocks to the availability of credit affect employment in a similar way as they affect capital.

Second, firms hit by a lower availability of external finance 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. In particular, we should observe that most affected firms fire workers that carry a lower firing cost (e.g., lower tenure workers).

Next, we turn to following workers trajectories in the medium/long term. In this respect, negative credit shocks may have long lasting effects on wages and employment, as they reduce firms' productivity (Doerr et al., 2018; Duval et al., 2019; Manaresi and Pierri, 2019). These effects may lead to an amplification mechanism as the decrease in high-skilled labor will make

complementary capital less productive, encouraging a further drop in investment (Dolado et al., 2021) and second round effects on employment and wages. As a result, employment and wages will be lower for most affected firms. These effects can also negatively impact wages and employment opportunities with new employers for two reasons: first, because those may also be affected firms and thus on a lower productivity trajectory; and second, because average wages in local labor markets may be lower if other firms operating locally are also affected (and are less productive). More generally, credit shocks may induce localized shocks that increase local unemployment, and this can affect employment and wages depending on the tightness of the local labor market.

We are not able to directly test the quantitative relevance of these different channels, but we provide evidence on whether their predictions in terms of what type of workers should be affected the most are verified.

3.2 Measuring the exposure of firms to the credit crunch

Our first step is to identify which firms were more exposed 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. Figure A.1 in Appendix A shows that in our data the growth rate of bank credit to firms (the variations of which can be driven by both changes in supply and in demand of credit) started dropping in 2007, fell very sharply in 2008, and continued to keep contracting in subsequent years as banks continued to deleverage.

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.[5] We label this variable $Interbank_{b,06}$, and this is our measure of banks' exposure to the GFC. 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 correlation with capital, profitability, bad loans ratio, average interest rates charged on the different asset classes at the bank level and 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 a variable $Interbank^f_{b,06}$ equal to the exposure to the interbank market of bank b lending to firm f in 2006.[6] We calculate our measure of firm's f specific risk of credit crunch by averaging bank exposure $Interbank^f_{b,06}$ over f. 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 granted to firm f in 2006, $credit_{f,06}$.

Formally:

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

In our sample, the exposure to the credit shock ($Interbank_{f,06}$) is 15%, on average, with a standard deviation of 6%.

For this to be a good measure by which to identify firms' exposure to the credit crunch following the crises, two conditions need to be met. First, we should exclude any possible sorting of firms into banks at the very first signals of tensions in the interbank market in 2007. To ensure this is not the case, we measure banks' interbank exposures as the average of 2003-2006; that is, before the start of the crisis. We also run regressions of the change in the share of credit in each bank-firm relationship between 2000 and 2005 on the bank's exposure to the interbank market in that period ($Interbank_{b,06}$, see Table A.2 in Appendix A). We find that interbank exposure is never statistically significant (and by a wide margin). This shows that banks more reliant on interbank funding in the period before the crisis were not systematically expanding credit.

Second, the interbank shock had to be unforeseen. This is the case as far as we assume

[5]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 and exclude ECB's refinancing.

[6]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).

that Italian firms in 2006 were unable to forecast 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. The firm-level exposure measure we adopt is analogous to those used by Iyer et al. (2013) and Cingano et al. (2016) for instance, and it also follows the same logic as Chodorow-Reich (2014), who uses different proxies of banks' exposure to the crisis: their participation in loan syndicates in which Lehman Brothers' was the lead arranger or the exposure to asset backed securities (ABS) measured by the correlation between banks' stock prices and an index of the value of ABS. Italian banks had limited direct exposure to Lehman Brothers'-related assets or to ABS (Cingano et al., 2016), which prevents us from using the same measure.

To test whether our measure of interbank exposure correlates with the evolution of firms' loans, we estimate the following regression at the firm-year level:

$$\Delta credit_{f,t} = \theta Interbank_{f,06} * \alpha_t + \alpha_f + \epsilon_{f,t}, \tag{2}$$

where $\Delta credit_{f,t}$ is the year-on-year growth rate of loans granted to firm f, $Interbank_{f,06}$ is our measure of the risk of being subject to the crunch, that ranges between 0 and 100, α_t are year dummies and α_f are firm fixed effects. This specification allows us to check for pre-trends that would invalidate our identification strategy and to look at the evolution over time of credit to firms after the shock. We estimate the model from 2002 to 2018.

Figure 1 reports the estimated coefficients. Relative to the omitted year (2005), before 2006 the elasticity of firm loans 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 percentage point increase in our index of credit crunch is associated with a -0.3pp average reduction in the growth rate of loans (which corresponds to about one standard deviation in credit growth). Overall, Figure 1 suggests that the structural break in the elasticity of credit to interbank market exposure has occurred since 2007. After that, banks more reliant on interbank funding kept supplying less credit than other banks. This evidence supports our strategy to identify 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.[7]

[7]Crouzet (2018) finds that aggregate bond issuance in the corporate sector increases as a response to a contraction in bank credit supply. However, Italian firms are mainly bank dependent. The share of bank debt over total financial debt in our sample of Italian corporations (incorporated companies from CERVED observed between 2000 and 2016) is on average 83% (the median is 100%), implying that for the vast

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 became involved in the crisis because of its high level of sovereign debt. This has been a long-standing problem for the Italian economy and was not due to the rescue of Italian banks after the GFC as it occurred in Ireland or Spain, for example, as documented in Bofondi et al. (2017) and the references therein. We argue that this second shock did not impact banks as a result of their reliance on interbank funding before the 2009 crisis and therefore, it does not represent a threat to the identification of our effects.

We support this point based on several results. First, Figure 1 does not show any change after 2011 in the difference in credit growth between firms more and less exposed to banks affected by the GFC. The larger differential effect occurs in 2007-2008 and then the difference remains relatively flat. Second, we run equation 2 for the change in credit between 2011 and 2015, controlling for the change in credit between 2010 and 2006 and its interaction with $Interbank_{f,06}$. This allows us to assess whether during the 2011 sovereign debt crisis, banks more exposed to the interbank market in the 2003-2006 period restricted credit more than banks less exposed, after controlling for the reduction that had already occurred during the GFC (2008-2009). The results shown in Table A.3 in Appendix A, indicate that when controlling for the credit growth between 2006 and 2010 (after the GFC), $Interbank_{f,06}$ does not have a significant effect on credit growth between 2015 and 2011 (after the sovereign debt crisis). Third, Table A.4 in Appendix A shows that banks' interbank funding ratio as of 2006, $Interbank_{b,06}$, is not correlated with other key bank characteristics as of 2010-2011 (capital, profitability) and is in fact negatively correlated with the share of government bonds to assets, which could be used as proxy for the impact of the sovereign debt crisis on Italian banks. Fourth, banks' interbank funding ratio as of 2006, $Interbank_{b,06}$ is positively correlated with the change in banks' average cost of funding between 2007 and 2010, but not between 2011 and 2015 (see Table A.5 in Appendix A). Finally, existing evidence shows that the drop in credit during the sovereign debt crisis has been more 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 banks' holding company. Taken

majority of firms in our sample, bank credit is the only source of external finance. Bond issuance by Italian non-financial firms is concentrated among only a few very large issuers. Retained earnings are also unlikely to have served as a buffer given that profits decreased significantly during the crisis. We confirm this in a robustness exercise that analyzes the heterogeneity in the firm-level credit supply contraction across firms with different levels of reliance on credit (Section 4.1).

together, all of this evidence suggests that the interbank funding ratio as of 2006 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.

A final concern is that firms' exposure to the credit shock may be systematically correlated with the labor market shocks at the province-year level. Figure A.2 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 Identifying affected firms and workers

The goal of the paper is to document the long-term effects on workers employed by firms impacted by the GFC credit shock. To this aim, we classify affected workers as those employed before the crisis in firms that used to borrow from banks more exposed to the interbank market (as measured by the variable $Interbank_{f,06}$). We then compare more and less affected workers adopting a difference-in-differences strategy.

Tables 1 and 2 display summary statistics for the 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] The upper part of Table 2 reports the characteristics of the firms by which the workers were employed in 2006. The tables suggest that the most treated firms are larger and pay higher wages on average than the less treated firms.[9] This occurs because smaller firms tend to be customers of smaller banks, that are less exposed to the interbank market. Nevertheless, as shown in the previous section, this structural characteristic of the Italian banking system has not changed in response to the expansion of credit before the GFC (i.e., we do not find evidence of strategic firm-bank sorting or of differential pre-trends). The lower part of Table 2 reports summary statistics for workers. Workers in the most exposed firms are more likely to be of a higher occupational level (white collar workers or managers) and tend to earn higher daily wages on average.

Since we adopt a difference-in-differences strategy, in order for our identification to hold, there can be differences in the type of workers and firms that are more exposed to the credit supply shock, as long as trends in the outcomes of treated and control workers would have

[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.

been parallel absent the shock. In the regression analysis, we always check that trends were parallel before the crisis. However, the credit shock that occurred during the GFC was followed by a series of other, non-necessarily credit-related, negative shocks, whose impact was heterogeneous depending on firms' characteristics, industries, and local labor markets. For our strategy to identify only the effect of the credit shock, we need to ensure that the workers and the firms we consider were comparable in terms of the impact of other possible shocks.

To this aim, since Tables 1 and 2 suggest the presence of some differences in observable characteristics across more and less exposed firms and workers, we rely on a propensity score matching procedure to obtain a balanced sample. In particular, we use a step matching estimator in the spirit of Schmieder et al., 2019 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.

For the firm level analysis, we estimate within each 1-digit industry the propensity of a firm belonging to the top 33 percentile of the distribution of exposure to the interbank market.[10] The matching variables refer to the base year (2006) and include firms' size, age, average wage per employee, geographical distribution, credit score and additional balance sheet information (e.g., assets, revenues, credit-to-asset ratio, capital intensity). Similarly, for the worker level analysis, we estimate within each 1-digit industry the propensity of being employed in 2006 in a firm belonging to the top 33 percentile of the distribution of exposure to the interbank market. The matching variables, both at the worker and the firm level, again refer to the base year (2006) and are the following: gender, age (linear and squared), full-time contract, tenure within the firm,[11] 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 75th percentile), firms' capital intensity (if firms' capital-to-labor ratio is above the median), firms' age (linear and squared), firms' size, and firms' average monthly wage. Columns 3 and 4 of Tables 1 and 2 display the average characteristics of more and less exposed firms and of workers employed in 2006 in more and less exposed firms, with a weighting for the propensity score. With this procedure, we obtain a highly balanced sample both at the firm and worker level.

At the firm level, we estimate the following equation for all firms included in the worker level analysis:

[10] We obtain similar results if we use different thresholds (namely, the top 25) and different matching variables.

[11] We create different buckets: less than 2 years, 2-5 years, 6-9 years, 10 years or more.

$$y_{f,t} = \gamma Interbank_{f06} * \delta_t + \delta_f + \delta_{st} + u_{f,t}, \tag{3}$$

where $y_{f,t}$ is the firm f outcome in year t, $interbank_{f,06}$ is firm f exposure to the credit shock, and δ_f are firm fixed effects. To further attenuate possible concerns that firms more exposed to the credit shock may have a different evolution in demand for their products, or be exposed to other type of shocks, we also saturate the model by including sector*time fixed effects δ_{st}.

Next, we estimate the response of workers' earnings, daily wage and days worked to the credit shock faced by the firm where the employee worked in 2006. The specification we estimate is:

$$y_{i,f,t} = \beta Interbank_{f06} * \alpha_t + \alpha_i + \alpha_{pt} + \alpha_{st} + \epsilon_{i,f,t}, \tag{4}$$

where $y_{i,f,t}$ is the outcome variable of worker i in year t employed in firm f and $interbank_{f06}$ is the exposure to the credit shock of firm $f06$ employing the worker i in 2006. The term α_i indicates worker fixed effects (and implicitly also controls for firm $f06$ fixed effects). In the benchmark specification we control for sector*time and province*time fixed effects (α_{st} and α_{pt}, respectively), where s refers to the sector of activity of firm $f06$ and p to the province of residence in 2006. In this way we control for possible time-varying confounders, most notably business cycle fluctuations at the workers' sector of employment in 2006 or at the local level. Standard errors are clustered at the level of the firm by which workers were employed in 2006, prior to the shock.

A potential 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]

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

[12]This is one of the reasons that we do not estimate a 2SLS instrumenting credit growth with interbank exposure; the other being that, as argued in Chodorow-Reich (2014) the interbank shocks also affect interest rates and possibly other lending margins on top of credit quantity, therefore potentially violating the exclusion restriction assumption.

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 job. The richness of our data allows us to perform these tests.

4 Results

4.1 Firm-level effects

We first provide direct firm-level evidence of the effects of the credit shock on firms' outcomes between 2002 and 2018 in Table 3. Column 1 shows the effect of being more exposed to the credit supply shock on the change in credit granted to firms. The results are consistent with the evidence presented in Figure 1; they indicate that a 10-pp higher exposure to the interbank market of banks lending to firms (which corresponds to the difference between the 90th and the 10th percentile of the shock distribution) implies a 3 pp reduction per year in credit growth at the firm level.[13] To further support this finding, we conduct a robustness check by considering firms' reliance on bank credit (measured as credit-to-asset ratio in 2006). The idea is that since bank credit is the key source of external finance for the firms in our sample, the credit to asset ratio represents a measure of firms' needs for external finance. Table A.6 in Appendix A shows that credit growth drops for all firms and that the effect is larger, the higher the reliance on bank credit was before the crisis.

Column 2 of Table 3 presents the effect on the probability of exiting the market, column 3 reports the estimates on firm's size growth and column 4 shows those on average monthly wage per employee (normalized to 1 in 2006). More specifically, our results imply that a 10-pp higher exposure to the shock leads to a 0.4-pp increase in the probability of exiting the market, a 1-pp reduction in firm size growth per year and a 0.4-pp reduction in average monthly wage per employee relative to its 2006 level.

As shown in panel a of Figure 2, the probability of exit is persistently higher for more affected firms during the entire period 2009-2018. Moreover, firms more exposed to the credit shock reduce their size growth and the average wage paid per employee compared to less affected firms starting in 2009. The effects on firm size and average wage dissipate, but only in the long term (after 2016 – see panels b and c of Figure 2).

Regarding the timing of the impact, the drop in credit growth in Figure 1 is immediate

[13] This is the regression version of Figure 1 in which the effect of the credit shock is averaged over the period 2007–2018, by the inclusion of a dummy equal to one for the years 2007–2018 interacted with the shock ($interbank_{f,06} * post06$).

(already in 2007), while the effects on exit and firm size take a couple of years to materialize (Figure 2). This is not surprising as the procedure of shutting down a business can be lengthy and there are several firing frictions in the Italian labor market (Sestito and Viviano, 2018).

The negative effect on the average wage could be due either to a downward adjustment of the wages of those workers who stay in the firm by which they were employed before the shock or to a re-composition of the firms' workforce towards lower paid employees. The worker-level analysis in the next section allows us to disentangle these effects and it provides supportive evidence of the latter channel, as workers who are more likely to permanently lose their job following the credit shock are those with higher wages.

Next, to explore the mechanism by which the credit shock affects employment and wages (see Section 3.1), we interact firms' exposure to the credit shock with their capital intensity (high versus low). Firms are classified as highly capital-intensive if their average capital-to-labor ratio between 2002 and 2006 is above the median. Table A.7 in the Appendix shows that firms with higher capital intensity did not have ex-ante a higher exposure to interbank-funded banks and that their characteristics and those of their workers are overall balanced.[14]

Results by capital intensity are shown in Table 4 and Figure A.3 in Appendix A. Exposure to the interbank shock leads to lower credit growth both for high and low capital-intensity firms, although the effects are larger among the former. By contrast, we detect an effect on the probability of exit only for highly capital-intensive firms. Moreover, consistent with the complementarity between capital and labor, we find that the contraction in employment is concentrated among highly capital-intensive firms. The drop in wages is quantitatively similar among the two groups.

Importantly, as panel b of Figure A.3 in Appendix A shows, we find that firms more exposed to the shock that used to be highly capital intensive permanently reduce their capital-to-labor ratio. This indicates that the credit shock leads to a more than proportional drop in capital than in labor and that firms more exposed to the shock reduce their capital intensity, thus potentially changing their demand for skilled labor in the long run. This finding is relevant to understand the heterogeneous impact of the shock across workers and the role of the capital-skill complementarity.

[14]The key difference is size, as capital-intensive firms are 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 more capital-intensive firms and their workforce suffer the greatest consequences as a result of the credit shock.

4.2 Worker-level effects

According to the firm-level evidence presented in the previous section, Italian firms reacted to the GFC by exiting the market, or by shrinking and reducing average wages. This occurred especially among firms that used to be highly capital-intensive. A possible implication of these firm-level findings is that credit constrained capital-intensive firms may change the composition of their workforce, for instance, in favor of workers that are less complementary to capital, such as low skilled workers (Krusell et al., 2000). It is therefore important to test if employment opportunities worsened for some groups of workers more than for others, and the resulting distributional consequences.

In this section, we first analyze the effect of credit shocks and their interplay with firms' capital intensity on all workers. We look at three outcomes: first, total labor earnings; second, the yearly number of days worked; and third, daily wages (normalized to 1 in 2006). The analysis at the worker level allows us to understand whether the reduction in firm size growth is translated into persistent job losses, to distinguish between "stayers" and "movers", and to assess whether the effect on the average wage at the firm level reflects changes in workforce composition or changes in workers' wages. We then analyze the heterogeneity among workers with different skills and tenure and their reallocation across firms with different capital intensity. This exercise sheds light on the role of capital-skill complementarity and allows us to assess the relevance of alternative mechanisms, such as the differences in firing costs across workers.

4.2.1 Overall effect on workers

Table 5 displays the effect of having been employed in 2006 by firms borrowing from banks that used to be more exposed to the interbank market on: first, total labor earnings (column 1); second,the yearly number of days worked (column 3); and third, daily wages (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 firm ("movers"), we also re-run estimates looking only at the number of days worked in the 2006 firm (column 2) and at wages for stayers only (column 5).

Column 1 of Table 5 reports the effect of being employed in a more exposed firm on earnings post 2006. Panel a of Figure 3 reports the same estimates year-by-year and allows us to assess the validity of the parallel trend assumption, as well as the evolution of the effect over time. They both show that labor earnings are persistently lower for workers who were

employed in more exposed firms before the crisis. 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 (column 2 and panel b). By comparing column 2 (panel b) with column 3 (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 does not fully recover by 2018. However, we do not detect any statistically significant effect on daily wages either among stayers (column 4 and panel d) or among movers (column 5). Among the latter, we find some downward wage adjustment only in certain years (panel e). This suggests that the decrease in average wage by employee at the firm level is likely to be driven by changes in workforce composition (as we show in detail in Section 4.2.2).

Overall, we find that a worker employed in a firm 10-pp more exposed to the credit shock (which corresponds the difference between the 10th and the 90th percentiles of exposure and to a 3pp 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 3,750 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., 2019). Earnings start recovering only in 2016; that is, nine years after the credit crunch.

To assess the relative contribution of days worked and daily wages for the overall effect on earnings, in Appendix B we decompose 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. (2019). Figure B.1 shows that changes in days worked account for the largest share of the effect on earnings, especially in the short term. In the long term, the effect of wages becomes more relevant, as workers start to find new jobs but are on lower wage trajectories. Our findings point out that an analysis confined to the effect on wages after displacement would only consider a selected sub-sample of workers and would therefore provide only a partial picture of the overall effect on earnings, both in the short and in the long term. Therefore, in order to quantify the longer-term labor market impact of a major shock, such as a credit shock, it is crucial to not only consider the workers' probability of remaining employed but also their probability of finding a job after displacement. While being fired or induced to leave their original firm may trigger a labor reallocation process for the worker, the ability of displaced workers to find new jobs, as well as the wage losses that may have to bear are crucial to be able to assess the impact on earnings' inequality, and thus to get a sense of the overall longer-term

effects of the shock.

We then investigate whether workers employed in highly capital-intensive firms in 2006 suffered the largest consequences of the credit shock. In line with the firm level estimates in Table 4, column 1 in Table 6 and panel a in Figure 4 show that the decrease in labor earnings was concentrated among those workers. Additionally, workers that separated from highly capital-intensive firms encountered major difficulties in reallocating (column 3 and panel c) and had to accept lower paying jobs in the medium to longer term (panel e). To sum up, our worker level analysis reveals persistent earnings' losses, and a rather slow reallocation, concentrated on workers who were originally employed at capital-intensive firms.

4.2.2 Which workers are affected the most and why

The results so far show that the negative effects of exposure to the credit shock are amplified if firms have a higher capital-to-labor ratio before the shock. This points to a mechanism going through an increase in the user cost of capital, which leads firms to reduce capital expenditures. We also document a drop in the capital intensity of firms, which may affect their willingness to employ high skilled workers due to the capital-skill complementarity. Alternatively, the capital-to-labor ratio may proxy for the firms' need for external finance and thus for their degree of liquidity constraints after the shock (i.e., the same shock determines stronger liquidity needs for highly capital-intensive firms). In that case, we would expect firms to fire workers with lower firing costs so as to reduce the cash outlays when the shock hits (see Section 3.1). In what follows, we run tests to explore the underlying mechanism at work.

As an initial step, we explore how firms choose which workers to displace. First, we study whether the impact of the credit shock and its interaction with the firms' capital intensity is heterogeneous between high wage and low wage workers.[15] Column 2 in the upper panel of Table 7 and panel d. in Figure A.4 in Appendix A show that high wage workers have a higher likelihood of separation from the firm by which they were employed in 2006 only if that firm was highly capital-intensive. A similar pattern emerges when we distinguish between white collar and blue collar workers (see Table A.8 and Figure A.5 in Appendix A). All of the job losses among white collar and high wage workers (these two categories only partially overlap) are concentrated among those who were employed at highly capital-intensive firms before the shock. Since wage and occupation can both be considered as a proxy for skills, these findings support the capital-skill complementarity channel. Moreover, these findings point

[15]We define high (low) wage workers as those whose daily wage in 2006 was above (below) the median.

out an important specificity of credit shocks, since they differ from those of the literature on the labor market effects of trade shocks (according to which losses 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).

Next, we investigate whether firing costs may be an alternative mechanism at work. Since short tenured workers typically entail lower firing costs, separately analyzing the effects on workers with shorter and longer tenure within the 2006 firm can help us understand whether firing costs drive the lay-off decisions of credit constrained firms.[16] Column 2 in the lower two panels of Table 7 and panels c and d in Figure A.6 in Appendix A confirm that job losses occur only at highly capital-intensive firms. However, longer and shorter tenured workers are equally likely to experience job separations. We reach a similar conclusion if we distinguish workers by age (the two lower panels of Table A.8 and Figure A.7 in Appendix A). Younger (aged 20-39 in 2006) and older (aged 40-50 in 2006) workers have a similar probability of separating from the 2006 firm and separations exclusively involve workers who were employed in 2006 by highly capital-intensive firms. The lack of heterogeneity among workers associated with different levels of severance payments implies that firing costs are unlikely to have played a crucial role in shaping firms' responses to the credit shock.

Then, we assess how displaced workers reallocate after the shock. First, some of them may exit the labor market. Second, among those who find a new job, the characteristics of the job or of the firms that hire them may matter. Column 4 in Table 8 reports the results on the probability of exiting. It shows that high wage workers from more exposed firms have a higher probability of permanently exiting the labor market if they were employed by highly capital-intensive firms before the shock. The effect is economically significant, as it points to a 7 pp higher probability of a permanent exit. Finding new employment may be particularly difficult for this group of workers, some of whom have no choice but to exit. Column 3 studies the effect on the intensive margin; that is, on the incidence of part-time work. It indicates that the entire effect on employment is due to adjustments in the extensive margin of labor at highly capital-intensive firms, while we hardly detect any adjustments in the intensive margin.

Next, we look at the characteristics of the new firms employing workers who find new employment and their capital intensity in particular. 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., 2019; Gulyas and Pytka, 2019). To analyze reallocation, in the spirit

[16] As in most countries, severance payments in Italy increase with tenure; see Boeri et al. (2017).

of Utar (2018) and Dauth et al. (2021), we decompose the total effect on workers' number of days worked (reported in column 1 of Table 9) into three components: first, the number of days lost in the original firm; second, the number of days recovered because displaced workers found jobs in a new firm of higher capital intensity than the 2006 firm; 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. Columns 2 to 4 present the results. Again, we confirm that workers of firms more exposed to the shock are less likely to stay with the firm by which they were employed in 2006 (column 2). By comparing columns 3 and 4, we see that some workers manage to reallocate, but mainly towards firms with a capital to labor ratio below that of the firm they were employed by in 2006; these effects, moreover, are concentrated on workers who were employed by highly capital-intensive firms in 2006.

This is consistent with the firm level results pointing towards a permanently lower demand of labor from highly capital-intensive firms after the shock (capital-intensive firms are not only more likely to exit and to shrink in size but they also become less capital-intensive, see Section 4.1). This result may explain why we observe that high-wage and white collar workers displaced from exposed firms with high capital-to-labor ratio experience the strongest negative effects; they only find employment at firms with lower capital intensity, where a different technology may be used for which their skills represent a worse fit. Therefore, these workers are likely to have both greater difficulties in finding new jobs and earn lower wages at their new firm, especially in the medium and long term (Figures B.1 and B.2).

A further important channel used to understand the mechanisms behind the main effects that we document are 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; Schmieder et al., 2019; Farber, 2017), with workers who are displaced during recessions bearing twice as large earnings' losses than workers displaced during economic booms. Moreover, the existing evidence shows that the characteristics of the pool of unemployed workers varies 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 depends on the economic cycle, these workers should be assisted through the use of counter-cyclical social safety nets; if instead it depends on a structural change (such as permanent shifts in demand), it would be necessary to intervene through structural measures (such as specific job training programs). Our shock measure is particularly suitable for this test because it is at the firm level rather than the local level and is spread across geographical areas in a way that is uncorrelated with the local

average unemployment rate (Figure A.2 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 analyze the effect of the credit shock interacted with the yearly unemployment rate in the province of the firm where each worker was employed in 2006, prior to the shock. Table 10 shows that a high local unemployment rate in conjunction with the exposure to the credit shock exacerbates earning losses. Moreover, when distinguishing between lower and higher capital-intensive firms, this indicates that employment losses among more exposed workers in higher capital-intensive firms are larger if the local unemployment rate is higher. However, these additionally displaced workers tend to find new jobs (column 3) due to their willingness to accept employment at significantly lower wages (column 4). This suggests that wages that are typically thought to be rigid *do* in fact react to the labor market slack and to the reduced bargaining power of workers under high unemployment conditions.

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 firms that had a high capital to labor ratio before the shock. These firms reduced their labor demand as well as their capital-to-labor ratio, and this affected the overall type of labor demand, with particularly negative effects for white collar and higher wage workers. These worker characteristics proxy for high skills, suggesting a specific mechanism for the impact of a large credit shock on workers, differing from that of other shocks that tend to more strongly affect low skill workers. Credit shocks increase the user cost of capital and lead to an adjustment in the capital labor mix. This in turn mostly affects high skilled workers who are complement to capital. Some of these workers may accept lower wages and move to less capital-intensive firms, while others may 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 a bargaining power: in this case, highly capital-intensive firms are more likely to displace workers who are then hired again but at much lower wages.

5 Conclusions

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, even in the long run. We find that firms that experience a restriction to credit supply face a persistently higher probability of exiting the market on average, permanently reduce in size, and pay lower wages. Moreover, workers who were formerly employed in these firms experience a significant reduction in labor earnings, compared to those employed in less exposed firms. The effect on earnings is sizeable and persistent over time. The earnings of workers employed in firms at the 90th 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 10th percentile of the shock distribution: this loss amounts to approximately 15% if we only consider displaced workers. This permanent loss in earnings is mainly caused by a reduction in days worked by more exposed individuals: this situation began to recover more than nine years after the credit shock first impacted firms.

Furthermore, we shed light on the mechanisms behind the observed employment and earnings' losses. Our findings point at 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 user cost of capital, 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 who used to be employed in highly capital-intensive firms suffer the largest earnings' losses both in the short and in the long term. This is mainly explained by a persistent drop in days worked, which we ascribe to a demand-side mechanism. As the credit shock increases the user cost of capital, firms lay off workers 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 and at lower wages in the medium/long term. Eventually, these workers are more likely to permanently exit the labor force.

More broadly, our paper speaks to the debate about how financial shocks affect labor income inequality 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 useful insights to policymakers. Our findings lead us to conclude that the policy reaction to any shock that leads to a halt in corporate financing should be immediate; this would prevent firms from reducing their capital investments and workers from ending up on a path of unemployment and low wage growth. Moreover, since the effects of even short-term shocks can be permanent, counter-cyclical policy instruments (such as unemployment benefits or furlough schemes) should be coupled with structural interventions, given that for some workers the effects are long-lasting and are due to potentially persistent changes in labor demand.

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Tables

Table 1: Summary statistics - firm level

	Most treated	Least treated	Most treated	Least treated
	Unweighted		Weighted (PSM)	
	top 33^{th} exp.	others	top 33^{th} exp.	others
	[1]	[2]	[3]	[4]
Interbank exp.	0.169	0.097	0.166	0.100
	(0.065)	(0.032)	(0.059)	(0.029)
Size	49.102	37.436	51.103	50.406
	(85.357)	(64.838)	(84.776)	(82.277)
Av. wage	2050.552	1939.159	2080.404	2064.944
	(748.996)	(682.008)	(721.867)	(708.772)
K/L	73.166	72.719	73.981	76.369
	(100.533)	(101.650)	(99.269)	(102.222)
Firm age	23.029	22.263	23.581	23.604
	(11.919)	(11.683)	(11.871)	(11.820)
Size growth	-0.026	-0.027	-0.026	-0.026
	(0.319)	(0.318)	(0.306)	(0.303)
Log(total assets)	8.439	8.184	8.508	8.504
	(1.408)	(1.337)	(1.360)	(1.379)
Log(net revenues)	8.481	8.221	8.557	8.543
	(1.433)	(1.375)	(1.393)	(1.406)
Credit/assets	52.167	54.021	52.094	53.284
	(38.395)	(37.409)	(35.522)	(35.639)
Manufacturing	0.542	0.509	0.566	0.566
	(0.498)	(0.500)	(0.496)	(0.496)
Observations	317716	630984	252342	177075

Note: Standard deviation in parentheses. Treated and control are the treatment and control groups, after having matched the most exposed firms (top 33th percentile of exposure) with the least exposed firms (all other firms).

Table 2: Summary statistics - worker level

	Most treated	Least treated	Most treated	Least treated
	Unweighted		Weighted (PSM)	
	top 33^{th} exp.	others	top 33^{th} exp.	others
	[1]	[2]	[3]	[4]
Firm level variables (characteristics in 2006 of 2006 firms)				
Interbank exp.	0.171	0.108	0.172	0.110
	(0.061)	(0.028)	(0.062)	(0.027)
Size	2879.146	1295.431	924.168	1243.662
	(10626.548)	(4123.675)	(2419.546)	(3401.556)
Av. wage	2207.230	2024.401	2194.618	2164.360
	(840.740)	(722.474)	(815.695)	(794.447)
Firm age	20.585	21.549	20.959	21.357
	(13.227)	(13.047)	(13.164)	(14.091)
Manufacturing	0.559	0.552	0.589	0.594
	(0.497)	(0.497)	(0.492)	(0.491)
Worker level variables (in 2006)				
Age	42.410	42.189	42.317	42.357
	(8.297)	(8.356)	(8.315)	(8.306)
Female	0.310	0.321	0.306	0.301
	(0.463)	(0.467)	(0.461)	(0.459)
Blue Collar	0.531	0.586	0.550	0.553
	(0.499)	(0.492)	(0.497)	(0.497)
High wage worker	0.518	0.477	0.531	0.535
	(0.500)	(0.499)	(0.499)	(0.499)
Tenure < 7 years	0.412	0.430	0.426	0.428
	(0.492)	(0.495)	(0.495)	(0.495)
Daily wage	93.975	86.906	93.350	94.273
	(78.140)	(58.632)	(78.271)	(76.101)
Days worked	297.606	296.789	297.694	297.332
	(44.568)	(45.298)	(44.478)	(44.734)
Yearly labour earning	27729.834	25600.454	27530.729	27818.673
	(17897.064)	(14811.235)	(17307.769)	(20140.506)
Observations	1,232,619	2,503,182	1,089,122	749,309

Note: Standard deviation in parentheses. Treated and control are the treatment and control groups, after having matched the workers working in most exposed firms (top 33th percentile of exposure) with the workers working in least exposed firms (all other firms). 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]	Av.wage (2006=1) [4]
interb.*post2006	-0.282***	0.045***	-0.103***	-0.040**
	(0.031)	(0.012)	(0.026)	(0.018)
N	346,823	371,604	370,104	370,104
Firm FE	Yes	Yes	Yes	Yes
st FE	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. The regressions include firm and sector times year fixed effects. Standard errors clustered at the firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Firm level evidence-heterogeneity by high and low K/L

Dep var:	Credit growth [1]	1=Exit [2]	Size growth [3]	Av.wage (2006=1) [4]	K/L [5]
interb.*post2006	-0.199***	0.003	-0.055	-0.037	-1.172
	(0.042)	(0.017)	(0.036)	(0.025)	(6.399)
int.*post*high KL	-0.168***	0.084***	-0.097*	-0.006	-36.38**
	(0.061)	(0.024)	(0.051)	(0.035)	(14.74)
N	346,823	371,604	370,104	370,104	344,006
Firm FE	Yes	Yes	Yes	Yes	Yes
st 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 receiving credit with available balance sheet information. High K/L if the firm lies above the median of the distribution of the average K/L between 2002 and 2006. The regressions include firm, sector times year fixed effects and whether the firm was high K/L times year fixed effects. Standard errors clustered at the firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: 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]
interb.*post2006	-1525.414**	-34.299***	-15.431***	-0.021	-0.015
	(699.218)	(11.716)	(5.236)	(0.019)	(0.022)
N	1838431	1838431	1838431	1637910	1283584
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 regressions include worker, sector (of the 2006 firm) times year fixed effects and province (of the 2006 firm) times year fixed effects. Standard errors clustered at the 2006 firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Worker level evidence - heterogeneity by high and low K/L

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]
			All		
interb.*post2006	-165.544	-14.644	-6.341	-0.018	-0.024
	(761.368)	(12.588)	(6.399)	(0.026)	(0.031)
int*post*high KL	-3109.203**	-48.262**	-21.585**	-0.016	0.022
	(1544.540)	(23.357)	(10.743)	(0.036)	(0.041)
N	1747005	1747005	1747005	1555611	1220704
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 K/L if the firm lies above the median of the distribution of the average K/L between 2002 and 2006. The regressions include worker, sector (of the firm in 2006) times year, province (in 2006) times year fixed effects and whether the firm was high K/L times year fixed effects. Standard errors clustered at the 2006 firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Worker level evidence - heterogeneity by workers' wage and tenure

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]
			High wage		
interb.*post2006	1431.104	0.280	2.274	0.034	0.002
	(1293.170)	(18.094)	(7.696)	(0.023)	(0.023)
int*post*high KL	-6631.056**	-74.436**	-41.081***	-0.051	0.016
	(2610.997)	(33.134)	(14.548)	(0.036)	(0.038)
N	916045	916045	916045	834637	660523
			Low wage		
interb.*post2006	-1391.677**	-24.875*	-12.679	-0.046	-0.033
	(621.292)	(12.750)	(7.723)	(0.039)	(0.047)
int*post*high KL	-451.091	-25.542	-5.595	0.002	0.028
	(1094.692)	(26.366)	(12.913)	(0.051)	(0.062)
N	830943	830943	830943	720937	560147
			Longer tenure		
interb*post2006	-663.173	-2.140	-6.927	-0.043	-0.051
	(1206.300)	(18.068)	(10.479)	(0.038)	(0.044)
int*post*high KL	-2334.182	-54.141*	-29.325*	0.018	0.075
	(2267.768)	(31.214)	(16.256)	(0.047)	(0.053)
N	816816	816816	816816	743319	624228
			Shorter tenure		
interb*post2006	340.971	-17.951	-2.769	-0.015	-0.015
	(818.849)	(13.494)	(7.225)	(0.030)	(0.036)
int*post*high KL	-3567.834**	-51.207*	-16.113	-0.028	-0.010
	(1744.725)	(26.606)	(12.664)	(0.047)	(0.056)
N	930189	930189	930189	812292	596467
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. Long-tenured workers are workers with more than 7 years of experience within the firm in 2006. High K/L if the firm lies above the median of the distribution of the average K/L between 2002 and 2006. The regressions include worker, sector (of the 2006 firm) times year, province (of the 2006 firm) times year fixed effects and whether the 2006 firm was high K/L times year fixed effects. Standard errors clustered at the 2006 firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Mechanisms: intensive and extensive margin adjustments

	Employed	Employed 2006 firm	Part time if empl.	Perm. exit
	[1]	[2]	[3]	[4]
Dep var:		*All*		
interb.*post2006	-0.005	-0.036	-0.013	0.003
	(0.018)	(0.044)	(0.017)	(0.015)
int*post*high KL	-0.059*	-0.179**	0.004	0.034
	(0.030)	(0.078)	(0.024)	(0.026)
N	1747005	1747005	1569023	1747005
Dep var:		*High wage*		
interb.*post2006	0.010	0.012	-0.003	-0.007
	(0.024)	(0.060)	(0.020)	(0.021)
int*post*high KL	-0.095**	-0.247**	-0.007	0.073*
	(0.043)	(0.108)	(0.029)	(0.039)
N	916045	916045	840976	916045
Dep var:		*Low wage*		
interb.*post2006	-0.016	-0.071	-0.020	0.010
	(0.022)	(0.045)	(0.023)	(0.017)
int*post*high KL	-0.029	-0.116	0.010	-0.003
	(0.037)	(0.091)	(0.033)	(0.029)
N	830943	830943	728010	830943
Worker FE	Yes	Yes	Yes	Yes
st FE	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes

Note: Worker level analysis. High wage workers are workers whose wage in 2006 was above the median. Long-tenured workers are workers with more than 7 years of experience within the firm in 2006. High K/L if the firm lies above the median of the distribution of the average K/L between 2002 and 2006. The regressions include worker, sector (of the 2006 firm) times year, province (of the 2006 firm) times year fixed effects and whether the 2006 firm was high K/L times year fixed effects. Standard errors clustered at the 2006 firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: 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]
		All		
interb*post2006	-14.228**	-32.785***	4.779	13.776**
	(5.876)	(11.582)	(5.903)	(5.506)
N	1695901	1695901	1695901	1695901
		from high K/L		
interb*post2006	-31.062***	-76.494***	18.717	26.707**
	(11.784)	(20.020)	(11.387)	(12.752)
N	741769	741769	741769	741769
		from low K/L		
interb*post2006	-8.204	-17.033	-0.033	8.864*
	(6.668)	(13.481)	(8.064)	(4.968)
N	954081	954081	954081	954081
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 5, 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); The regressions include worker, sector (of the 2006 firm) times year, province (of the 2006 firm) times year fixed effects and whether the 2006 firm was high K/L times year fixed effects. Standard errors clustered at the 2006 firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

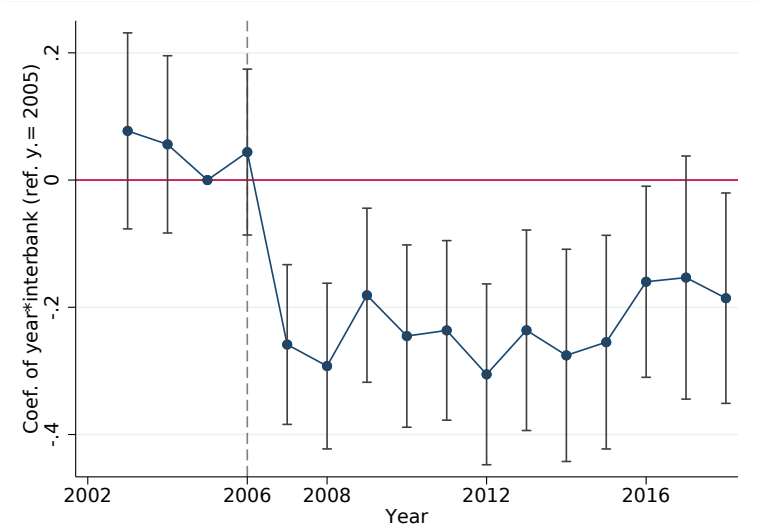
Table 10: Worker level evidence - heterogeneity by local unemployment rate

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]
			All		
interb.*post2006	-939.791	-27.362**	-12.126**	-0.018	-0.013
	(609.499)	(11.647)	(5.530)	(0.020)	(0.022)
int*post*UR	-1107.634***	-14.796	-6.284	-0.025	-0.036
	(392.901)	(8.931)	(4.214)	(0.015)	(0.023)
N	1747005	1747005	1747005	1555611	1220704
			from high K/L firms		
interb.*post2006	-3838.952***	-68.769***	-27.544**	-0.047*	-0.027
	(1242.782)	(17.931)	(11.451)	(0.026)	(0.034)
int*post*UR	-1873.465*	-34.588***	-13.107	-0.050**	-0.047
	(1062.156)	(9.691)	(8.303)	(0.024)	(0.039)
N	763487	763487	763487	690814	554500
			from low K/L firms		
interb.*post2006	189.627	-12.828	-6.705	-0.004	-0.006
	(664.146)	(14.272)	(6.313)	(0.025)	(0.029)
int*post*UR	-778.090**	-6.234	-3.528	-0.012	-0.030
	(383.737)	(10.651)	(4.816)	(0.016)	(0.025)
N	983467	983467	983467	864740	666112
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 firm lies above the median of the distribution of the average K/L between 2002 and 2006. The regressions include worker, sector (of the 2006 firm) times year and province (of the 2006 firm) times year fixed effects. Standard errors clustered at the 2006 firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

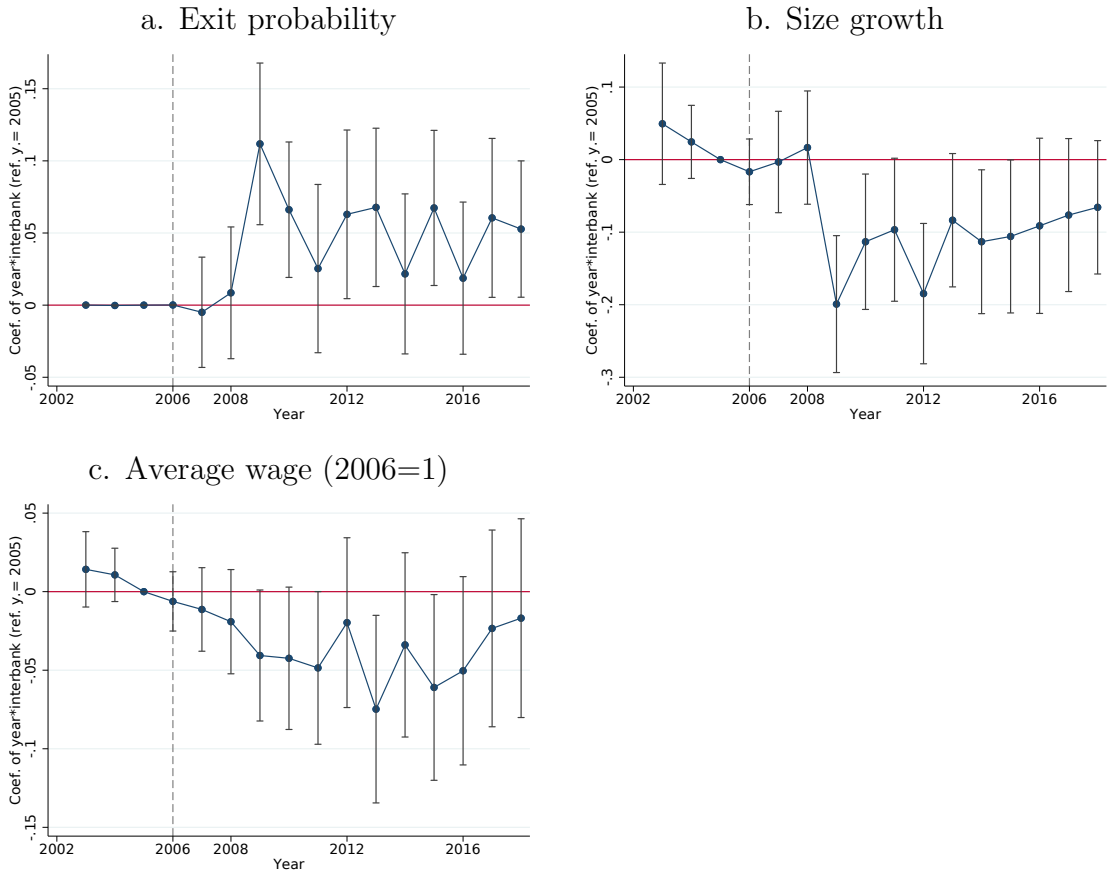
Figures

Figure 1: Effect on credit growth at the firm level



Note: interactions of 2006 exposure to interbank of the firms with year dummies. Vertical bars represent 95% confidence intervals. Standard errors clustered at the firm level. Additional controls: firm and year times sector fixed effects.

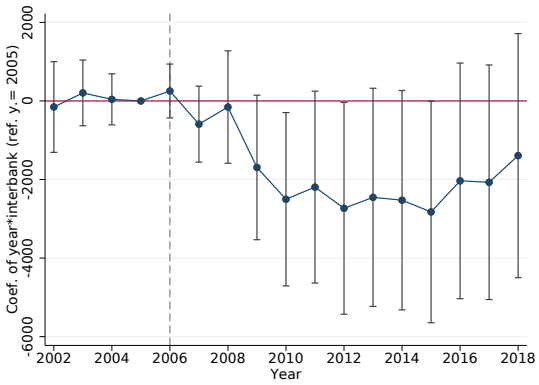
Figure 2: Effect on exit probability, firms' size growth, and average wage per employee



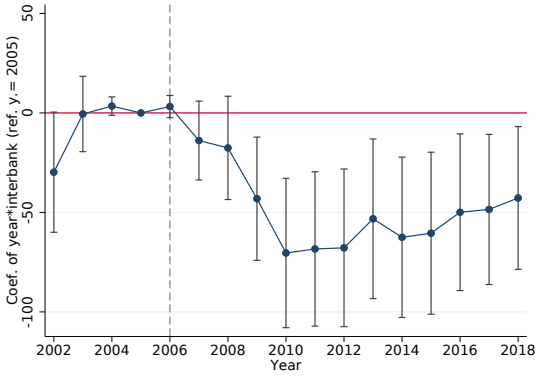
Note: interactions of 2006 exposure to interbank of the firms with year dummies. Vertical bars represent 95% confidence intervals. Standard errors clustered at the firm level. Additional controls: firm and year times sector fixed effects.

Figure 3: Effect on workers' earnings, days worked and daily wages

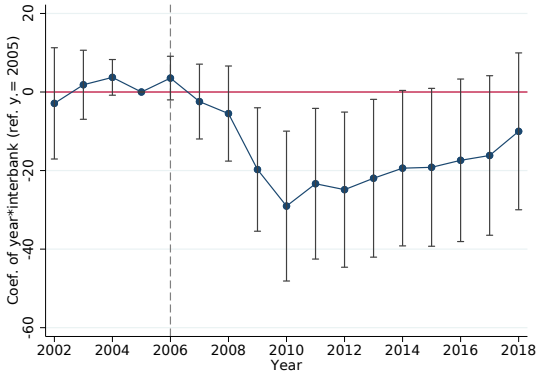
a. Labour Earnings



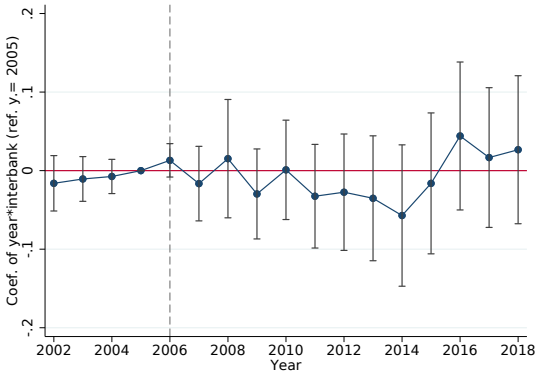
b. Days worked in 2006 firm



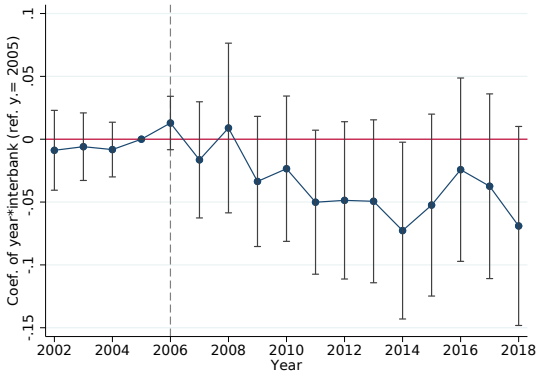
c. Days worked in any firm



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



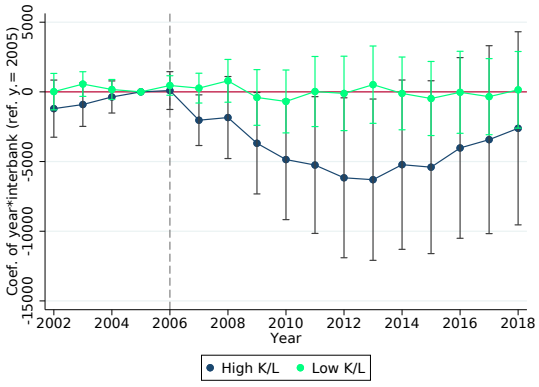
e. Daily wages in any firm (2006=1)



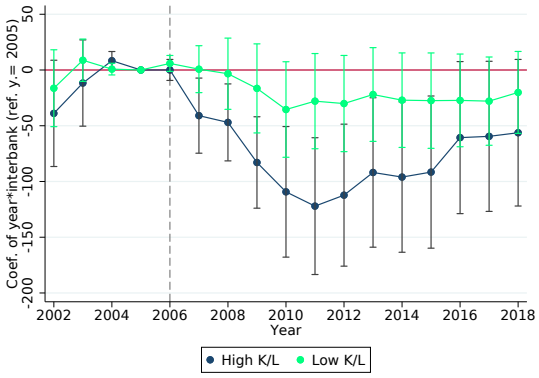
Note: interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals. Additional controls: worker, sector (of the 2006 firm) times year and province (of the 2006 firm) times year fixed effects. Standard errors clustered at the 2006 firm level.

Figure 4: Effect on workers' earnings, days worked and daily wages by K/L

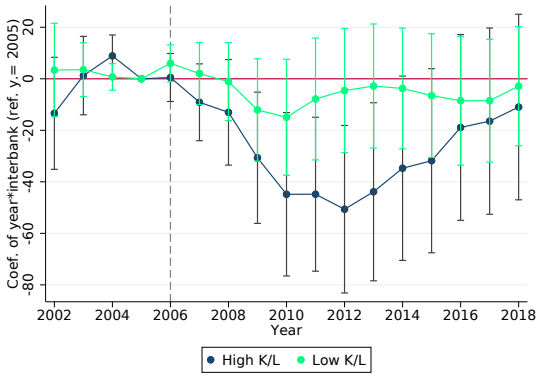
a. Labour Earnings



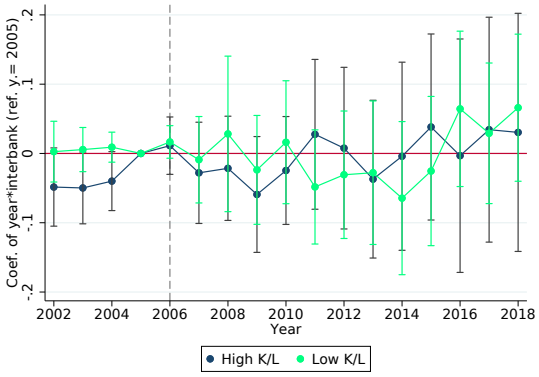
b. Days worked in 2006 firm



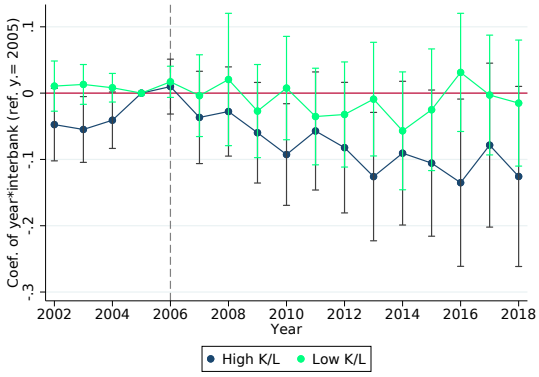
c. Days worked in any firm



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



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



Note: The graph displays coefficients of the interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies in two different regressions (one for high K/L firms and one for low K/L firms). Vertical bars represent 95% confidence intervals. Additional controls: worker, sector (of the 2006 firm) times year and province (of the 2006 firm) times year fixed effects. Standard errors clustered at the 2006 firm level. High K/L if the firm lies above the median of the distribution of the average K/L between 2002 and 2006.

The Long-term Earnings Effects of a Credit Market Disruption

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Online Appendix

A Additional Tables and Figures

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

Dep var:	Interbank/Assets	
	[1]	[2]
capital ratio	-0.00724	-0.0122
	(0.0127)	(0.0137)
bank roa	0.703	0.708
	(0.906)	(0.893)
liquidity ratio	-0.0886**	-0.0895**
	(0.0347)	(0.0371)
retail deposits/assets	-0.205***	-0.199***
	(0.0426)	(0.0431)
bad loans/assets	0.315	0.331
	(0.211)	(0.219)
interest rate on assets	0.00244	0.00203
	(0.00212)	(0.00245)
log bank assets	0.199	
	(0.381)	
Constant	12.55***	14.31***
	(3.969)	(2.703)
Dummies for deciles of bank size	No	Yes
Observations	470	470
R^2	0.281	0.297

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]
interbank06$_b$	0.001	0.001
	(0.000)	(0.003)
% credit 2000		-1.009***
		(0.006)
N	538169	538169
Firm FE	Yes	Yes

Note: Regression at the bank-firm level, it shows 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 2003-2006). Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table A.3: Change in firm-level credit to firms more exposed to the interbank market in 2006

	Delta cred 2010-2006	Delta cred 2015-2011	Delta cred
	[1]	[2]	[3]
interbank06*post 2011			-0.009
			(0.046)
post 2011			-32.0505***
			(0.597)
l.delta cred			0.1150***
			(0.00461)
l.delta cred*post 2011			-1.268***
			(0.0101)
interbank06	-0.285***	-0.0904***	
	(0.0268)	(0.0342)	
l.delta cred	-0.101***	-0.128***	
	(0.00389)	(0.00588)	
N	223263	209206	294690
Firm FE	No	No	Yes

Note: Regression at the firm level, it shows whether the change in credit (2015 and 2010) of different firms is correlated to the banks' exposure to interbank markets (average in 2003-2006, weighted by firm-bank outstanding credit in 2006), after controlling for the drop in credit observed between 2010 and 2006. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table A.4: Correlation between bank characteristics as of 2010-2011 and interbank exposure as of 2006 at the bank level

	[1] capital/assets	[2] tier1/assets	[3] capital/rwa	[4] roa	[5] govt bonds/assets
interbank06$_b$	-0.0221	-0.0116	-0.0217	-0.000242	-0.162***
	(0.0169)	(0.0173)	(0.0388)	(0.00467)	(0.0509)
N	469	469	469	469	469
R^2	0.192	0.252	0.132	0.017	0.151

Note: The table shows correlations between interbank funding to total assets (average in 2003-2006) of each bank and measures of capital, profitability, and exposure to the sovereign debt crisis. These measures are 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.5: Change in bank's average cost of funding

Dep var:	Change in average cost of funding	
	2006-2010	2011-2015
	[1]	[2]
interbank06$_b$	0.0484**	0.000735
	(0.0238)	(0.0130)
initial cost of funding (level)	-1.285**	-0.388**
	(0.521)	(0.166)
N	448	443
R^2	0.119	0.085

Note: The table shows correlations between interbank funding to total assets (average in 2003-2006) of each bank 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.6: Effect on credit growth-heterogeneity by firm's reliance on credit

Dep. var:	Credit growth	Credit growth	
		High (credit/assets)06	Low (credit/assets)06
	[1]	[2]	[3]
interb.*post2006	-0.150***	-0.315***	-0.188***
	(0.032)	(0.037)	(0.050)
interb.*post2006*(credit/assets)06	-0.0108***		
	(0.00038)		
N	342464	177556	164905
R^2	0.112	0.153	0.089
Firm FE	Yes	Yes	Yes
st FE	Yes	Yes	Yes

Note: Regression at the firm level, it shows whether the effect on credit growth is heterogeneous among firms of different reliance on credit as source of financing. Firms' reliance on credit is measured as credit/assets in 2006. The regressions include firm and year times sector fixed effects. Robust standard errors clustered at the firm level in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table A.7: Summary statistics by K intensity

	K intensive [1]	others [2]
Firm level variables (characteristics in 2006 of 2006 firms)		
Interbank exp.	0.140	0.142
	(0.046)	(0.063)
Size	1584.291	720.981
	(3530.850)	(2383.622)
Av. wage	2419.819	2007.383
	(788.350)	(772.779)
High type firm	0.745	0.568
	(0.436)	(0.495)
Firm age	21.110	21.188
	(13.594)	(13.656)
Manufacturing	0.690	0.520
	(0.463)	(0.500)
Worker level variables (in 2006)		
Age	42.628	42.128
	(8.288)	(8.320)
Female	0.270	0.328
	(0.444)	(0.470)
Blue Collar	0.525	0.571
	(0.499)	(0.495)
High wage worker	0.589	0.494
	(0.492)	(0.500)
Tenure < 6 years	0.413	0.437
	(0.492)	(0.496)
Daily wage	100.072	89.308
	(82.105)	(73.167)
Days worked	299.834	295.852
	(41.467)	(46.656)
Yearly labor earnings	29735.925	26192.023
	(19307.218)	(18210.900)
Observations	763,487	1,074,944

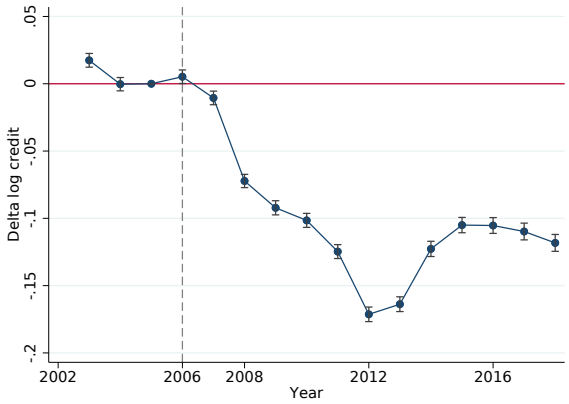
Note: Standard deviation in parentheses. K intensive firms are firms above the median in distribution of the average K/L ratio between 2002 and 2006. High-wage workers are workers whose wage in 2006 was above the median.

Table A.8: Additional heterogeneity tests: workers' occupation and age

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]
			White collars and Managers		
interb.*post2006	1456.424	-4.999	1.431	-0.002	-0.009
	(1219.024)	(18.520)	(9.085)	(0.031)	(0.038)
int*post*high KL	-4931.617**	-71.435*	-33.455**	-0.027	0.000
	(2448.993)	(39.275)	(15.686)	(0.056)	(0.066)
N	714765	714765	714765	642560	500644
ymeanc	30891.849	211.526	267.005	1.161	1.131
			Blue collars		
interb.*post2006	-1229.019*	-21.922	-11.857	-0.029	-0.031
	(670.877)	(13.603)	(7.502)	(0.038)	(0.043)
int*post*high KL	-1461.272	-32.071	-12.267	0.008	0.052
	(1321.220)	(24.111)	(12.731)	(0.045)	(0.050)
N	985405	985405	985405	872154	688989
			Old		
interb.*post2006	-107.682	-21.701	-9.896	-0.004	-0.015
	(893.399)	(15.046)	(7.689)	(0.030)	(0.035)
int*post*high KL	-4109.194**	-32.034	-24.132*	-0.047	-0.004
	(1995.564)	(25.993)	(13.397)	(0.042)	(0.048)
N	1108587	1108587	1108587	986698	790044
			Young		
interb*post2006	-195.908	-3.331	0.005	-0.043	-0.045
	(945.472)	(13.277)	(8.313)	(0.033)	(0.038)
int*post*high KL	-1169.381	-71.141***	-14.717	0.031	0.074
	(1640.661)	(26.314)	(13.389)	(0.049)	(0.056)
N	638418	638418	638418	568913	430644
Worker FE	Yes	Yes	Yes	Yes	Yes
st FE	Yes	Yes	Yes	Yes	Yes
pt FE	Yes	Yes	Yes	Yes	Yes

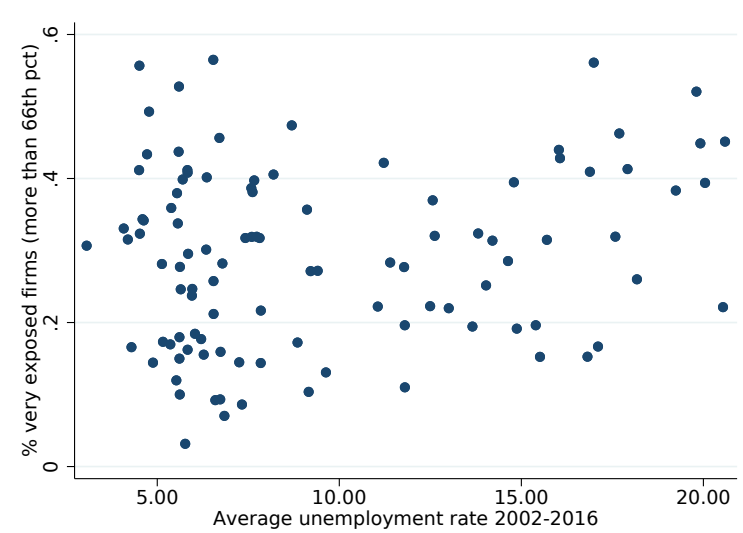
Note: Worker level analysis. Additional controls: the yearly unemployment rate in the province where each worker used to work in 2006 (also interacted with the post 2006 dummy), and worker and sector (of the 2006 firm) times year fixed effects. Younger workers are workers younger than 35 in 2006. Standard errors clustered at the 2006 firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure A.1: Dynamics of aggregate credit growth



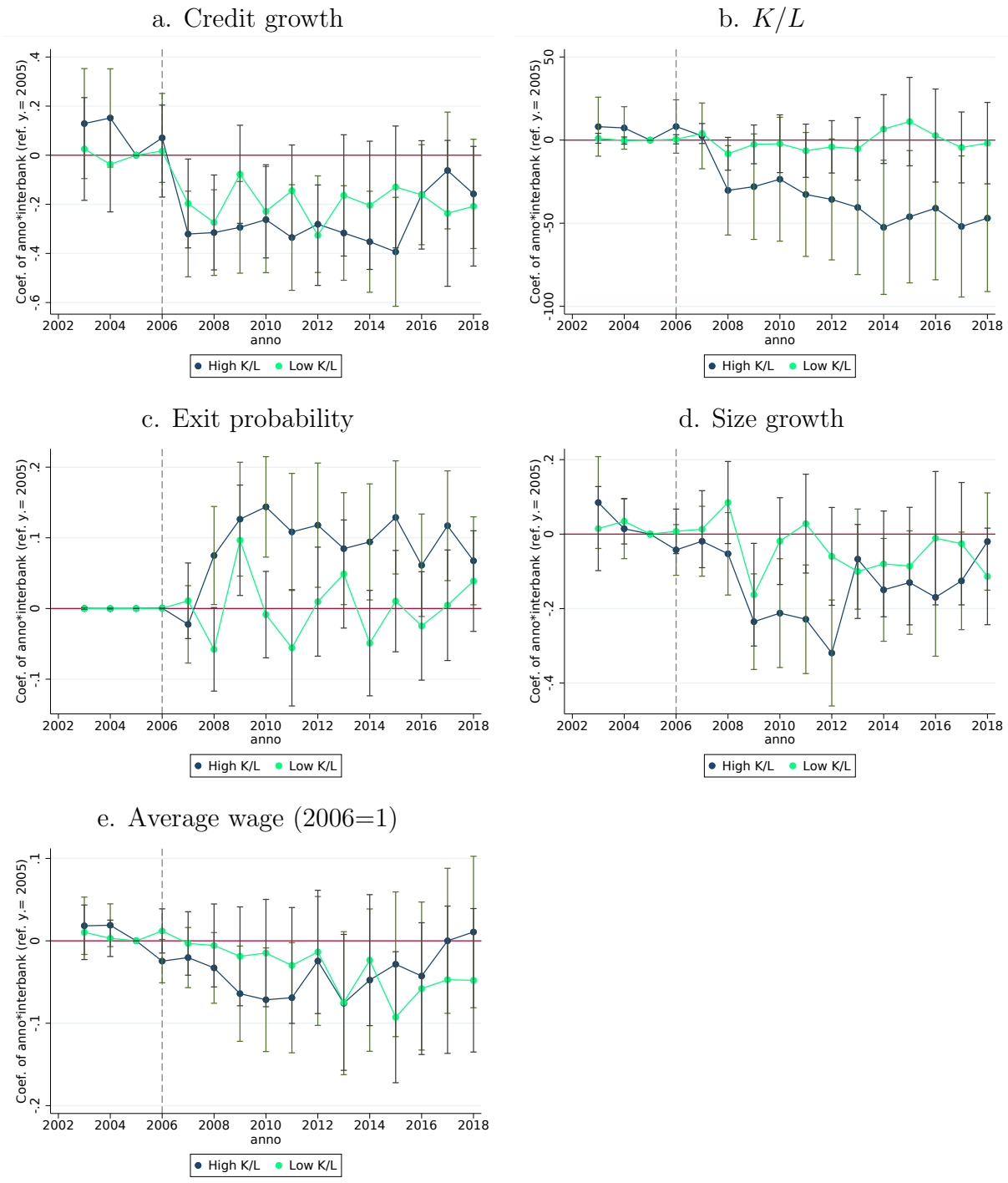
Note: This figure plots the level of overall credit growth experienced by all firms in our sample, relative to 2005.

Figure A.2: 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.

Figure A.3: Effect by firms' average level of K intensity in 2002-2006- high and low K/L

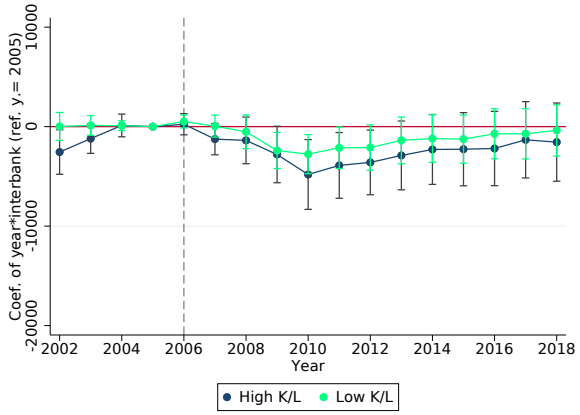


Note: interactions of 2006 exposure to interbank of the firms with year dummies in two different regressions (one for high K/L firms and one for low K/L firms). Vertical bars represent 95% confidence intervals. Standard errors clustered at the firm level. Additional controls: firm and year times sector fixed effects. High K/L if the firm lies above the median of the distribution of the average K/L between 2002 and 2006.

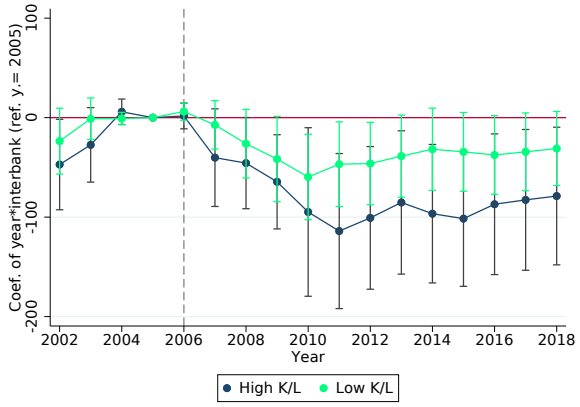
Figure A.4: Effect by workers' wage- high and low K/L firms in 2006

Low wage workers

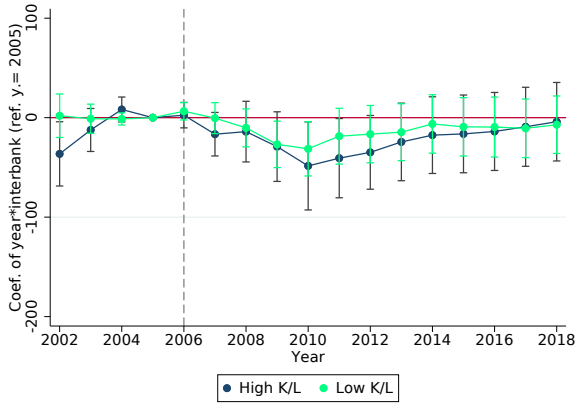
a. Labor Earnings



c. Days worked 2006 firm

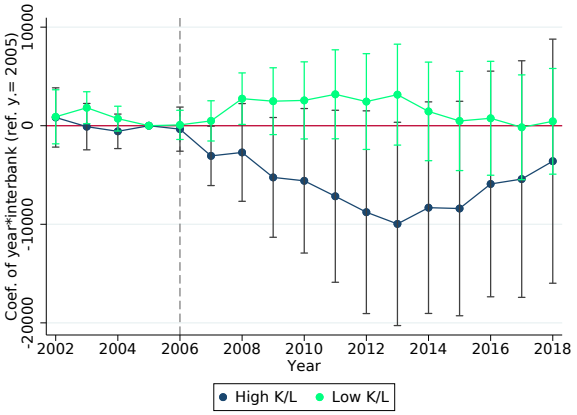


e. Days worked in any firm

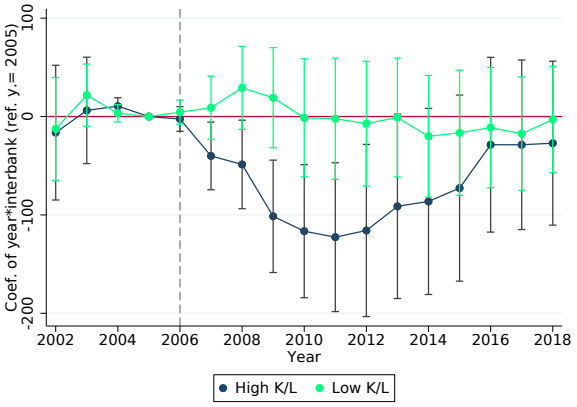


High wage workers

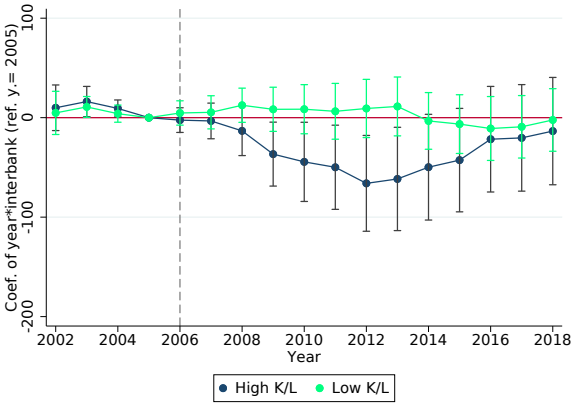
b. Labor Earnings

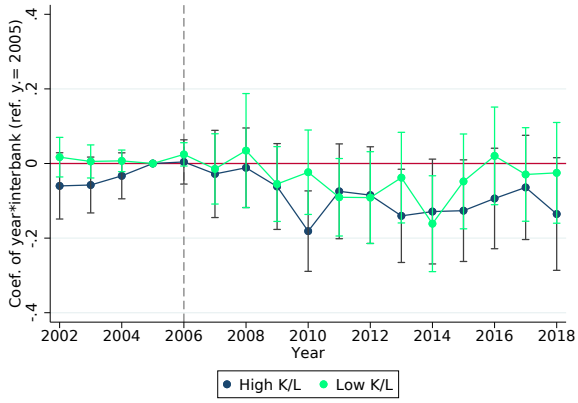


d. Days worked 2006 firm

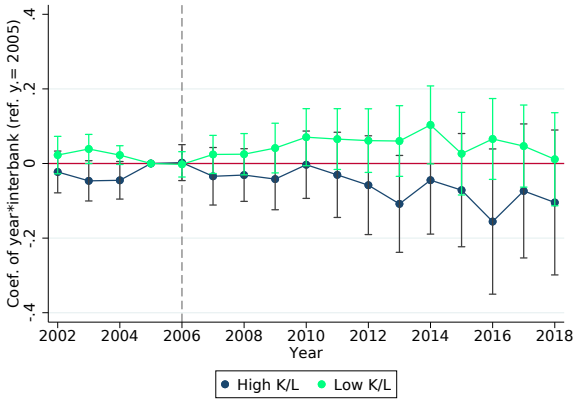


f. Days worked in any firm

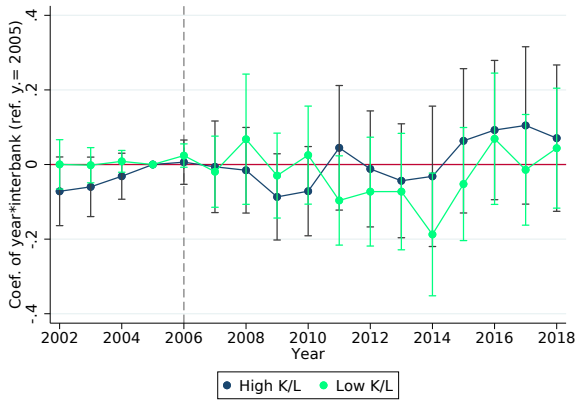




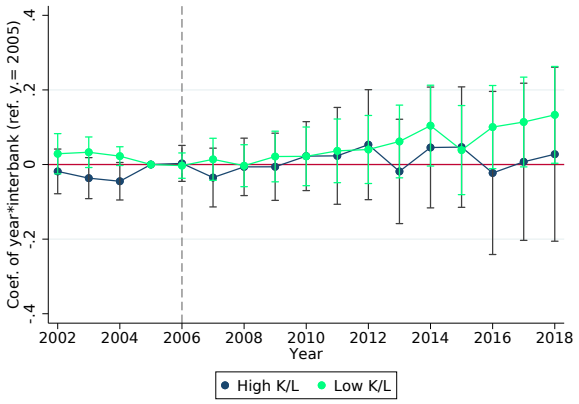
g. Daily wages in any firm (2006=1)



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



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



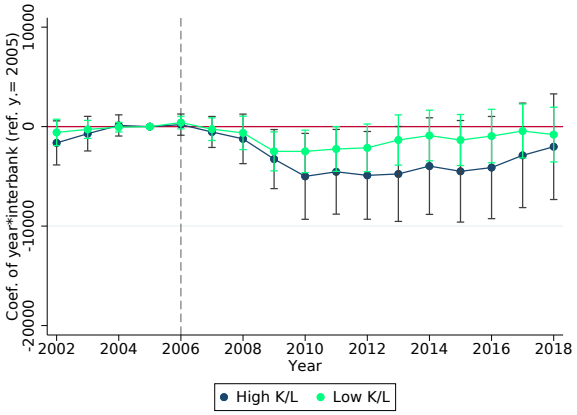
j. Daily wages in 2006 firm (2006=1)

Note: The graph displays coefficients of the interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies in two different regressions for each subgroup (one for high K/L firms one for low K/L firms). Vertical bars represent 95% confidence intervals. Additional controls: worker, sector (of the 2006 firm) times year and province (of the 2006 firm) times year fixed effects. Standard errors clustered at the 2006 firm level. High-wage workers are workers whose wage in 2006 was above the median. High K/L if the firm lies above the median of the distribution of the average K/L between 2002 and 2006.

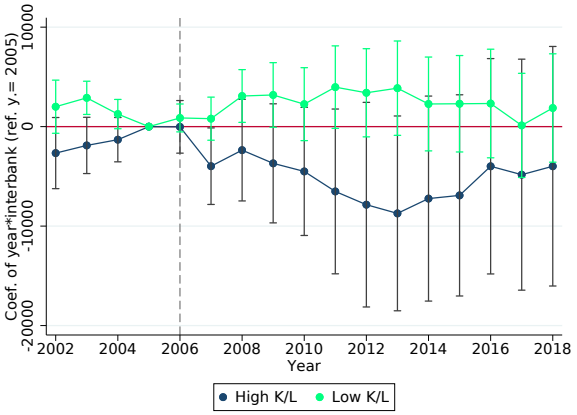
Figure A.5: Effect by workers' occupation- high and low K/L firms in 2006

Blue Collars | **White Collars and Managers**

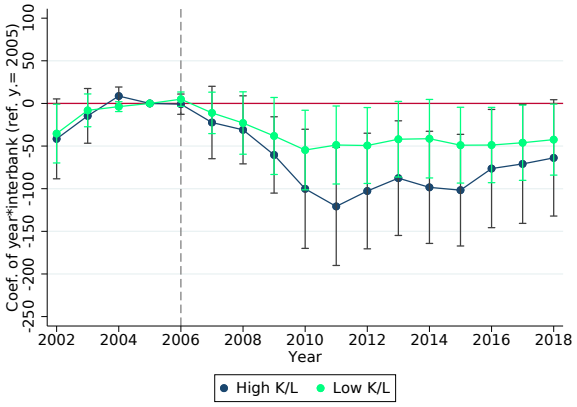
a. Labor Earnings



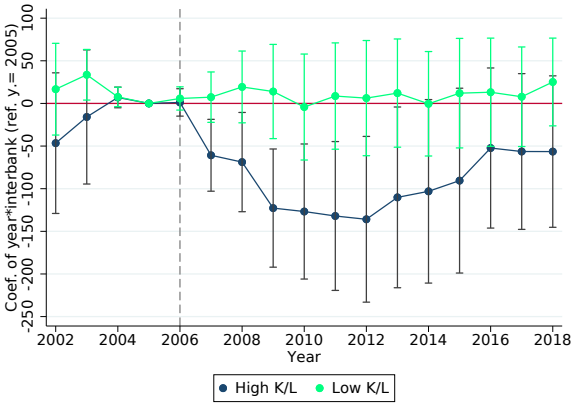
b. Labor Earnings



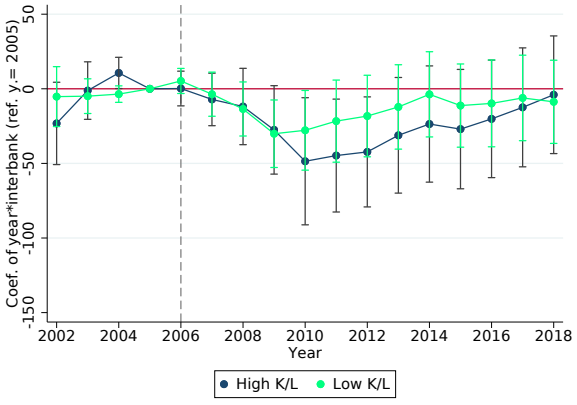
c. Days worked 2006 firm



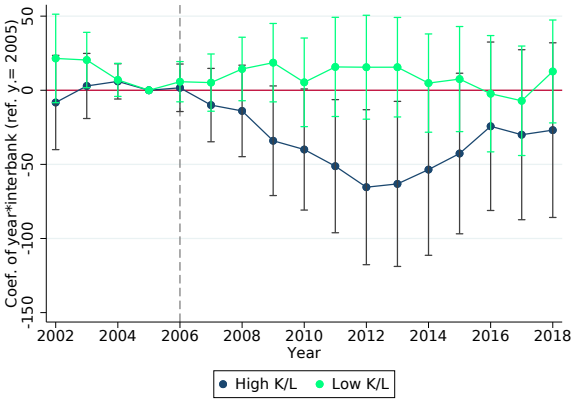
d. Days worked 2006 firm

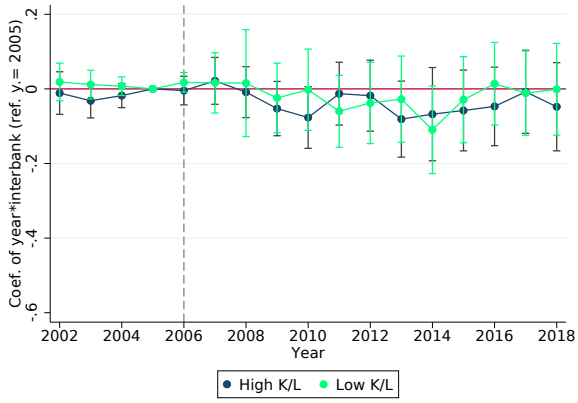


e. Days worked in any firm

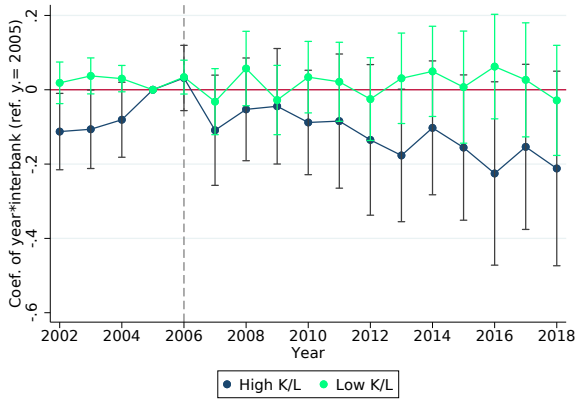


f. Days worked in any firm

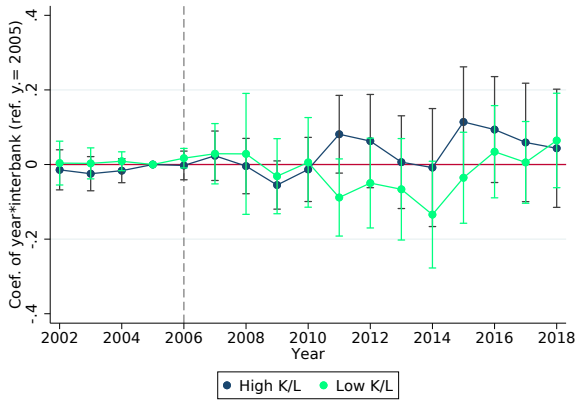




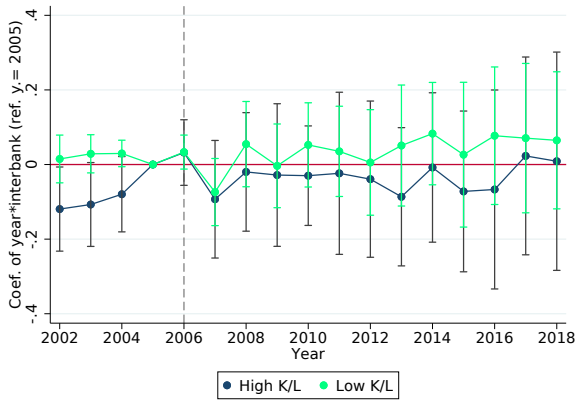
g. Daily wages in any firm (2006=1)



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



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



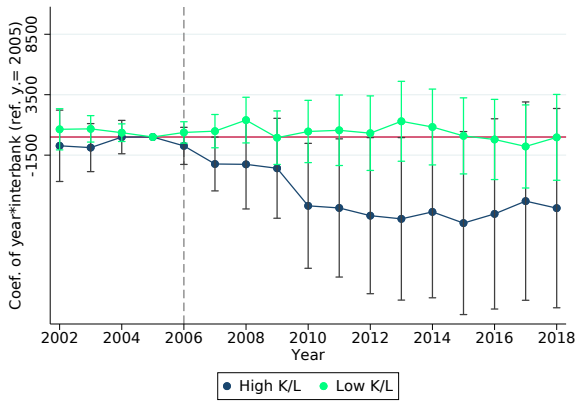
j. Daily wages in 2006 firm (2006=1)

Note: The graph displays coefficients of the interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies in two different regressions for each subgroup (one for high K/L firms one for low K/L firms). Vertical bars represent 95% confidence intervals. Standard errors clustered at the 2006 firm level. Additional controls: the yearly unemployment rate in the province where each worker used to work in 2006 (also interacted with the post 2006 dummy), and worker and sector (of the 2006 firm) times year fixed effects. High K/L if the firm lies in the top 3 deciles of the firm-level distribution of the average K/L between 2002 and 2006.

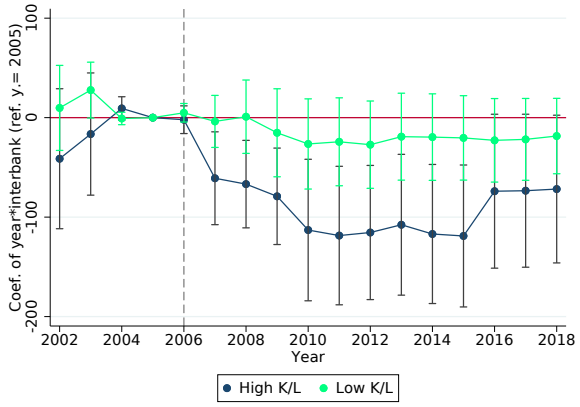
Figure A.6: Effect by workers' tenure- high and low K/L firms in 2006

Workers with shorter tenure

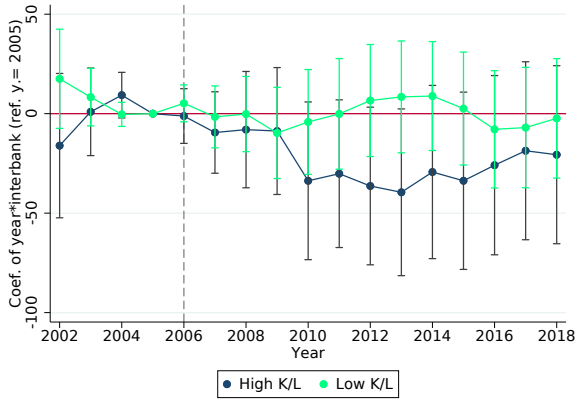
a. Labor Earnings



c. Days worked 2006 firm

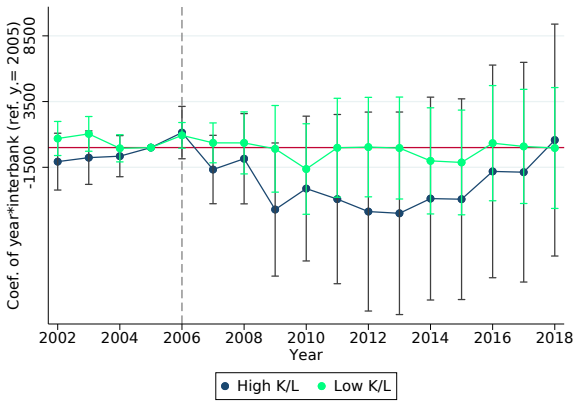


e. Days worked in any firm

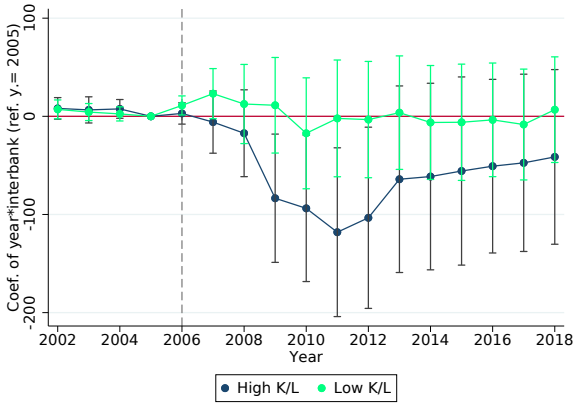


Workers with longer tenure

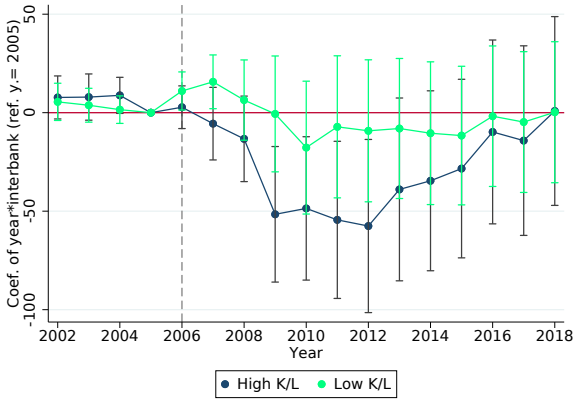
b. Labor Earnings

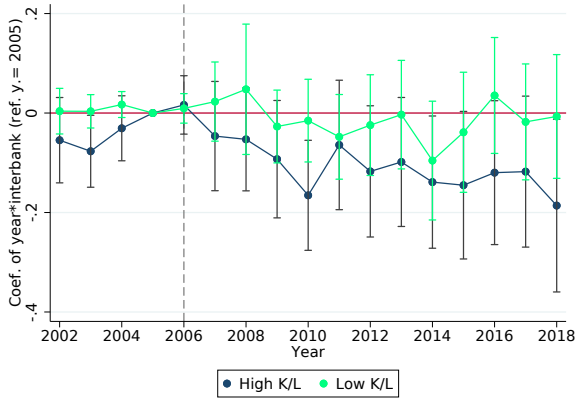


d. Days worked 2006 firm

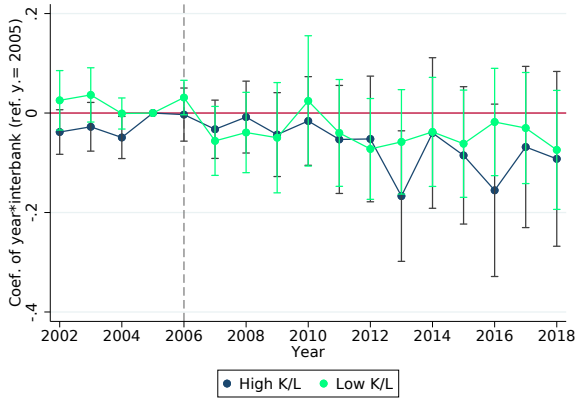


f. Days worked in any firm

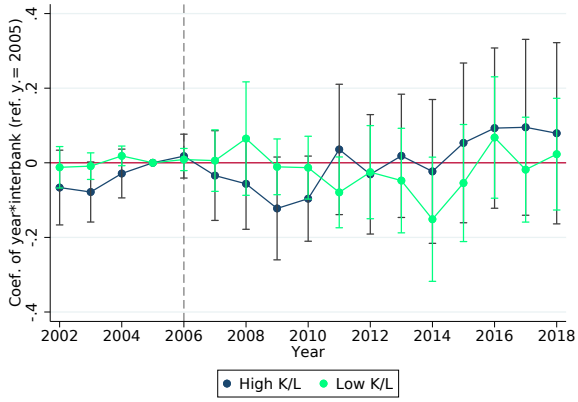




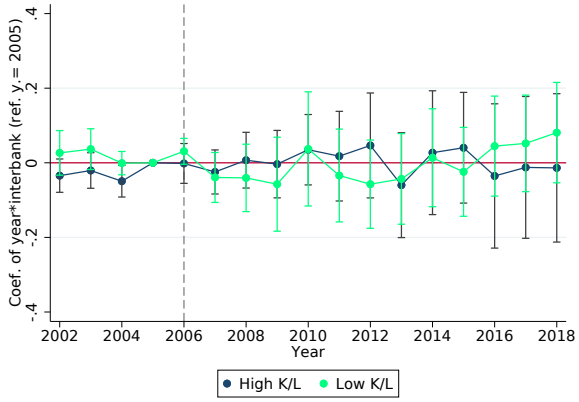
g. Daily wages in any firm (2006=1)



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



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



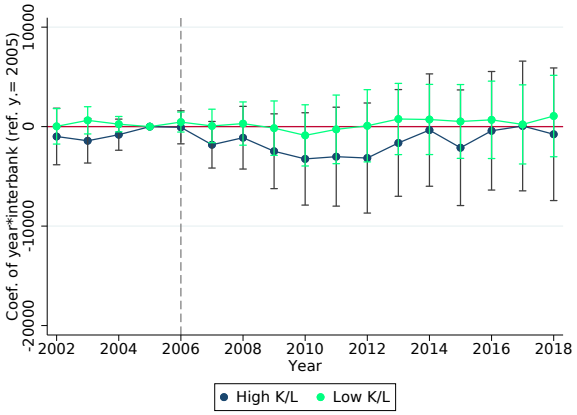
j. Daily wages in 2006 firm (2006=1)

Note: interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals. Additional controls: worker, sector (of the 2006 firm) times year and province (of the 2006 firm) times year fixed effects. Standard errors clustered at the 2006 firm level. Long-tenured workers are workers with 7 or more years of experience within the firm in 2006. High K/L if the firm lies above the median of distribution of the average K/L between 2002 and 2006.

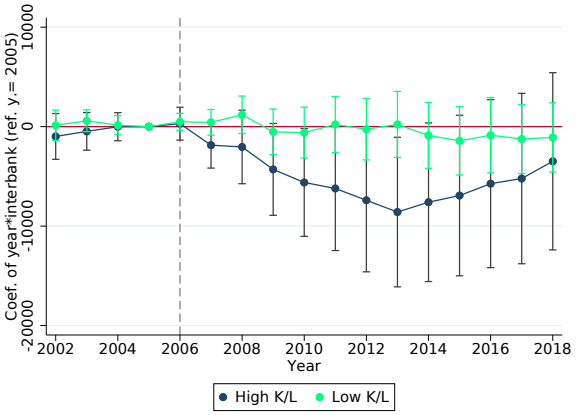
Figure A.7: Effect by workers' age- high and low K/L firms in 2006

Younger workers | **Older workers**

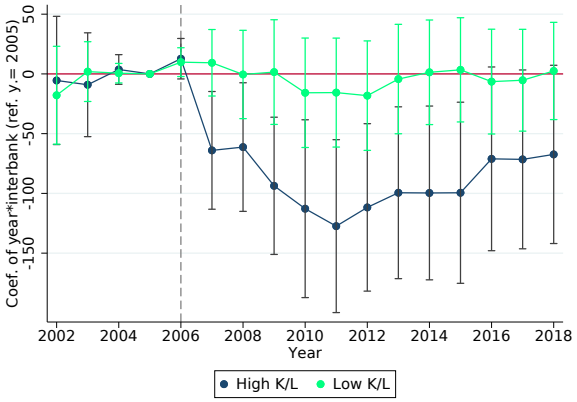
a. Labor Earnings



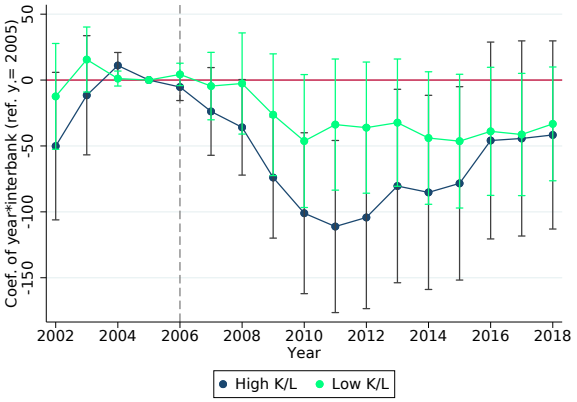
b. Labor Earnings



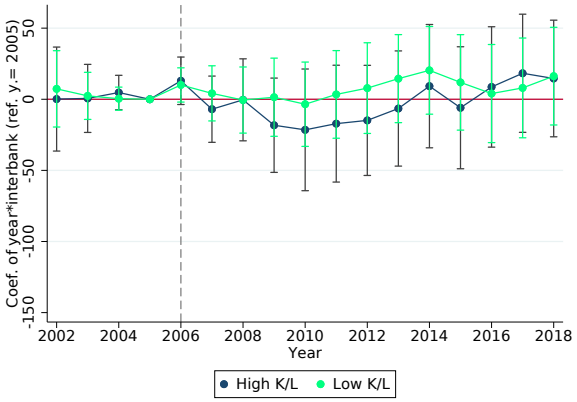
c. Days worked 2006 firm



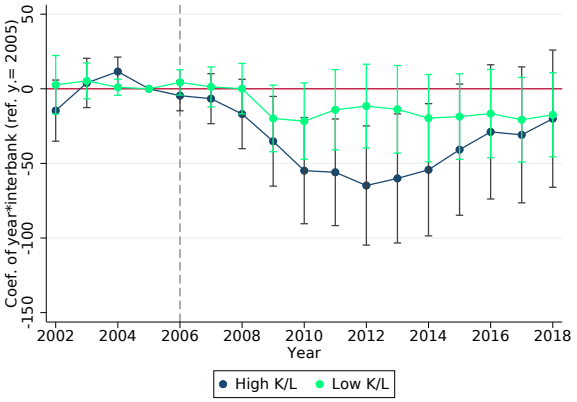
d. Days worked 2006 firm

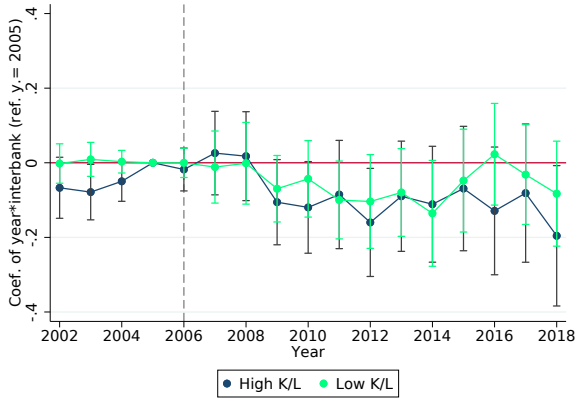


e. Days worked in any firm

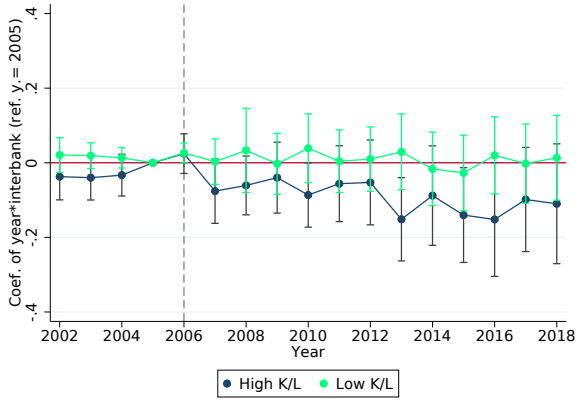


f. Days worked in any firm

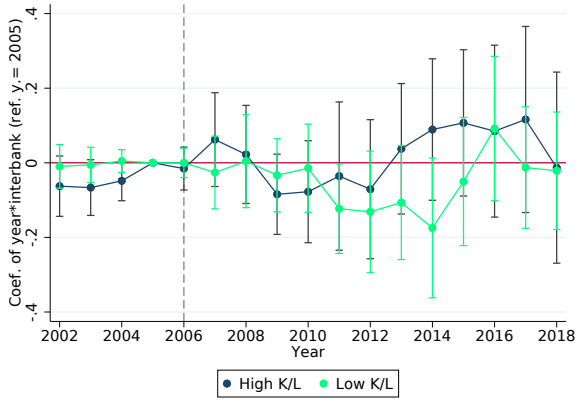




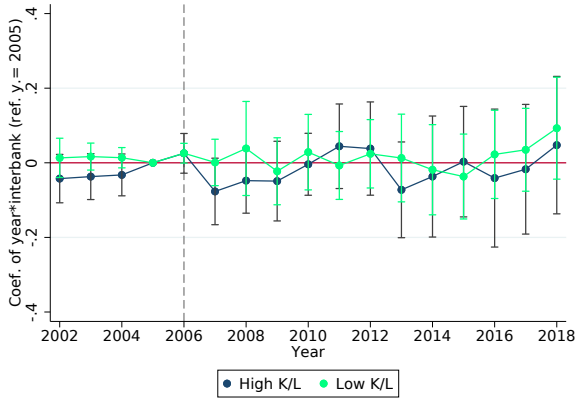
g. Daily wages in any firm (2006=1)



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: interactions of exposure to interbank of the firms where the worker was employed in 2006 with year dummies. Vertical bars represent 95% confidence intervals. Additional controls: worker, sector (of the 2006 firm) times year and province (of the 2006 firm) times year fixed effects. Standard errors clustered at the 2006 firm level. Younger workers if aged 20-39 in 2006; older workers if aged 40-50 in 2006. High K/L if the firm lies above the median of distribution of the average K/L between 2002 and 2006.

B 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. (2019).

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

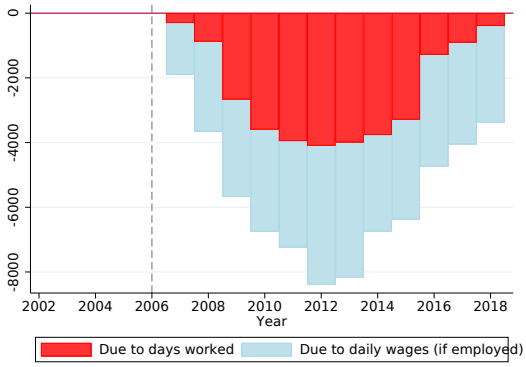
$$\Delta E_t = \Delta L_t * w_{06} + \Delta w_t * L_{06} + \Delta L_t \Delta w_t. \tag{1}$$

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 B.1 applies this decomposition to our differences-in-differences framework, for the sample of workers who experience the largest losses, 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.

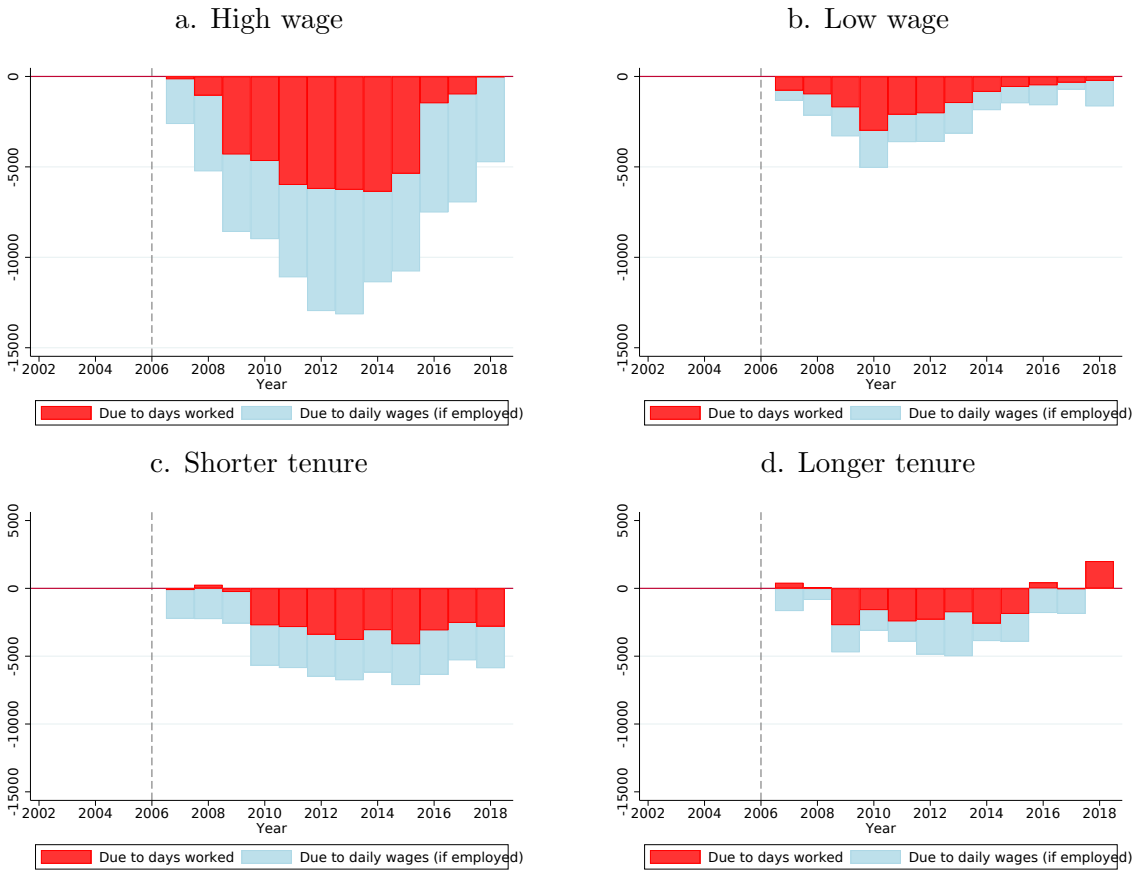
Figure B.2 Decomposes the effect for different types of workers. From the figure it is clear that the earning loss of high wage workers is determined by wage losses more than for low wage workers. Moreover, It shows that for older workers the loss in earnings depends largely on a reduction of days worked, which is very long lasting 8also due to higher early retirement probability).

Figure B.1: Decomposing earnings losses



Note: interactions of 2006 exposure to interbank of the firms 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 line indicates the difference between the overall effect and the effect due to days worked (wage effect and interaction/selection effect). Usual controls.

Figure B.2: Decomposing earnings losses, worker heterogeneity



Note: interactions of 2006 exposure to interbank of the firms 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 line 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. Shorter tenure workers are workers with less than 7 years of tenure in 2006. Usual controls.

References

Schmieder, J., T. von Wachter, and J. Heining (2019). The Costs of Job Displacement over the Business Cycle and its Sources: Evidence from Germany. *Mimeo*.