Banks, firms, and jobs*

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Abstract: Job disruptions is one of the most visible effects of financial crises and a broad literature shows that credit supply shocks lead to a reduction in employment. We contribute to this literature investigating individual heterogeneity across firms, workers and jobs in the response to a financial shock. We use an extremely rich data set on job contracts in one Italian region, matched with the universe of firms and their lending banks. To isolate the effect of credit supply shocks we build a firm-specific time-varying measure of credit restrictions and we take into account the confounding role of demand and productivity shocks saturating the model with fixed effects. Our findings indicate that a credit supply contraction reduces employment and the effect is economically large. The impact of the credit crunch is concentrated in fixed-term contracts and in services and it is stronger in more leveraged firms, foreign citizens, women and less educated workers.

JEL Codes: G01; G21; J23; J63

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1 Introduction

The credit crunch started in the aftermath of the global financial crisis has left long lasting consequences on a number of economies. Unemployment rates increased substantially in the US and in several European countries: at the end of 2014 the unemployment rate in the euro area is 11.6 percent, 4 percentage point higher than in 2008. Over the same period (Dec. 2008 – Dec. 2014), the stock of outstanding loans to non-financial corporations in the euro area decreased by 11.5 percent. These facts have triggered a renewed interest on the relationship between finance and employment (Pagano and Pica, 2012; Boeri *et al.*, 2013) and, more specifically, on the effects that credit supply shocks have on firms' employment decisions (Chodorow-Reich, 2014; Bentolila *et al.*, 2015; Duygan-Bump *et al.*, 2015; Haltenhof *et al.*, 2014).[1]

While this literature provides original insights on the effects of financial crisis on total employment at the firm or state level, it is silent about intra-firm dynamics and the relative effects of credit availability on different types of jobs. We contribute to this strand of literature zooming in on the employment dynamics within the firm, providing a series on policy-relevant insights on how firms adjust the level and composition of the labor force in response to credit shocks. We do so thanks to the availability of an original and extremely rich data set, based on an administrative archive that collects daily information on individual job contracts and labor market flows for the universe of firms (including individual and micro-enterprises) in an Italian region, matched with their lending banks. The degree of granularity of the data makes it possible to go beyond the standard job destruction/job creation dichotomy to investigate differential responses to a credit supply shocks across firms, workers, and job contracts.

This paper contributes to the growing literature that uses micro data to look at the real effect of credit supply shocks (Cingano *et al.*, 2013; Paravisini *et al.*, 2015; Kalemli-Ozcan *et al.*, 2015) and it is closely related to the recent contributions by Chodorow-Reich (2014), Benmelech *et al.* (2015), Popov and Rocholl (2014), and Bentolila *et al.* (2015), that investigate the effects of a reduction in credit supply on employment. Using more aggregate data other papers provides additional support to the employment costs of the financial crisis, considering either the US and Europe (Boeri *et al.*, 2013; Greenstone *et al.*, 2014; Haltenhof *et al.*, 2014; Duygan-Bump *et al.*, 2015).

Within this strand of literature, our work shares with the one by Bentolila *et al.* (2015) the unique feature of being based on loan level data from the credit register. In this set-up we control for demand and productivity shocks with a set of firm and time fixed effects, which allow for firm-specific time invariant demand shifters and for time-varying demand shocks which

[1] Data are taken from Eurostat (unemployment rate) and ECB (stock of outstanding loans).

are common to a narrowly defined set of borrowers. Moreover, to deal with the endogeneity of credit supply we do not consider aggregate credit supply shocks, as in Greenstone *et al.* (2014), but we are able to assign to each firm its specific measure of credit restriction based on all its banking relationships. In particular, we extend the approach proposed by Greenstone *et al.* (2014) building an exogenous firm-specific time-varying measure of credit supply restriction. We first estimate a bank-quarter fixed effect which can be interpreted as an indicator of the time-varying bank's lending policy given that, by construction, it is nationwide and purged of local loan demand (and of any other province-quarter level idiosyncratic shock). Second, we build a firm-level credit supply shock, using firm-specific banks' loan share to weight the bank-level indicator, and we show that this measure is strongly correlated with loan growth at the firm level.

In this way we can: 1) measure the firm-level 'aggregate' bank lending channel (Jiménez *et al.*, 2014), which takes into account general equilibrium effects (i.e. the possibility that firms substitute for credit across banks), and 2) obtain more precise estimates than the ones obtained with more aggregate data, given that we can saturate the model with a large set of firm-specific time-varying fixed effects to control for unobserved heterogeneity.

With respect to the analysis by Bentolila *et al.* (2015), our data make it possible to: 1) focus on micro enterprises, that are strongly dependent on bank financing and constitute the majority of Italian non-financial firms and a non-negligible share of firms in other countries, and 2) investigate heterogeneous response to a credit restriction across firms, workers and job contracts.

Thanks to the contract-firm-bank matched data we can exploit individual heterogeneity in the response of employment dynamics to bank credit supply. First, we assess whether firms adjust employment in different ways, depending on their sector of activity, size, leverage and their relationship with the banking system. Second, the information on labor market flows makes it possible to explore the mechanisms behind aggregate job losses, considering the effect of a reduction in credit supply on the composition of the labor force, differentiating between permanent and fixed-term contracts, adjustment via reduced inflows or higher outflows (and within them, via dismissal, expiration of contract or quit), and transitions between full-time, part-time and temporary contracts.[2] Finally, we exploit workers heterogeneity to assess which workers are more likely to be affected by the contraction in credit supply, separating across educational attainment, skills, age, gender, and nationality.

[2]In this way, our contribution relates to and extends the evidence discussed by Caggese and Cuñat (2008), who show that financially constrained firms have a more volatile labor force and employ a larger proportion of fixed-term workers than financially unconstrained firms.

One limitation of our data is the lack of information on wages, so that we can investigate only the quantity response to a financial shock, while we cannot say anything about price effects. However, very recent empirical evidence on Europe shows that the prevailing labor cost reduction strategy that firms had adopted in response to the Global Recession has worked through the adjustment of quantities rather than prices (Fabiani *et al.*, 2015), consistently with the presence of downward wage rigidities (see Devicienti *et al.*, 2007, for a discussion about Italy). Moreover, we observe the contract level bargained at the national level, which in Italy is a very good proxy of the wage level and allows for identification of promotions/demotions.

The paper proceeds as follow. In the next section we present the different sources that we have used to put together the data set, and some stylized facts about bank credit and employment. Section 3 describes in detail our identification strategy and the empirical model. Our main results are discussed in Section 4, while Section 5 presents a set of robustness tests. Section 6 concludes.

2 Data

Our analysis relies upon unparalleled loan-level information about the entire population of workers, firms and financial intermediaries operating in Veneto, a large Italian region with a population of 4,9 million individuals and a workforce of 2,2 million workers. Veneto accounts for roughly 9% of the Italian value added and of total employment; its productive structure is representative of the national one (Figure 1).

The structure of the banking system in Veneto is similar to the national one (in 2012 there were 120 banks), even though Veneto is more financially developed than the average region (Figure 2, left panel). Aggregate lending to non-financial corporations followed a similar dynamic in Veneto and Italy (Figure 2, right panel).

Veneto is hence very well representative of the Italian situation, which in turn represents an extremely interesting case studies for at least two reasons: first, Italian firms mostly rely on bank credit for their business activities, and more than other firms in the Euro area (Figure 3, left panel); second, small firms (less than 10 employees) are the most indebted, and the Italian productive structure is strongly biased towards small production units (Figure 3, right panel).

Of this extremely informative situation, our dataset brings together an extremely rich set of information coming from different administrative sources. Daily labor market flows from the regional public employment service are indeed matched to stock information form the national social security administration and to the Italian credit register maintained by the Bank of Italy using firm-level unique identifiers, namely their VAT numbers. These feature of the

data guarantee at the same time wide population coverage, high information reliability and a nearly total frequency of success in the matching procedure. In the following we provide an accurate description of our data sources.

2.1 The PLANET and ASIA archives

The bulk of labor market information comes from PLANET, an administrative dataset of daily labor market flows maintained by the regional employment agency *Veneto Lavoro*.[3] PLANET builds upon the obligation for firms operating in Italy to notice the national and local employment agencies about all labor market transitions for which they are held responsible, including hires, firings and transformations of individual employment arrangements (e.g., from full-time to part-time, from temporary to permanent, and the like). Firm-level observables include geographical location and sector (5-digit NACE code), while workers' in turn cover gender, age, nationality, occupation (5-digit ISCO code), type of contract (44 different employment arrangement), educational attainment (13 categories), time schedule (full-time or vertical, horizontal or mixed part-time), and reasons for separation.

In order to overcome limitations in terms of labor market stocks, PLANET is complemented with information from ASIA, the archive of active firms maintained by the National Statistical Institute (ISTAT) with register data from the Social Security Administration.[4] ASIA provides yearly data about firms whose economic activity spans for at least six months within a calendar year. To our purposes, ASIA adds information on firm size, on whether the observed firm belongs to a group with other production units in Italy (in Veneto or elsewhere) and contributes to the identification of firm closures.

2.2 The Italian credit register

Credit data are drawn from two main sources. The time-varying bank lending policies are estimated using data drawn from the Bank of Italy Supervisory Report (SR) database. Specifically, we use confidential data on outstanding loans extended by Italian banks to the firms in the local credit markets (i.e. provinces). This variable is, then, translated at the firm level using banks' loan share for each firm as weights. The credit extended to each firms is observed trough the Credit Register (CR) database, managed by the Bank of Italy, that records all loan contracts granted by all banks and financial intermediaries operating in Italy to each borrower whose total debt from a bank exceeds 75,000 euros until December 2008, and 30,000 euros since January 2009.

[3] Further information on PLANET (in Italian) is available here: www.venetolavoro.it/public-use-file
[4] Further information on ASIA (in Italian) is available here: www.istat.it/it/archivio/106814

In order to check the external validity of our credit supply index (see below) we also use data from the Bank Lending Survey (BLS). The BLS is a qualitative survey conducted by the national central banks of the euro area in collaboration with the European Central Bank; in Italy the 8 main credit groups are involved. The survey produces "diffusion indexes" that reflect subjective assessments of the lender on the relative importance of demand and supply factors in explaining the lending patterns.[5]

2.3 Sample selection and the final data set

All data sources are merged together using VAT numbers as univocal identifiers of firms. Genuine non-matches between PLANET and ASIA are possible, and are due to two reasons: very short-lived firms (less than a semester in a calendar year) are not recorded within ASIA, while firms with a very stable employed workforce (meaning no changes in both the intensive and the extensive margins, including the type of contract) do not appear in PLANET. None of the two entails any limitation to our purposes, as i) the stock of employed workforce for very short-lived firms can be easily induced from workers' flows, and ii) the worker flows in stable firms are by definition null. This grants that truly unsuccessful matches are infrequent and largely due to misreporting of VAT numbers by either the firms or the statistical offices maintaining the single sources, an occurrence that we can safely assume to be random and – due to the extremely large sample size – almost irrelevant from a statistical standpoint. For these reasons, non-matches are retained in our data sources, and the related (missing) information inputted.

Sample selection is due to a number of reasons. First, although the available time series cover a longer period, we narrow our focus on the years from 2008 to 2012 (the last available year in most sources at the time of our analysis). The reason is that until 2007 the obligation for firms to notice hires and firings (from which PLANET originates) concerned dependent workers only and occurred largely through paper documents. The first limitation resulted in an incomplete coverage of labor market flows, inasmuch as independent contractors and disguised self-employees – widely spread in the Italian labor market and at high risk to represent a buffer stock of employment during downturns – were not observed in the data. The second limitation entailed in turn a non-negligible delay of data completion. Both have been overcome during 2007, when digital notice became compulsory for all workers, including independent ones.

[5]Technically, the diffusion index is the (weighted) difference between the share of banks reporting that credit standards have been tightened and the share of banks reporting that they have been eased (see www.ecb.europa.eu/stats/money/surveys/lend/html/index.en.html).

Second, we focus on the private non-financial non-primary sectors. The reasons are self-evident. Employment in the public sector depends on different rationales that include macroeconomic stabilization, budget control and the supply of public services, and its funding relies to a great deal on out-of-market sources (taxes). The agriculture sector in turn is highly subsidized all over the EU and a credit crunch from the private sector may be overcome by financial resources that we cannot observe at the micro level. Finally, credit flows within the financial sector often respond to different factors than flows from banks to non-financial corporations.

Third, and last, we removed from our sample temp agencies, care givers and house cleaners. The reason for temp agencies is that we cannot distinguish between the internal staff and the workers leased to other firms, and since temp agency workers are also included within the employed workforce of the firms they are leased to, retaining temp agencies would results in a duplication of flow records. Care givers and house cleaners, instead, are dropped out as in most cases they appear as self-employees if not individual firms. They would mistakenly increase the number of actual firms.

The final sample includes about 450,000 firms and 2.3 million firm-quarter observations.

2.4 Some stylized facts

The firms included in the sample are predominantly micro and small enterprises, reflecting the structure of the Italian industry. Over the sample period 2008-2012, the number of active firms declines by roughly 2,000 units, with some degree of seasonality. Correspondingly, the number of employees drops from 1,410,000 to less than 1,390,000. These trends mimic the aggregate data from the National Institute of Statistics (Figure 4)

Overall, about 90% of the firms in the sample have less than ten employees. The average firm size is between 4 and 5 employees. This distribution is consistent with Census data both in terms of firms and employees (Figure 5)

Over the sample period in which the firm is present in the panel, the job loss for the average firm is equal to 0.4 employees, while credit declined by 7 percent (specifically, we consider the growth rate of used loans), consistently with the evidence of a significant credit crunch in Italy following the Lehman's collapse (Presbitero *et al.*, 2014). However, the reduction in bank credit and employment is not common across the board, as 28 percent of firms experienced a positive change in employment and credit has grown for 43 percent of firms in the sample. The correlation between credit growth and changes in the labor force across firms is positive but small (0.06). However, collapsing the data over the time dimension forces us to loose all the variability over time, which is exactly the source of variation that we will use to identify

the effect of bank lending on jobs.

3 Identification strategy

3.1 The empirical model

We test for the effect of credit supply on firm employment decisions estimating the following model:

$$\Delta EMPLOYMENT_{ijt} = \beta \Delta LOAN_{ijt} + \delta_i + \tau_t + (\gamma_j \times \tau_t) + \epsilon_{ijt} \tag{1}$$

where $\Delta EMPLOYMENT_{ijt}$ and $\Delta LOAN_{ijt}$ are changes in total employment and loans granted by the banking system for firm i in sector j over the quarter t, calculated as:

$$\Delta X_{ijt} = \frac{X_{ijt_1} - X_{ijt_0}}{0.5 \times X_{ijt_1} + 0.5 \times X_{ijt_0}} \tag{2}$$

where X_{t_0} and X_{t_1} are, respectively, the values of employment and bank lending at the beginning and the end of the quarter t. Variations calculated in this way are widely used (Moscarini and Postel-Vinay, 2012; Haltiwanger *et al.*, 2013) because they have the advantage of being symmetric and bounded between -2 (exiters) and $+2$ (entrants) and they are equal to zero for firm that does not register any variation in employment or lending within the quarter. Since labor decisions are sticky and the real effects of a financial shock could be visible with some lag (Greenstone *et al.*, 2014; Popov and Rocholl, 2014), in the baseline specification we lagged the changes in granted loans by two periods (formally, we use $\Delta LOAN_{ijt-2}$). However, results are robust if we calculate the overall cumulative change in bank lending between t and $t-2$.

The estimate of β gives the magnitude of the bank lending channel on employment dynamics. To assess the effect of bank lending on firm employment we face two main challenges. First, bank lending is endogenous to firms' economic conditions and employment choices, so that standard OLS estimates are likely to be downward biased. To isolate a credit supply shock from a lower demand for credit we rely on an instrumental variable (IV) approach similar to the one proposed by Greenstone *et al.* (2014). We construct a time-varying firm-specific index of credit supply (CSI_{it}) – discussed in detail in the following section – and we use it as an instrument for $\Delta LOAN_{ijt}$. Second, the observed amount of bank credit is the equilibrium of demand for and supply of credit.

To deal with possible demand and productivity shocks we first add firm and time (quarter) effects, which allow for firm-specific time invariant demand shifters and for common global shocks occurring at a quarterly frequency. Then, we saturate the model with more sophisticated industry $\times$ quarter fixed effects (Kalemli-Ozcan *et al.*, 2015) and with a set of dummies

that vary across quarters and firm class size (micro, small and medium-large firms). The degree of granularity of fixed effects is such that our identification hinges on the assumptions that: 1) firm unobserved heterogeneity which drives labor demand (i.e. managerial risk appetite) is time invariant, and 2) all firms operating in the same 2-digit industry and in the same class size face the same demand or productivity shock in each quarter.

As we are considering the universe of firms in a single Italian region, the comparison within 2-digit industry and three firm size classes should be granular enough to isolate time-varying demand shocks, which we assume to be common within industry and firm size class and of quarterly frequency.

Employment dynamics could be affected also by the *housing net worth* channel, which can compress demand because of a direct wealth effect or tighter borrowing constraints, through a fall in collateral values. This channel has been responsible for a significant drop in employment in the U.S. during the financial crisis (Mian and Sufi, 2014) and it could also be important in our set-up, because of high home ownership rates in Italy (76% of households own their house in Veneto) and because, differently from most of the literature, we deal with entrepreneurs of micro firms, who are likely to post their house as a collateral for business loans. However, the housing boom-and-bust cycle in Italy has been quite limited, and even more so in Veneto (Figure 6). In any case, to further avoid any confounding factor affecting our estimates, we add time-varying house prices at the municipality level.

3.2 Credit supply index

To isolate the exogenous component of credit supply we follow Greenstone *et al.* (2014) and use a *modified shift-share approach* that is purged of province-level time-varying demand shocks. Specifically, we estimate the following equation at the bank level and excluding Veneto:

$$\Delta L_{bpt} = \alpha + \delta_{bt} + \gamma_{pt} + \epsilon_{bpt} \tag{3}$$

where the outcome variable ΔL_{bpt} is the percentage change in outstanding business loans by bank b in province p at time t; γ_{pt} is a set of province-quarter fixed effects that capture the variation in the change of lending due to local economic factors, which we can also interpret as broadly measuring local demand; the bank-time fixed effects δ_{bt} represent our parameters of interest and capture (nationwide) bank lending policies. The identification of both γ_{pt} and δ_{bt} is guaranteed by the presence of multiple banks in each province (i.e. multiple banks exposed to the same local demand) and the presence of each bank in multiple provinces (i.e. multiple provinces exposed to the same bank supply conditions).

We then construct a time-varying firm-specific index of credit supply, aggregating the bank-specific supply shocks estimated above with the (lagged) banks' shares at the firm level as weights. Specifically, the credit supply for the firm i at time t is:

$$CSI_{it} = \sum_{b} w_{bit_0} \times \overline{\delta_{bt}} \tag{4}$$

where $\overline{\delta_{bt}}$ are the bank-fixed effects estimated in equation (1) and w_{bit_0} is the bank b market share for firm i at the beginning of the period (end-2007).

By construction, CSI_{it} captures the time-varying stance of the credit supply at the firm level and its sources of variability are the substantial heterogeneity in changes in business lending across banks and the variation in bank market shares across firms.

We start by documenting some reassuring descriptive statistics on the credit supply indicator. At the nationwide level, the growth rate of business loans follows the stance of credit supply orientation in the first part of the crisis, while they are less correlated in more recent years (Figure 7, panel a); the latter pattern might be due to the prevalence of demand factors in the second part of the crisis as main drivers of loans growth rate. Moreover, the large drop in credit supply conditions from the beginning of the financial crisis onward was mostly concentrated among large banks (panel b), consistent with the fact that those banks were more exposed to the liquidity drought in interbank markets (Bonaccorsi Di Patti and Sette, 2012)[6]; on the contrary, the effects of the outbreak of the sovereign debt crisis on the credit supply orientation (from the summer of 2011 onward) were stronger among small banks. For large banks, our indicator perfectly mirrors the credit supply orientation as measured by the Bank Lending Survey (BLS) up to 2011 while it fails to find any significant tightening of credit supply due to the sovereign debt crisis (panel c). Finally, for each period we divide banks into two groups, depending on whether their estimated credit supply orientation was below or above the median, and we examine credit patterns for both groups: as expected, tight banks recorded more negative patterns than ease ones (panel d).

Our measure of credit supply shows the expected correlation with bank characteristics. We run a set of bank level regressions on the cross section of banks, taking the average CSI over the period 2008-2012 as the dependent variables and a set of bank characteristics measured at end-2007 as explanatory variables. These regressions show that credit tightening has been stronger for banks that are smaller, have a larger funding gap and a larger share of non-performing loans (Table 1).

[6] Bonaccorsi Di Patti and Sette (2012) show that the decline in lending after Lehman was very heterogeneous across banks and concentrated among the five largest banking groups, likely due to the fact that those banks have a higher share of assets that are funded by wholesale sources.

3.2.1 Exogeneity of the CSI

The exogeneity of CSI_{it} relies on the two terms w_{bit_0} and $\overline{\delta_{bt}}$. As for the first term, our assumption is that the bank market shares at the firm level, once we have controlled for firm-fixed effects, are not correlated with the employment trend at the firm level. Though this is a reasonable assumption, one may still has some concerns. For example, if main banks specialized in larger firms that were more exposed to the economic cycle (thus experiencing an employment decrease) and if those same banks also restricted credit supply more than other lenders, then a correlation between our credit supply indicator and firm employment growth would be spurious. In order to address this point we also include in the specification trend variables varying by economic sector and firms size. If our parameter of interest is fairly stable we may argue that the argument discussed above in not an issue in our case.

As far as the second term is concerned, bank fixed effects ($\overline{\delta_{bt}}$) are exogenous by construction since they are purged of unobserved province-year factors and it is rather implausible that unobserved effects at the province level are able to affect nationwide banks' lending policies. In addition, the Veneto provinces are not part of the analysis, so that we exclude the effect of demand condition in the region from the calculation of bank fixed effects.

A possible concern is that bank policies can vary across banks characteristics (e.g. size) and the latter could be correlated with firms characteristics (e.g. larger banks grant loans to larger firms). If this is true and if firm characteristics are correlated with firms employment outcomes – as plausible – then the instrument will not be orthogonal to the error term in equation 1. However, summary statistics reported in Table 2 shows that there is no systematic correlation between the size of the exposure to the credit supply shocks and a set of firm characteristics, such as size, leverage, banking relationships and sector of activity.

3.2.2 Relevance of the CSI

To assess the relevance of the instrument, Table 3 reports the empirical results of the first-stage regression. As expected, the CSI is positively associated with the change in granted loans and the coefficients is precisely estimated. Moreover, Figure 8 (left panel) illustrates that firms exposed to a low credit supply (the ones for which the CSI is below the sample median) show, on average, a declining level of bank debt over the sample period. By contrast, firms exposed to a high credit supply (CSI above the sample median) report, on average, an increasing level of debt. The same Figure, in the right panel, represents the reduced form model: it correlates the credit supply index with average employment over time. As before, separating firms exposed to a low and high credit supply reveals that the former show, on

average, a declining employment, while average employment increases for the latter.

4 Results

4.1 Baseline results

Table 4 reports the results of the baseline model, estimated with a range of fixed effects on the whole sample of firms, and on a smaller sample which is based on borrowers with bank debt that exceeds a threshold of 75,000 euros throughout the entire period. The first panel reports the 2SLS regressions with the change in granted loans lagged by two quarters, while the middle panel reports results for the average change in granted loans in the contemporaneous and the previous two quarters. We report all the estimates with robust standard errors, while in the robustness section we experiment with alternative clustering of the standard errors to allow for intra-group correlation in the error term. Overall, the 2SLS estimates confirm that the instrument is relevant, given that the first-stage F-statistic ranges between 46 and 69 in the full sample, well above the critical value of 10 suggested by Staiger and Stock (1997).

The results shown in the top panel indicate that the growth rate of granted loans has a positive effect on changes in employment at the firm level. The point estimate of the bank lending channel is 0.4, meaning that a 10 percent contraction in bank lending translates into a 4 percent reduction in employment. This effect remains stable when adding time-varying fixed effects (columns 2 and 3) and when controlling for housing prices at the municipal level (column 4), which allow for borrower-specific demand and productivity shocks to vary at a quarterly frequency. The stability of the estimate of β across different model specifications suggests that there is no additional unobserved heterogeneity driving our estimates. Therefore, from now on we will estimate equation 1 with standard firm and quarter fixed effects. Additional results with more demanding fixed effects will be discussed in the robustness section.

When we limit the sample to borrowers with an exposition to the banking system above 75,000 euros the coefficient on $\Delta LOAN$ slightly increases to 0.47, but it is still precisely estimated (column 5). Considering the overall change in lending over three quarters confirms the main finding of a negative effect of credit availability on employment and, as expected, the point estimates become larger. The bottom panel, instead, shows the results of the reduced form equation, in which the CSI is included directly in equation 1. Results indicate that the exogenous component of credit supply is positively associated with changes in employment.

Our main results, so far, confirm the existing evidence about the negative effect of a credit supply shock on employment (Chodorow-Reich, 2014; Bentolila *et al.*, 2015; Popov and Rocholl, 2014). In the following sections we take advantage of granularity of our dataset to investigate

a number of heterogeneous responses to credit supply shocks.

4.2 Firms' heterogeneity

In this section we extend the baseline results discussed above and we look at the heterogeneity across firms. Results are reported in Table 5. First, we are interested in assessing whether the employment response to a credit supply shock differ across firm size. Interestingly, the significance of our results is limited to micro (less then 10 employees) and small (between 10 and 49 employees) firms, while the coefficient on $\Delta LOAN$ is not statistically significant in the sample of medium-large firms (the coefficient is positive but imprecisely estimated, and the first-stage F-statistic suggests that there are weak identification problems, possible due to the reduced sample size).

Differently, when we split our sample across sectors we find that employment reacts to credit shocks only in services, while there is no evidence that manufacturing or construction firms reduce employment in response to a credit crunch.

Third, we explore the possibility that the extent of job disruption following a credit supply shocks is not homogeneous but depends on the strength of the bank-firm relationship. Recent evidence on the effects of the financial crisis in Italy shows that firms that borrowed from fewer banks suffered a smaller contraction of bank credit and a lower increase in lending rates following the Lehman Brothers' bankruptcy (Gobbi and Sette, 2014; Gambacorta and Mistrulli, 2014). We measure the strength of the bank-firm relationship by the number of bank relationships differentiating between firms which borrow exclusively from one bank during the sample period and firms with multiple bank relationships. Our results do not lend support to the standard view that relationship lending acts as a shock absorber, since firms with stronger bank relationships reduced employment more than other firms in response to the same credit supply shock.

Finally, we differentiate between high and low indebted firms, splitting the sample in correspondence of the median value of the debt-per-employee ratio. Results indicate that highly leverage firms adjust their labor force more than low-debt firms.

4.3 Jobs' heterogeneity

The second step of our analysis will zoom in this adjustment to assess in which way firms changed the composition of their workforce (Table 6). At first, we differentiate between inflows and outflows and we find that our results are mostly driven by the dynamics of inflows, which are lower for firms more exposed to the credit supply shock. When considering outflows, we

find evidence that these are exclusively due to non-renewal of expired contracts, while there is no evidence that the adjustment works through dismissal or quit.

Then, we consider open-ended and fixed-term contracts to test whether firms reacted to more binding financing constraints reducing the use of fixed-term contracts more than open-ended ones. We estimate equation 1 taking as dependent variables either the quarterly change of open-ended contracts at the firm level or the same variation referred to fixed-term contracts. Consistent with expectations, we find that the adjustment happened exclusively through the lay-off (or non-renewal) of fixed-term contracts. The coefficient on $\Delta LOAN$ is positive and statistically significant; by contrast, the same coefficient in the open-ended contract model is not statistically different from zero.

We also observe that a contraction in credit availability implies a lower likelihood to transition from part-time to full-time jobs, while there is no evidence on the opposite transition and on the one from temporary to permanent contracts.

Finally, firms adjust their employment mostly though a contraction of non-manual jobs, rather than manual ones.

4.4 Workers' heterogeneity

The third source of individual heterogeneity that we investigate is the one across workers. In particular, we are interested in assessing whether the firm adjust their labor force differentiating across workers, depending on age, skills, education, gender and nationality.

Our results suggest that the adjustment in employment in response to a reduction in the supply of credit is concentrated among women and less educated workers. There is also evidence that younger people are more likely to be hit by consequence of the credit crunch. Finally, foreign workers contribute for more than a fourth of the adjustment: given their limited share in the labor market, their relative contribution to employment dynamics is quite large.

5 Robustness

We have run a battery of additional exercises to test the robustness of our main findings. In particular, we show that:

- Results hold using different definition of bank lending – granted loans and gross loans – for both the main explanatory variable and the CSI.
- Findings are robust to alternative clustering of the standard errors (sector, sector $\times$ firm size, sector $\times$ firm size $\times$ town size).

- Using the reduced form confirms our main findings, as well as calculating the average effect over two quarters, rather than the lagged one.
- Coefficients are stable on a smaller sample that uses the common threshold of 75,000 euros and including large firms that are not headquartered in the region.
- Heterogeneous effects survive the inclusion of time-varying fixed effects.

6 Conclusions

In this paper we exploit a novel dataset on the universe of firms in a region (including micro firms) to look at the within-firm personnel dynamics. Our preliminary results confirm that financially constrained firms reduced employment. The aggregate effect, based on our estimates, is economically meaningful. In addition, we also show that the adjustment has been concentrated in services, has mainly affected less educated and unskilled workers and it has been driven by the lay-off or non-renewal of temporary contracts, while there is no evidence of any adjustment in manufacturing and construction, and for open-ended contracts.

References

BENMELECH, E., BERGMAN, N. K. and SERU, A. (2015). Financing labor, National Bureau of Economic Research.

BENTOLILA, S., JENSEN, M., JIMENEZ, G. and RUANO, S. (2015). *When Credit Dries Up: Job Losses in the Great Recession*. Working Paper Series 4528, CESifo.

BOERI, T., GARIBALDI, P. and MOEN, E. R. (2013). Financial Shocks and Labor: Facts and Theories. *IMF Economic Review*, **61** (4), 631–663.

BONACCORSI DI PATTI, E. and SETTE, E. (2012). *Bank balance sheets and the transmission of financial shocks to borrowers: evidence from the 2007-2008 crisis*. Temi di discussione (Working Papers) 848, Banca d'Italia.

CAGGESE, A. and CUÑAT, V. (2008). Financing constraints and fixed-term employment contracts. *Economic Journal*, **118** (533), 2013–2046.

CHODOROW-REICH, G. (2014). The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis. *The Quarterly Journal of Economics*, **129** (1), 1–59.

CINGANO, F., MANARESI, F. and SETTE, E. (2013). *Does credit crunch investments down? New evidence on the real effects of the bank-lending channel*. Mo.Fi.R. Working Papers 91, Money and Finance Research group (Mo.Fi.R.) - Univ. Politecnica Marche - Dept. Economic and Social Sciences.

DEVICIENTI, F., MAIDA, A. and SESTITO, P. (2007). Downward Wage Rigidity in Italy: Micro-Based Measures and Implications. *The Economic Journal*, **117** (524), F530–F552.

DUYGAN-BUMP, B., LEVKOV, A. and MONTORIOL-GARRIGA, J. (2015). Financing constraints and unemployment: Evidence from the Great Recession. *Journal of Monetary Economics*, **75**, 89–105.

FABIANI, S., LAMO, A., MESSINA, J. and ROOM, T. (2015). *European firm adjustment during times of economic crisis*. Working Paper 1778, European Central Bank.

GAMBACORTA, L. and MISTRULLI, P. E. (2014). Bank Heterogeneity and Interest Rate Setting: What Lessons Have We Learned since Lehman Brothers? *Journal of Money, Credit and Banking*, **46** (4), 753–778.

GOBBI, G. and SETTE, E. (2014). Do firms benefit from concentrating their borrowing? evidence from the great recession. *Review of Finance*, **18** (2), 527–560.

GREENSTONE, M., MAS, A. and NGUYEN, H.-L. (2014). *Do Credit Market Shocks affect the Real Economy? Quasi-Experimental Evidence from the Great Recession and 'Normal' Economic Times*. NBER Working Papers 20704, National Bureau of Economic Research.

HALTENHOF, S., LEE, S. J. and STEBUNOVS, V. (2014). The credit crunch and fall in employment during the great recession. *Journal of Economic Dynamics and Control*, **43**, 31–57.

HALTIWANGER, J., JARMIN, R. S. and MIRANDA, J. (2013). Who creates jobs? Small versus large versus young. *Review of Economics and Statistics*, **95** (2), 347–361.

JIMÉNEZ, G., MIAN, A. R., PEYDRO, J.-L. and SAURINA, J. (2014). The Real Effects of the Bank Lending Channel, Available at SSRN: http://ssrn.com/abstract=1674828.

KALEMLI-OZCAN, S., LAEVEN, L. and MORENO, D. (2015). Debt Overhang on Europe: Evidence from Firm-Bank-Sovereign Linkages, university of Maryland.

MIAN, A. and SUFI, A. (2014). What Explains the 2007–2009 Drop in Employment? *Econometrica*, **82** (6), 2197–2223.

MOSCARINI, G. and POSTEL-VINAY, F. (2012). The contribution of large and small employers to job creation in times of high and low unemployment. *The American Economic Review*, **102** (6), 2509–2539.

PAGANO, M. and PICA, G. (2012). Finance and employment. *Economic Policy*, **27** (69), 5–55.

PARAVISINI, D., RAPPOPORT, V., SCHNABL, P. and WOLFENZON, D. (2015). Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data. *The Review of Economic Studies*, **82** (1), 333–359.

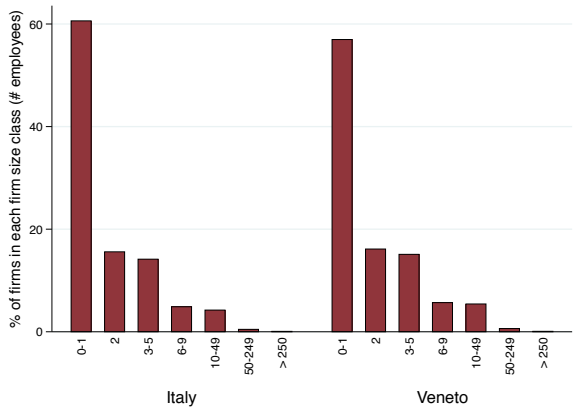
POPOV, A. and ROCHOLL, J. (2014). Financing constraints, employment, and labor compensation: Evidence from the subprime mortgage crisis, ECB and ESMT.

PRESBITERO, A. F., UDELL, G. F. and ZAZZARO, A. (2014). The home bias and the credit crunch: A regional perspective. *Journal of Money, Credit, and Banking*, **46** (s1), 53–85.

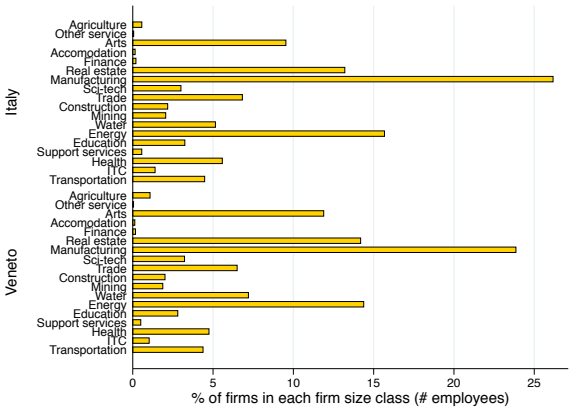
STAIGER, D. and STOCK, J. H. (1997). Instrumental variables regression with weak instruments. *Econometrica*, **65** (3), 557–586.

Figures

Figure 1: External validity: firm distribution across size and sectors in Veneto and Italy



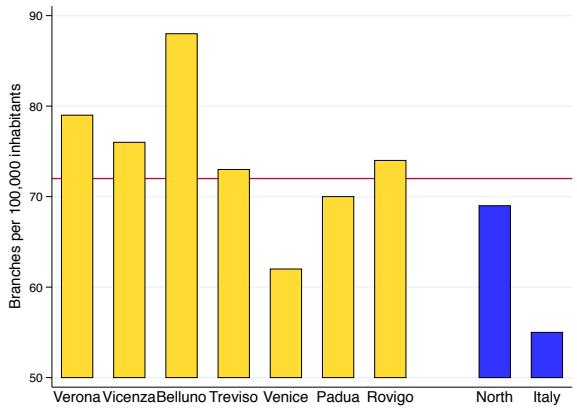
(a) Distribution of firms across size



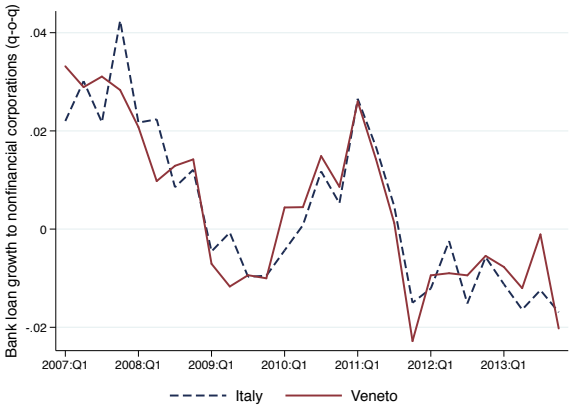
(b) Distribution of firms across sectors

Notes: elaborations on ISTAT data (census 2011).

Figure 2: External validity: bank penetration and lending in Veneto and Italy



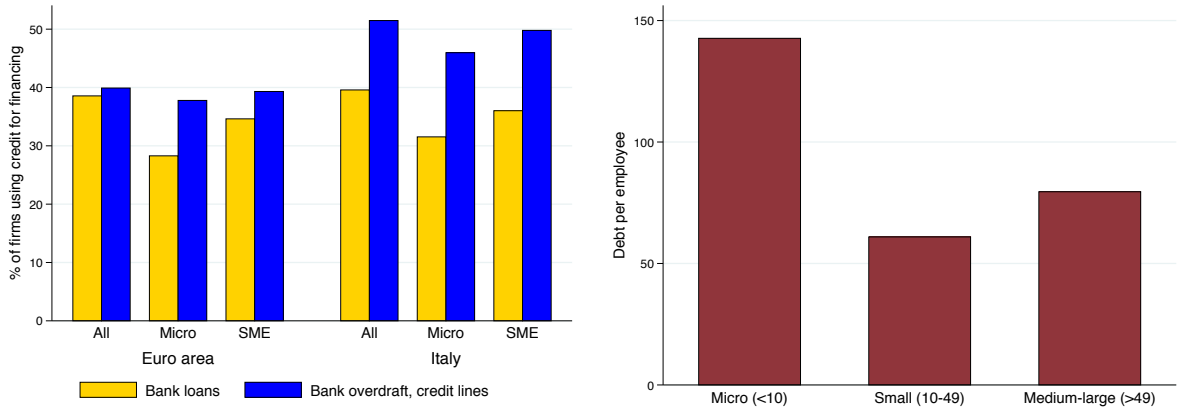
(a) Financial development



(b) Loans growth

Notes: elaborations on data from Bank of Italy.

Figure 3: Bank financing in Italy across firm size

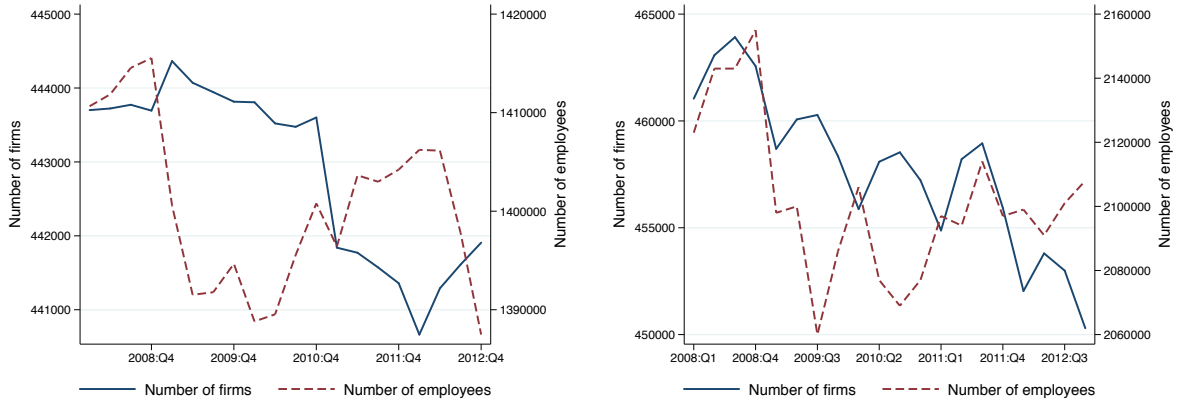


(a) Bank credit (Average 2009-2012, SAFE)

(b) Firms' indebtedness (our data)

Notes: elaborations on data from the Survey on the Access to Finance of Enterprises (SAFE, European Central Bank), Bank of Italy, PLANET, and ASIA.

Figure 4: Sample representativeness, dynamics of firms and employment

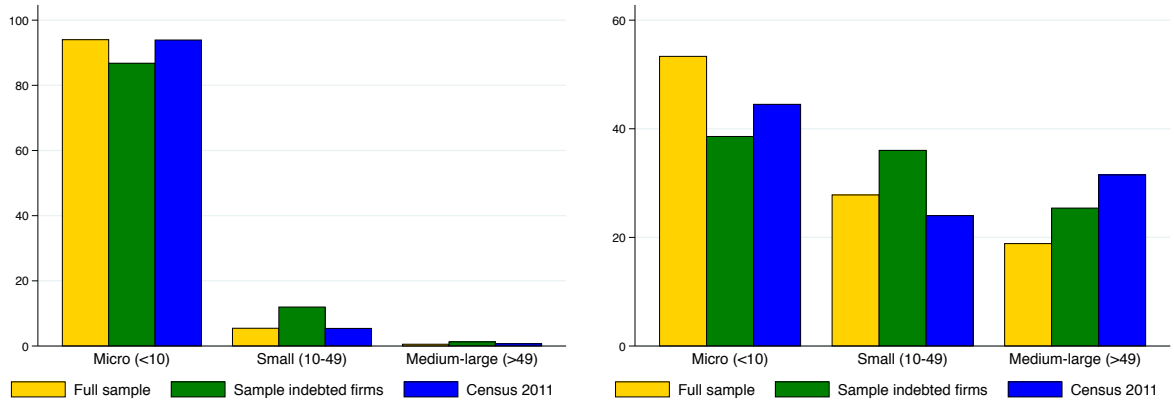


(a) Sample, non-financial private sector (deseasonalized data)

(b) Universe, total economy (Source: ISTAT, RFL)

Notes: elaborations on data from PLANET, ASIA and ISTAT (Rilevazioni della Forza Lavoro – RFL).

Figure 5: Sample representativeness, comparison with the Census

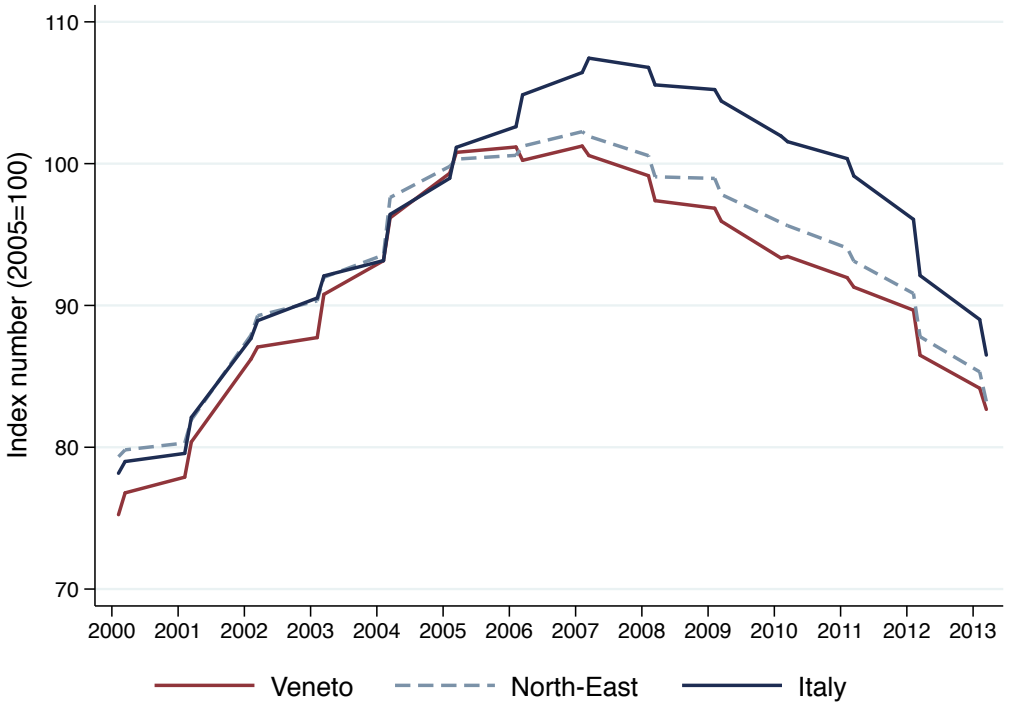


(a) Firms' distribution (%)

(b) Employees' distribution (%)

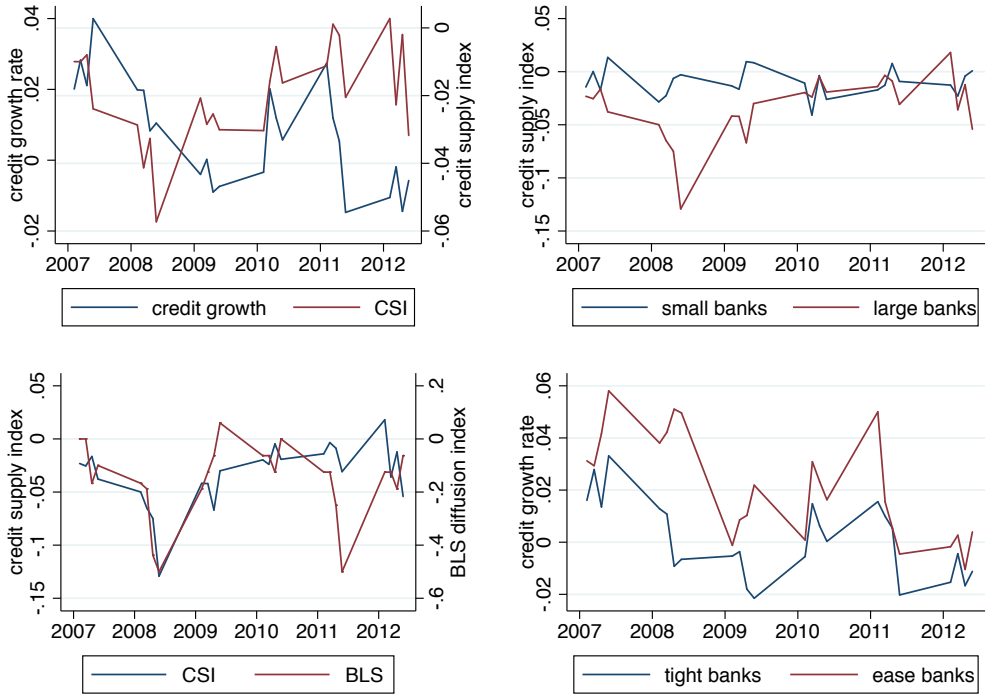
Notes: elaborations on data from ISTAT (2011 census), PLANET, and ASIA.

Figure 6: Housing prices in Veneto and Italy, 2000–2013



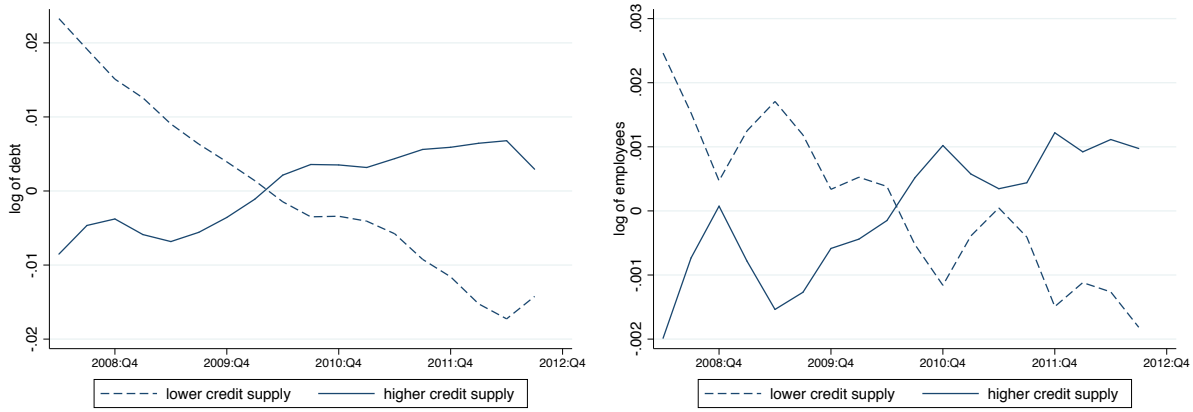
Notes: elaborations on data from XXX.

Figure 7: Credit supply index: descriptive statistics



Notes: The credit supply index is obtained using the approach by Greenstone *et al.* (2014) and aggregating bank-quarterly fixed effects with banks' market share; the bank lending survey (BLS) diffusion index is reported with the inverted sign, so that positive (negative) values indicate easing (tightening) in bank lending standards; small banks are mutual banks while large banks are the five largest banks; tight (ease) banks are those that, in each quarter, have a credit supply index below (above) the median.
Source: elaboration on data drawn from the Bank of Italy SR, CR and BLS.

Figure 8: Credit supply index: relevance



(a) Credit supply & debt (1^{st}-stage) (b) Credit supply & employment (2^{nd}-stage)

Notes: Charts plot average credit (LHS) and employment (RHS) for two groups of firms, distinguishing those who were more or less exposed to the deterioration of credit supply. Firm-bank specific averages and common shocks have been preliminarily differenced out so that values greater (lower) than zero indicates firms having credit above (below) average.

Tables

Table 1: Credit supply and bank heterogeneity

Dep. Var.:	*CSI* at the bank level (average 2008-2012)			
Bank size	-0,0052***	-0,0038**	-0,0014	-0,0029*
	(-0,0016)	(-0,0017)	(-0,0015)	(-0,0016)
Funding gap		-0,0010**	-0.0025***	-0,0026***
		(-0,0004)	(-0,0005)	(-0,0005)
Tier 1 Capital ratio			0.13125	0.0144
			(-0,0233)	(-0,0217)
Share of NPLs				-0,1410***
				(-0,0497)
Observations	628	587	544	544
R-squared	0.025	0.051	0.033	0.058

Notes: The table reports the results of a set of OLS regressions at the bank level (in cross section) in which the dependent variable is the average credit supply index (*CSI*) at the bank level over the sample period 2008-2012 and the explanatory bank-level variables are measured as of end-2007. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Orthogonality conditions

	Quintile of exposure to credit supply shock					Correlation with
	1	2	3	4	5	credit supply
Credit supply	-0.056	-0.027	-0.017	-0.007	0.030	1,000
% manufacturing	0.119	0.153	0.159	0.153	0.117	-0.007
% construction	0.120	0.114	0.108	0.106	0.118	-0.006
% private services	0.475	0.477	0.481	0.478	0.502	0.013
# employees	6.029	8.435	7.318	5.659	4.115	-0.010
debt per employee	196084	281016	331606	305758	240842	0.001
= 1 if multiple relationships	0.216	0.304	0.330	0.330	0.197	-0.020

Notes: The table reports the average values of a set of variables (by row) for each quintile of the sample distribution of the (*CSI*). The last column reports the correlation between each of the row variables and the *CSI* in the whole sample.

Table 3: First-stage results

Dep. Var.:	$\Delta LOAN_{t-2}$			
	(1)	(2)	(3)	(4)
CSI_{t-2}	0.0250***	0.0244***	0.0243***	0.0243***
	(0.00307)	(0.00311)	(0.00311)	(0.00311)
Observations	2,216,315	2,177,106	2,177,106	2,172,602
R-squared	0.091	0.092	0.092	0.092
Firm FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	.	.	.
Industry × quarter FE	No	Yes	Yes	Yes
Size × quarter FE	No	No	Yes	Yes
Geo × quarter FE	No	No	No	Yes

Notes: Panel regressions with firm and time fixed effects. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Baseline regressions – IV estimates

Dep. Var.:	$\Delta EMPLOYMENT_t$				
Sample:	All firms				drop <75k
	2SLS: (2 quarters) lagged effect				
$\Delta LOAN_{t-2}$	0.400***	0.400***	0.411***	0.413***	0.467***
	(0.0623)	(0.0656)	(0.0670)	(0.0670)	(0.0821)
Observations	2,165,737	2,164,989	2,164,989	2,162,146	1,650,648
1^{st}-stage F-statistic	69.29	62.13	61.45	61.96	53.15
	2SLS: cumulative effect over three quarters				
$\Delta LOAN_{t,t-2}$	0.566***	0.560***	0.572***	0.576***	0.685***
	(0.0944)	(0.0976)	(0.101)	(0.101)	(0.121)
Observations	2,477,264	2,476,374	2,476,374	2,473,180	1,825,463
1^{st}-stage F-statistic	53.18	48.87	46.75	47.44	45.71
	Reduced form: (2 quarters) lagged effect				
CSI_{t-2}	0.0100***	0.0100***	0.00967***	0.00980***	0.0108***
	(0.00101)	(0.00101)	(0.000994)	(0.000994)	(0.00125)
Observations	2,307,695	2,307,695	2,306,866	2,303,870	1,817,588
Firm FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	.	.	.	Yes
Industry × quarter FE	No	Yes	Yes	Yes	No
Size × quarter FE	No	No	Yes	Yes	No
House prices	No	No	No	Yes	No

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The regressions reported in the first four columns are based on the whole sample of firms (with the threshold in the Credit Register changing at end-2008; the last column uses an homogeneous threshold and drops, in each quarter, all borrowers with an exposition to the banking system which is below 75,000 euros.

Table 5: Firms' heterogeneity

Dep. Var.:	$\Delta EMPLOYMENT_t$				
	Firm size			Relationship lending	
	Micro	Small	Medium-Large	Mono-bank	Multi-bank
$\Delta LOAN_{t-2}$	0.386***	0.523***	1.037	0.478***	0.297***
	(0.0682)	(0.163)	(2.368)	(0.0893)	(0.0932)
Observations	1,828,746	304,603	32,388	1,204,306	922,729
1^{st}-stage F-statistic	54.91	15.16	0.205	41.04	27.65
	Sector			Leverage	
	Manufacturing	Construction	Services	Low debt	High debt
$\Delta LOAN_{t-2}$	-0.0996	-0.0832	0.619***	0.279***	0.764***
	(0.198)	(0.0833)	(0.0978)	(0.0545)	(0.187)
Observations	407,900	311,191	1,240,686	1,070,299	1,095,438
1^{st}-stage F-statistic	2.177	12.47	52.68	53.11	25.13
Firm FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Industry × quarter FE	No	No	No	No	No
Size × quarter FE	No	No	No	No	No
House prices	No	No	No	No	No

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Firm size bins identify micro (less than 10 employees), small (between 10 and 49 employees) and medium and large firms (50 or more employees). Low and high debt firms are identified depending on their level of debt per employee being, respectively, below or above the sample median.

Table 6: Jobs' heterogeneity

Dep. Var.:	$\Delta EMPLOYMENT_t$				
	Flows		Reasons for outflows		
	Inflows	Outflows	Dismissal	Expiry	Quit
$\Delta LOAN_{t-2}$	0.297***	-0.0805*	-0.000168	-0.0807***	-0.00386
	(0.0576)	(0.0476)	(0.0176)	(0.0280)	(0.0220)
Observations	2,090,539	2,090,539	2,165,737	2,165,737	2,165,737
1^{st}-stage F-statistic	59.97	59.97	69.29	69.29	69.29
	Contract		Transitions		
	Open-ended	Fixed-term	Full to part-time	Part-time to full	Temp to perm
$\Delta LOAN_{t-2}$	-0.0166	0.327***	0.00391	0.0179***	0.00918
	(0.0218)	(0.0457)	(0.00554)	(0.00519)	(0.00669)
Observations	2,165,737	2,165,737	2,165,737	2,165,737	2,165,737
1^{st}-stage F-statistic	69.29	69.29	69.29	69.29	69.29
	Type of work				
	Non-manual	Manual			
$\Delta LOAN_{t-2}$	0.347***	0.0527**			
	(0.0517)	(0.0242)			
Observations	2,165,737	2,165,737			
1^{st}-stage F-statistic	69.29	69.29			
Firm FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Industry × quarter FE	No	No	No	No	No
Size × quarter FE	No	No	No	No	No
House prices	No	No	No	No	No

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Workers' heterogeneity

Dep. Var.:	$\Delta EMPLOYMENT_t$				
	Gender		Age		
	Male	Female	under 30	30-45	over 45
$\Delta LOAN_{t-2}$	0.130***	0.271***	0.165***	0.145***	0.0898***
	(0.0307)	(0.0419)	(0.0291)	(0.0284)	(0.0213)
Observations	2,165,737	2,165,737	2,165,737	2,165,737	2,165,737
1^{st}-stage F-statistic	69.29	69.29	69.29	69.29	69.29
	Skill		Education level		
	High	Low	Low	Medium	High
$\Delta LOAN_{t-2}$	-0.00968	0.0503***	0.216***	0.170***	0.0200*
	(0.0124)	(0.0123)	(0.0372)	(0.0310)	(0.0105)
Observations	2,165,737	2,165,737	2,165,737	2,165,737	2,165,737
1^{st}-stage F-statistic	69.29	69.29	69.29	69.29	69.29
	Nationality				
	Italian	Foreign			
$\Delta LOAN_{t-2}$	0.289***	0.111***			
	(0.0486)	(0.0214)			
Observations	2,165,737	2,165,737			
1^{st}-stage F-statistic	69.29	69.29			
Firm FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Industry × quarter FE	No	No	No	No	No
Size × quarter FE	No	No	No	No	No
House prices	No	No	No	No	No

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.