DISCUSSION PAPER SERIES

No. 7793

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FINANCIAL ECONOMICS

Centre for Economic Policy Research

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Available online at: www.cepr.org/pubs/dps/DP7793.asp

ISSN 0265-8003

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Discussion Paper No. 7793
April 2010

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CEPR Discussion Paper No. 7793

April 2010

ABSTRACT

Credit within the Firm*

We exploit time variation in the degree of development of local credit markets and matched employer-employee data to assess the role of the firm as an internal credit market. In less developed local credit markets firms can offer a flatter wage-tenure profile than firms in more developed credit markets to lend implicitly to their workers or offer a steeper profile to implicitly borrow from their workers. We find that firms located in less financially developed markets offer wages that are lower at the beginning of tenure and grow faster than those offered by firms in more financially developed markets, helping firms finance their operations by raising funds from workers. Because we control for local market effects and only exploit time variation in the degree of local financial development induced by an exogenous liberalization, the effect we find is unlikely to reflect unobserved local factors that systematically affect wage tenure profiles. The size of implicit loans is larger for firms with more problematic access to bank credit and workers less likely to face credit constraints. The amount of credit generated by implicit lending within the firm is economically important and can be as large as 30% of bank lending. Consistent with credit market imperfections opening up trade opportunities within the firm, we find that the internal rate of return of implicit loans lies between the rate at which workers savings are remunerated in the market and the rate firms pay on their loans from banks.

JEL Classification: G3, J3 and L2
Keywords: financial frictions, implicit contracts, tenure profile and wage setting

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*This Paper is produced as part of the CEPR project 'Politics, Economics and Global Governance: The European Dimensions' funded by the European Commission under its Seventh Framework Programme for Research (Collaborative Project) Contract no. 217559. We thank Joe Altonji, Costas Azariadis, Luca Deidda and Pierre-André Chiappori for useful discussions and seminar participants at Stanford University, UC Davis, UCLA, the EUI, the 2009 Conference on Comparative Analysis of Enterprise Data in Tokyo, the 2009 Applied Micro Summer Conference at the Federal Reserve Bank of San Francisco and the 2009 Alghero conference 'Financial market imperfections, corporate governance, and economic outcomes' for helpful comments. Luigi Guiso thanks the EUI and EIEF and Fabiano Schivardi the MIUR for funding. This paper was started when Schivardi was working at the Research Department of the Bank of Italy.

Submitted 13 April 2010

1 Introduction

In an economy with financial frictions the firm ceases to be merely a place where production occurs. The pooling of assets and human capital, besides allowing production of goods and services, naturally creates a "market" where implicit labor contracts can be designed to redistribute factor rewards across states or over time, partially overcoming the consequences of imperfect insurance and financial markets. In the implicit contract literature, differences in preferences for risk makes it optimal for risk neutral entrepreneurs to offer insurance to risk averse workers (Knight 1921, Baily 1974, Azariadis 1975). In this setting firms effectively smooth workers' consumption across *states* when insurance markets fail to work due to moral hazard or limited commitment problems. In a similar spirit, the wage contract may reflect opportunities to redistribute factor rewards across *time* when access to the credit market is limited or too costly. By tilting the wage profile relative to its frictionless counterpart, the payment of wages over the course of an employer-employee relationship can be front-loaded or back-loaded, thus making funds available to the party - the worker or the firm - that currently needs them most.

This paper focuses on the role of the employment relationship as an implicit credit market and tests how credit frictions in local financial markets are reflected in the wage contract that firms and workers agree upon. The key idea is that the relative ease to access credit should be reflected in the shape (slope and location) of the wage profile. If firms have easier access to the loan market than workers and/or are less in need of cash (e.g., because they are well endowed with collateral, can produce hard information, or can - more easily than workers - establish repeated relationships with their lenders), they can lend implicitly to their credit constrained workers by offering a wage profile that, over the workers' tenure with the firm, is flatter than the profile the same workers would face in a frictionless environment. In other words, the worker achieves consumption smoothing by having the firm offer a smooth income profile rather than borrowing from financial intermediaries. This case is examined by Azariadis (1988), who studies a setting where, due to extreme adverse selection, workers are excluded from the loan market while firms have perfect access to it. Since loan repayment promises, as reflected in the wage tenure profile, are not enforceable, what makes it possible for lending within the firm to take place is workers' investment in firm-specific human capital, which reduces workers' incentive to leave the firm before repayment.

Implicit lending opportunities need not be limited to the case of workers borrowing from the firm. After all, firms even more than workers are users of capital to finance their investment plans and firms may also have limited access to the financial market, as a large literature on firm borrowing constraints suggests (see e.g., the surveys in Hubbard (1998) and Stein & Center (2003)).

Michelacci & Quadrini (2009) study this case and show that a credit-constrained firm can at least partly make up for the shortage of capital by reshaping the workers' wage contract relative to its frictionless equivalent. In particular, the firm may pay workers less at the beginning of their tenure and more towards the end, resulting in a steeper wage profile relative to the case in which access to credit is unimpeded. In this setting, contracts can be made self-enforceable by firms' investment in worker-specific human capital, which limits firms' incentives to fire a worker that has lent implicitly to it. But alternative mechanisms - such as the existence of firing costs or reputational concerns - may in practice also serve the same scope.

To test the role of the firm as an internal credit market and establish the direction of implicit credit flows, we use two sources of data. First, we rely on matched Italian longitudinal firm-employee data. The data report workers' wages and employment histories over a long span of time (1974-1997) allowing us to construct tenure and experience profiles. Second, we exploit systematic differences in financial development across local markets that exist at the start of our sample period and, most importantly, exogenous changes in these differences induced by the financial market liberalization of the 1990s. Under the well-grounded assumption that firms, particularly small ones, and *a fortiori* workers can only borrow locally (Petersen & Rajan 2002), workers and firms' ability to borrow in the market are directly tied to the degree of *local* credit market development. Variations in the latter should then be reflected in the slope and location of the wage profile experienced by workers joining the firm in different time periods. We construct an index of financial market backwardness as the "excess" spread between loan rates and deposit rates that a given firm faces in its local credit market relative to what an observationally equivalent firm borrowing from an observationally equivalent bank would face in the most developed local credit market. We then attach to each worker-firm relationship the degree of backwardness in their local credit market at the time tenure with the firm starts, and use a two-step estimation strategy to identify how the slope and intercept of the wage-tenure profile respond as the degree of financial development varies over time and spatially across local markets. This two-step strategy allows us to address the endogeneity of tenure and labor market experience and the endogenous sorting into firms. We find that wage profiles are steeper and have a lower intercept when firms face a less developed local credit market, which is consistent with the hypothesis that workers lend implicitly to their firms.

To give a sense of the magnitudes involved, we calculate that the entry wage of a worker matched with a firm facing a local market that has an index of financial backwardness 50% above the median is 17.8 percent lower than that of a (observationally equivalent) worker matched with a (observationally equivalent) firm facing the median local credit market. Moreover, her wage grows at a rate that is 0.32 percent faster for each month of tenure. This implies that a typical worker will be lending to the firm over the first 54 months (4.5 years) of his tenure before starting to be "paid back".

These implicit wage contractual differences can generate substantial flows of funds from workers to firms. A representative firm located in the *median* developed credit market raises from workers as much funds as 11 percent of what it gets from banks. This share increases to 30 percent for a firm located in a market at the 75th percentile of our index of financial market backwardness. Our estimates of the internal rates of return of these implicit loans range between 1 and 4 percent, depending on the degree of financial development. Interestingly, these rates always sit between the rate on deposits (a measure of the return to workers' savings) and the rate on bank loans (the cost of firm debt), confirming the mutual advantage for contracting by workers and firms in imperfect financial markets.

Since the response of wage contracts to financial market imperfections should depend on firm and worker characteristics, we rely on observable heterogeneity to further corroborate our findings. We find that firms with plausibly more problematic access to the loan market, as measured by the credit score they receive from credit bureaus, react to financial market imperfections by offering steeper wage profiles than firms with easier access to loans - conditioning on being located in the *same* credit market. This is consistent with the idea that firms with more problematic access to credit need to rely on implicit borrowing from workers more than those with easier access. Interestingly, this finding is inconsistent with our results simply capturing the idea that better access to the loan market raises investment in human capital and hence the steepness of the wage profile. If this were the case, we should find that, as access to credit markets deteriorates, firms with a bad credit score should offer *flatter* profiles as they curtail investment (including investment in human capital) compared to better score firms. We find the exact opposite. Similarly, we find that workers who have presumably better access to the loan market and thus better alternative sources of consumption smoothing, as measured by their job position, face a steeper wage tenure profile in response to financial market frictions than workers with more problematic access to the market. This is in line with the idea that workers that are less dependent on borrowing are also more willing to implicitly lend to the firm.

Several papers have studied the occurrence of lending within the firm from a theoretical perspective. Besides Azariadis (1988) and Michelacci & Quadrini (2005, 2009), Bernhardt & Timmis (1990) were among the first to formalize the idea, already noticed in Azariadis (1975), that the employment relationship can help to “complete” financial markets when the workers cannot use human capital as collateral and are thus excluded from credit markets or when firms face borrowing restrictions due to financial frictions. More recently, Burdett & Coles (2003) study a labor market where firms post wage-tenure contracts and show that in equilibrium wages increase with tenure and the structure of the contracts reflects both the workers' preferences as well as the parameters of market environment that firms and workers face, including financial frictions. Our paper is, as far as we know, the first to systematically undertake the empirical task of showing how credit market frictions shape the wage contracts. The closest predecessor to our paper is Brandt & Hosios (1996). In a fascinating empirical contribution they use data on wage/employers contracts for some villages in 1936 rural China where presumably financial markets were absent. They show that wage contracts do indeed generate lending, whose direction - from the employer to the worker or vice versa - depends on preference parameters and the initial endowments of the two parties. However, in Brandt & Hosios (1996) credit frictions are given and taken as a realistic feature of the environment. In contrast, our main contribution is to establish how wage contracts respond to observed and measured differences in the financial markets that firms and workers face in a modern economy. Michelacci & Quadrini (2009) exploit the joint implications of their model on the wage process and firm dynamics to test for the existence of credit flows from workers to firms. In their model, credit constrained firms pay initially lower wages and grow faster than unconstrained firms as they borrow from workers to reach the optimal size; moreover, wages also grow faster with firm growth, as workers are “paid back” as the firm approaches the optimal size and credit constraints are relaxed. Using Finnish matched data, they find that wage growth is positively related to firm growth and starting wages are negatively related to future firm growth, consistent with the model's predictions. Differently from these estimates, which use firms' dynamics to proxy for financial constraints, we directly relate the wage-tenure profile to measured frictions in local financial markets. More broadly, our paper contributes to a literature that studies the interrelations between credit and financial markets (i.e., Wasmer & Weil 2004, Benmelech, Bergman & Enriquez 2010). Our paper is also related to the debate on the returns to tenure (Altonji & Shakotko 1987, Altonji & Williams 2005, Topel 1991) and on the factors that affect them (see Dustmann & Meghir (2005) and references therein). In particular, Abowd, Kramarz & Roux (2006) document both heterogeneity in returns to tenure and a tendency for returns to be higher in low starting-wage firms. Recognizing that the wage-tenure profile also reflects implicit credit flows contributes to explaining both findings.

The reminder of the paper is organized as follows. Section 2 illustrates our empirical strategy and reviews some of the relevant literature. Section 3 describes the data and discusses the sources of variation in local financial market development. Section 4 illustrates the identification strategy behind our two-step estimator. Section 5 shows the main estimation results. We exploit heterogeneity in firms and workers to further corroborate our findings in Section 6 and perform a series of robustness checks in Section 7. Section 8 estimates the size of implicit lending within the firm and Section 9 concludes.

2 "Credit regimes" and Wage Tenure Profiles

2.1 Cases of Interest

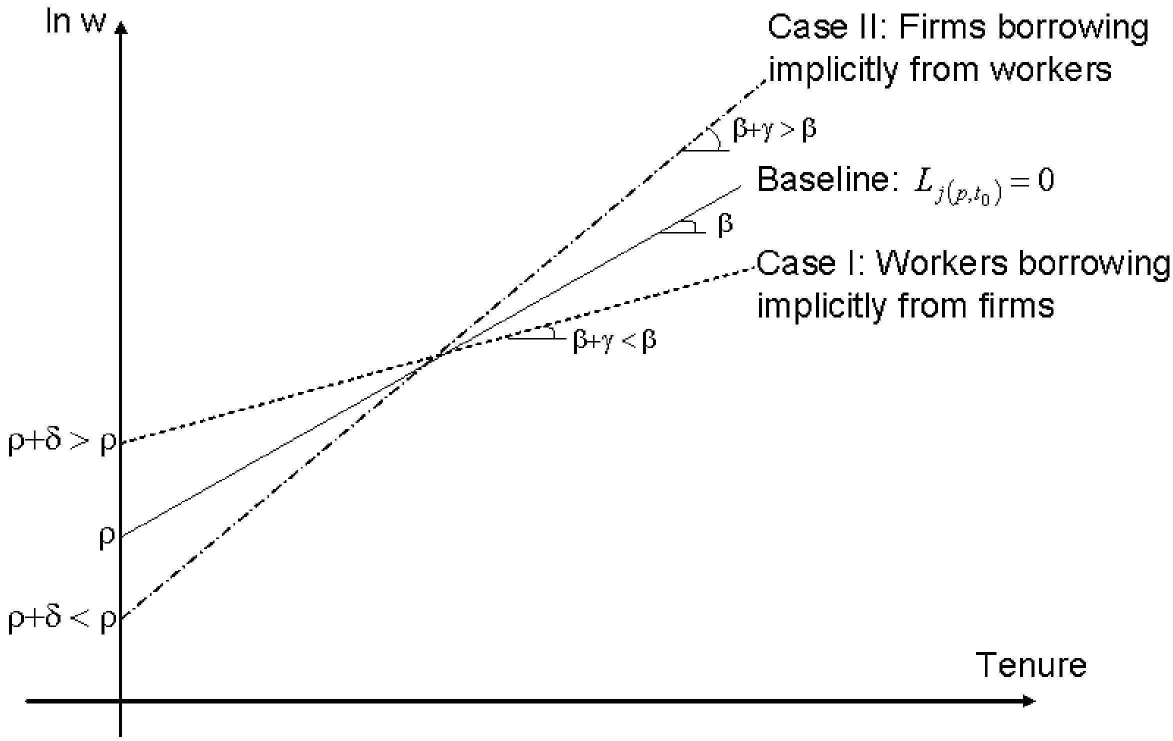
To illustrate how inefficiencies in local credit markets can affect (implicit) wage contracts, consider the following log wage equation:

$$\ln w_{ij(p,t_0)t} = \rho + \beta T_{ij(p,t_0)t} + \delta L_{j(p,t_0)} + \gamma T_{ij(p,t_0)t} \times L_{j(p,t_0)} + \varepsilon_{ij(p,t_0)t} \tag{1}$$

for $t = 1, 2, ..., T$. The actual wage equation we estimate below controls for a variety of other characteristics; here we use (1) for illustrative purposes. The subscript $j\,(p, t_0)$ indexes the firm j located in market p that the worker joined in year t_0, i indexes the individual, and t indexes the current year. In (1) $T_{ij(p,t_0)t}$ is tenure (hence $T_{ij(p,t_0)t} = (t - t_0)$), and $L_{j(p,t_0)}$ is a continuous measure of the degree of financial market imperfection in the area where firm j is located. Without loss of generality, we normalize $L_{j(p,t_0)} = 0$ in the most developed credit market. We assume that the relevant credit market imperfections for the wage contract set with worker i are those that prevail at the time of hiring; hence, we do not consider the possibility of renegotiation.

Figure 1 illustrates the possible cases of interest. In the baseline case ($L_{j(p,t_0)} = 0$) the initial wage is ρ and it grows at rate β per month of tenure with the firm. The signs of δ and γ determine the type of "credit regime" in which workers and firms operate. Consider first case I, in which $\gamma < 0$ and $\delta > 0$, implying that the wage profile in more backward credit markets is flatter than in more developed markets. Here, workers are implicitly borrowing from the firm. Their wage payments are front-loaded. This tilting of the wage profile may be interpreted as a response to credit market imperfections when workers and firms can establish long-term relationships through, for example, firm-specific human capital investments. In a perfect credit market, individuals with the growing wage-productivity profile depicted in the baseline case would borrow from banks at the start of their relationship with the firm to smooth consumption intertemporally. However, acquiring reliable information about aspects of the exchange relation between employer and employees may be costly for banks, which respond by limiting credit (in the extreme, denying access to it altogether).

Figure 1: Credit flows and tenure profiles.



Azariadis (1988) and Bernhardt & Timmis (1990) were among the first to suggest that in this case the firm can act as a "lender of last resort" for its workers, *implicitly* lending to them by offering a wage profile that is flatter than in the frictionless case. In other words, in underdeveloped financial markets consumption smoothing is achieved through wage smoothing (or implicit borrowing), rather than through (or in addition to) formal borrowing.

There is an opposite view about the shape of the wage-tenure profile, articulated in Michelacci & Quadrini (2005, 2009). The intertemporal exchange may involve a liquidity-constrained firm implicitly borrowing from its workers. This can be achieved by back-loading wages, i.e., paying lower wages at the beginning of the worker-firm relationship (relative to the frictionless case) in exchange for higher wages at a later stage. This corresponds to case II in Figure 1. Here $\gamma > 0$ and $\delta < 0$ and the wage profile in less developed credit markets is steeper than in more developed credit markets.

Which of the two "credit regimes" shapes the wage-tenure profile? The answer depends on the signs of δ and γ. We estimate these two parameters below using variation over time in access to credit in the location where the employment relationship takes place. The estimation procedure allows us to distinguish between the two above hypotheses. Other confounding issues are discussed below.[1]

2.2 Enforcement and Alternative Stories

What makes the contracts discussed above enforceable? Given that they involve implicit promises, they are not legally enforceable. However, as remarked by, among others, Azariadis (1988), Lazear (1981) and Michelacci & Quadrini (2009), *specific* human capital investments can be sufficient to make these contracts self-enforceable. In case I workers have little incentive to quit before repayment if they have made firm-specific human capital investments. In case II firms have little incentive to fire workers before their loans are fully repaid if they have made worker-specific investments. If specific human capital were not enough to make these contracts self-enforcing, e.g., because human capital is (mostly) specific to the industry rather than to the firm (as argued by Neal 1995), or specific to an occupation rather than to a worker, enforcement may be provided by other mechanisms. For instance, reputational concerns may facilitate implicit contract enforcement if the borrower's behavior is public information. Firing and higher costs on the firms' side and mobility costs on the workers' side may also contribute to reduce the incentive to terminate the employment relationship to avoid repayment.

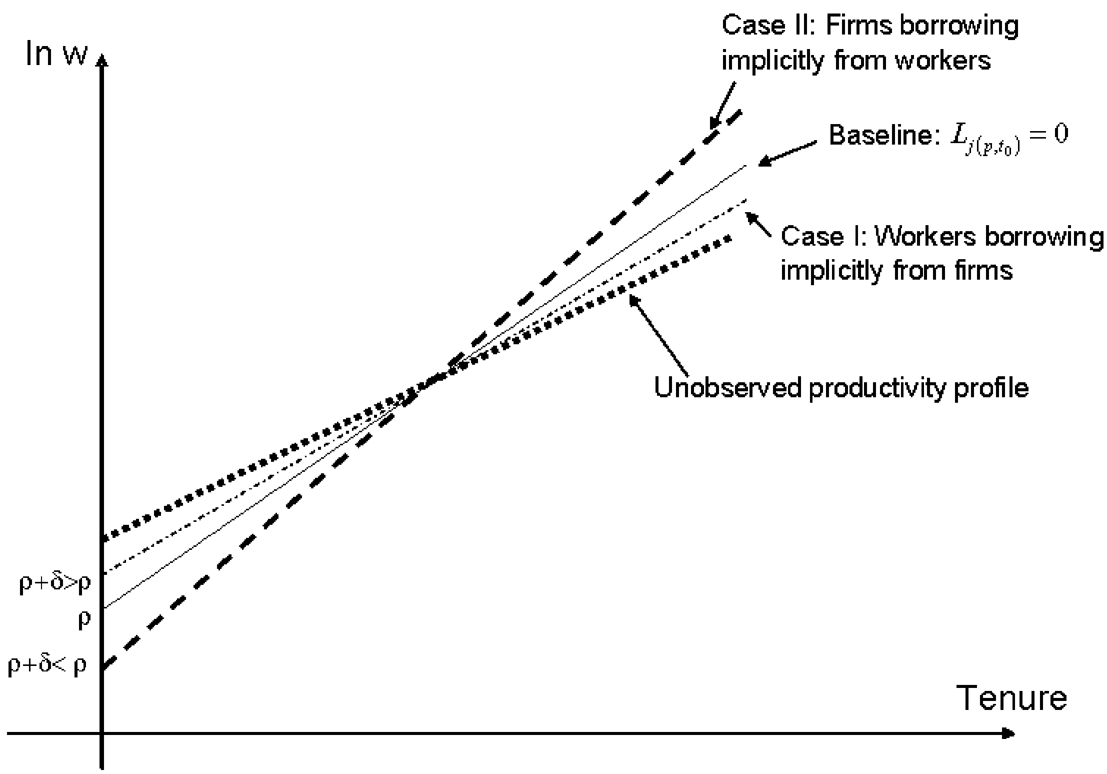
Finally, it is worth mentioning the difference between the cases discussed in this section and that studied by Lazear (1981), in which firms tilt upward the wage profile relative to the worker's productivity profile to induce workers to exert effort. If one assumes that in the baseline case wages coincide with productivity, it would appear that the finding that the wage profile is steeper in more backward credit markets relative to the baseline (which turns out to be the empirically relevant case) can be made consistent both with an incentive story à la Lazear and a liquidity-constraint story à la Michelacci-Quadrini. Notice however that while in Lazear it is true that the firm "implicitly" borrows from its workers at the beginning of their relationship, the borrowing is *incidental* (it is the only way to implement the incentive aspect of the wage profile) and it is *independent* of whether the firm is liquidity constrained. As we shall see, this is not going to be the case empirically: more implicit borrowing is found among firms that are presumably more liquidity constrained.

Unfortunately we cannot test whether a Lazear-type mechanism is at work because we do not observe productivity. However, we stress that our test is valid even if such mechanism is indeed at work. Figure 2 illustrates this point graphically. The heavy dotted line represents the unobserved

[1] Of course, there are two other cases that may emerge empirically: $\gamma > 0$ and $\delta > 0$, and $\gamma < 0$ and $\delta < 0$. These cases would be inconsistent with our interpretation that differences in the wage-tenure profile across local financial markets reflect implicit credit flows between firms and workers, thus providing a direct falsification test for our story.

worker's productivity profile. In the baseline (no liquidity constraints or $L_{j(p,t_0)} = 0$), the wage profile is steeper than the productivity profile to supply incentives for workers. If firms are subject to liquidity constraints (case II above), they would make the wage profile even steeper for the additional purpose of borrowing implicitly from workers. The case of workers borrowing from firms (case I above) is aptly described by the following quote from Lazear's paper: "if workers have utility functions which are time separable and concave in income, then the optimal [wage] path will remain upward sloping,[2] even if all borrowing is prohibited, but will tend to be somewhat *flatter* than it is when no borrowing constraints are imposed" [italics added]. Hence, the wage profile would be still steeper than the productivity profile, but less steep than in a perfectly functioning credit market (where $L_{j(p,t_0)} = 0$). This is exactly the effect we are studying.[3]

Figure 2: Credit flows and tenure profiles with tenure considerations.



[2]In Lazear's case productivity is flat due to absence of specific human capital.

[3]Lazear-type mechanisms may pose a different problem for our estimates. Since we rely on geographical variation in access to the credit market, one may argue that heterogeneity in local credit market development may be correlated with shirking. If in a province individuals are more prone to shirk on the job, they may also be more likely to default on loans, making banks less willing to lend. However, as we discuss in Section 4, our identification strategy relies on geographical heterogeneity in variation *over time* in financial development and the effect of local factors on wage tenure profiles, including diversity across areas in shirking attitudes, are captured by province dummies.

3 Data

To identify the effect of credit market imperfections on wage contracts, we need longitudinal data on workers' histories with the firms they have worked for and local credit markets that differ in efficiency. Italy offers both. First, administrative data from the Italian Social Security Administration allow us to obtain information on workers' earnings histories matched with their firms. Second, due to a number of "accidents of history" dating back to at least the 1930s, the development of Italian credit markets has differed markedly across localities as small as provinces (the equivalent of a US county). As a consequence of these initial disparities, credit market liberalization that took place over the 1990s differentially affected local credit markets. Hence, access to external finance for workers and firms in different areas differs greatly, differentially affecting their incentives to make up for these inefficiencies in the wage contracts. In what follows, we illustrate the main features of the data and of the procedure to construct the indicator of local financial market development, referring the interested reader to the data appendix for further details.

3.1 Worker Wages and Firm Characteristics

We obtain wage data from the Italian Social Security registry (INPS) which provides information on total compensation and its components for a sample of workers. The INPS data are provided for the entire population of workers registered with the social security system whose birthday falls on either March 1^{st} or October 1^{st}. Data are available on a continuous basis from 1974 to 2002. The data cover private sector employees (but not the self-employed or public employees) and derive from employer forms roughly comparable to those collected by the Social Security Administration in the US.[4] Misreporting is prosecuted. Besides providing information on workers earnings, the INPS data also contain some demographics. However, as is typical of administrative data, demographics information is scant and limited to age, gender, place of birth, and job category (blue collar, white collar or manager).

For our estimates we restrict the sample to workers aged between 18 and 60 observed over the years 1990-1997. We do not use data after 1997 because INPS switched to a new data archiving system (from OM1 to SA770). We do not use data before 1990 because (as we explain below) we do not have information on local credit market imperfections before that date. However, we use the INPS data before 1990 to construct measures of actual labor market experience and tenure with the firm. Each record in the original data set is a social security contribution record for a

[4] While the US administrative data are usually provided on a grouped basis, INPS has truly individual records. Moreover, US earnings records are censored at Social Security cap, while the Italian data set is not subject to top-coding.

given worker/firm/year observation. For each record, there is information about which months the worker was employed at that firm. Apart from self-employment or public employment spells, our measures of labor market experience and tenure should thus be free from measurement error (at least for those observed after 1974). We construct gross monthly earnings (our measure of wage in the regressions below) as total yearly earnings with a firm divided by the number of months the worker has been employed by the firm in that year. Table 1 reports summary statistics for the sample of workers used in estimation. Further details are in Appendix A.1.

We use firm data from the Company Accounts Data Service (*Centrale dei Bilanci*, or CB for brevity) matched with Credit Register (CR) data for the same firms.[5] The CB data span from 1982 onwards and give detailed information on a large number of balance-sheet items together with a full description of firm characteristics (location, year of foundation, sector, ownership structure), plus other variables of economic interest usually not included in balance sheets, such as flow of funds. Company accounts are collected for approximately 30,000 firms per year by the Service; as we explain in detail in the appendix, the data quality is high and the sample covers a large fraction of overall production. For our purposes the most important feature of the matched CB/CR data set is that it provides for each firm and for all the years from 1990 to 1997 two types of relevant information. First, the interest rate on credit lines charged by each bank that lends to the firm. We use these data to create a provincial measure of financial development, as described in Subsection 3.4. Second, a credit score used by banks when screening firms and allocating credit. As we will discuss later, this is a particularly attractive measure of firm-level creditworthiness which will prove useful when we look at heterogeneity in firms' motives for relying on internal lending. For the latter purpose, we merge the INPS worker data set with the CB/CR data set. This is possible because the INPS data provide us with the employer's tax code. Since our INPS data contains information only on a sample of workers, when we merge them with the CB/CR data set we lose observations. The matched employer-employee dataset (with information on both worker and firm characteristics) has 106,277 records, with information for 15,179 firms and 24,639 workers (note however that some firms have missing records on the credit score variable in some years).[6] Table 2 reports summary statistics for the sample of firms used to construct the measure of financial development (see below).

[5]More details on the matched CB/CR dataset can be found in Panetta, Schivardi & Shum (2009).

[6]See Guiso, Pistaferri & Schivardi (2005) for more details on the matched employer-employee data set.

3.2 Measuring Financial Development

To implement our test we require that firms and their workers, though located within the borders of the same country, have differential access to the loan market. Variation of this sort may arise if: (a) credit markets are geographically segmented so that a worker or a firm located in a certain local market is bound to borrow in that market; and (b) local credit markets differ in their degree of development.

There is ample evidence that firms, particularly small businesses like the ones in our sample (and thus *a fortiori* single individuals) are tied to their local credit markets. For instance, Petersen & Rajan (2002) show that lending to small businesses is a highly localized activity as proximity between borrowers and lenders facilitates information acquisition.[7] Segmentation of local credit markets is thus very likely to occur. Our geographical unit is the province, an administrative unit roughly comparable to a US county. Provinces are a proper measure of local markets in banking for at least three reasons. First, this was the definition of a local market used by the Bank of Italy to decide whether to authorize the opening of new branches when entry was regulated. Second, according to the Italian Antitrust authority the "relevant market" in banking for antitrust purposes is the province. Third, the bankers' rule of thumb is to avoid lending to a client located more than three miles from the branch. At the time of our data, there were 95 provinces.

Due to a number of historical legacies surveyed in detail by Guiso, Sapienza & Zingales (2004, 2006), Italian local credit markets traditionally differ in their degree of development in ways that are plausibly unrelated to differences in the level of economic development. Such differences can be traced back to the different political traditions before the country was unified at the end of the nineteenth century. Moreover, they have been perpetuated by a 1936 banking law that, in response to the 1929 crises, heavily regulated the sector, with strong limits to entry and expansion of banks. This regulatory system was maintained almost unchanged until the late 1980s, preserving and actually amplifying the differences in financial development across local markets that existed in the early 1930s. Hence, when at the beginning of the 1990s the process of financial liberalization started, it displayed its effects on a set of heterogeneously developed local credit markets. As a consequence of these different initial conditions, financial liberalization was relatively more beneficial to local markets that were lagging behind as of 1990. We will exploit these differential geographical effects of financial liberalization to identify the effect of credit market imperfections on wage contracts.

[7] Bofondi & Gobbi (2006) show direct evidence of the informational disadvantage of distant lenders in Italy. They find that banks entering new markets suffer a higher incidence of non performing loans. This increase, however, is more limited if they lend through a newly opened local branch than if they lend at a distance. Degryse & Ongena (2005) find that small firms' loan conditions depend on distance. Lerner (1995) documents the importance of distance in the venture capital market.

A good measure of financial development would be the ease with which individuals that need external funds can obtain them and/or the premium (adjusted for risk) they have to pay for these funds; in fact, in a perfect credit market this premium would be zero. The key idea is to exploit the geographic variation in access to the credit market or in its cost to estimate the ease with which otherwise equal firms or workers can obtain lending in two different local markets. Here we follow Guiso, Sapienza & Zingales (2006) and use the variation across firms in the cost at which they can borrow to obtain a measure of the efficiency of the local credit market. We use the matched CB/CR data containing information on the interest rate on credit lines charged by each bank that lends to the firm. We then compute the interest rate spread with respect to the rate on deposits in the province where the firm is located to obtain a measure of the mark-up on loans and argue that banking markets that, *ceteris paribus*, are characterized by larger mark-ups, are less financially developed.[8] More formally, let s_{jbpt} denote the interest rate spread (relative to the province's average deposit rate) paid by firm j to bank b in market p in year t, F_{jpt} denote a vector of firm controls and B_{bpt} denote a vector of bank controls.[9] We run the regression

$$s_{jbpt} = \beta_t F_{jpt} + \gamma_t B_{bpt} + f_{pt} + \eta_{jbpt} \tag{2}$$

where f_{pt} is a vector of province-year fixed effects that captures the time variation at the local level in financial development, following the process of financial liberalization over the 1990s. We estimate equation (2) year by year between 1990 and 1997, and retrieve the estimated fixed effect $\widehat{f}_{pt}$ for each one of the 95 provinces in which the country is divided and for each year between 1990

[8] One criticism to this indicator is that it is based on the cost of obtaining a loan rather than the amount one can obtain; another is that it relies on firms' ease in accessing local credit markets and ignores workers' access. Guiso, Sapienza & Zingales (2004) use a similar methodology but rely instead on data from the Survey of Households Income and Wealth (SHIW) on households that were turned down by a bank to obtain a measure of financial development across Italian regions (which are larger geographical units than the province). This measure of financial development is highly correlated with the one we use; as shown by Guiso et al. (2006) this indicator can explain about 25% of the variation in the interest rate spread across provinces in 1990. Thus, in local markets where, *ceteris paribus*, workers are more likely to be turned down when applying for loans, the pricing of a granted loan to firms deviates more from the competitive benchmark. Furthermore, the variation over time in the fraction of households that were turned down is consistent with that in the spread indicator. Casolaro, Gambacorta & Guiso (2006) document that while the fraction of applicants that were turned down was around 50% before financial liberalization, it fell to 25% in 1998 and to 10% in 2002. Unfortunately, there are not enough data in the SHIW to obtain reliable estimates of the variation over time at the *province* level in the fraction of people that were turned down and use this as an alternative indicator of the change in local financial development.

[9] Firm controls make sure that province fixed effects do not reflect borrowers' differences in riskiness while bank controls make sure that they do not reflect differences across banks in the cost of making loans. Firm controls include the firm return on sales, its leverage (as a proxy for financial fragility), its size (measured by log assets) to capture the fact that smaller firms are more likely to fail, and the firm credit score. The latter is a particularly good control for firm riskiness as it is used by the banks that belong to the CB consortium to decide whether to grant a loan and to price it. As bank controls we use: the size of the lending bank (measured by log assets), its return on assets, the ratio of non-performing loans on total loans outstanding, and dummies for state or local government bank ownership. Since the same firm often borrows from multiple banks (see Detragiache, Garella & Guiso 2000), as an alternative to these bank controls we insert a full set of bank dummies obtaining very similar results.

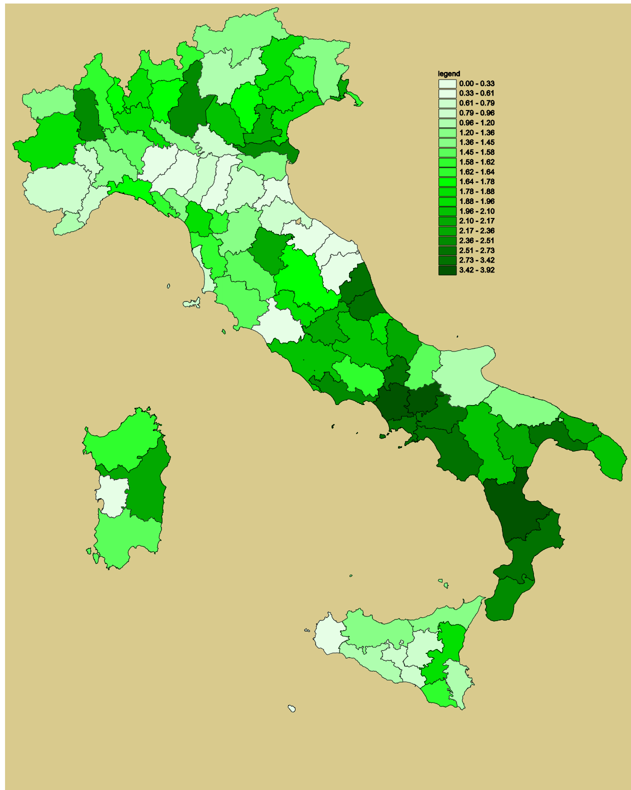
and 1997. Finally, we define our indicator of financial backwardness by recentering the measure as: $L_{pt} = \widehat{f}_{pt} - \min(\widehat{f}_{pt})$. Hence, the most developed (i.e., the most competitive local credit market) is set to zero and the measure of financial backwardness is the deviation of the interest rate spread from the province where it is smallest.

Table 3 shows for each province the mean value of our measure of financial market backwardness, the value in 1990 - the first year in the sample - and the change in the indicator between 1990 and 1997 (our last sample year). There is ample variation across areas with a clear geographical pattern that shows more financially backward provinces, both at the beginning of sample and on average, in the Southern regions.[10] This is more clearly visible in Figure 3, which reports the map of our average measure by province. While a North-South divide is a feature of the data, there is considerable variation in financial development within the Center-North and the South.

At the beginning of the sample period, before the liberalization process started, the least financially developed province was Cosenza (in the Southern region of Calabria) while the most developed was Ravenna (in Emilia, one of the Northern regions); the interest rate spread between these two local markets was close to 400 basis points with a standard deviation across all markets of 81 basis points, implying highly segmented local credit markets and substantial dispersion in financial development. Differences across provinces in variation over time are also very pronounced (third column) with a standard deviation of 71 basis points. This is reassuring, since we will primarily use the time variation in the degree of financial backwardness to identify its effect on wage contracts (see the next section for details). Interestingly, provinces that were more backward just before the liberalization started are the ones where the improvement in financial development has been more marked. This is consistent with our contention that less developed markets benefit more from financial liberalization, providing the basis for our identification strategy. We document formally the convergence induced by the liberalization process in Table 4, which shows growth-type regressions of the change in financial backwardness between 1990 and 1997 on the initial value. The size of the negative coefficient on the initial level of L_p in column 1 implies that a province with a level of financial backwardness that was one standard deviation above the mean in 1990 has experienced a decline in the interest rate spread of 40 basis points. Convergence is apparent from Figure

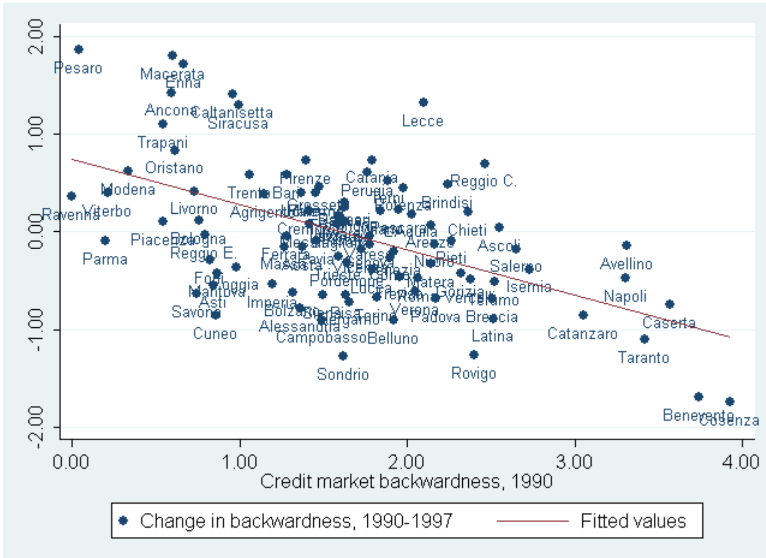
[10] Sicily is an exception as it shows lower values of the index of financial backwardness than other provinces in the South. This is most likely a consequence of a different regime of regulations that prevailed in Sicily since the post war period. In Sicily the authorization to open new banks and new bank branches was granted by the regional government rather than by the Bank of Italy. As a consequence, the number of local bank branches over a 20 year period went up by 586% compared to a national average of 83% and the number of banks went up by 21% while it was shrinking in the rest of the country. This is hard to explain with economic convergence but is consistent with the less stringent regulatory regime. At any rate, excluding Sicily from our sample does not change the results (see Table 10).

Figure 3: Credit market backwardness, Italian provinces, 1990



4, which plots the change in the backwardness indicator against its value in 1990, together with the regression line of Table 4. To investigate further the idea that heterogeneity across provinces in the effects of financial liberalization on financial development is due to the differences in the level of financial development that prevailed just before the liberalization started and that were largely the unintended consequence of the 1936 banking regulation, in the second column we report IV regressions where the 1990 level of financial backwardness is instrumented with measures of the structure of the banking industry in the region in 1936 as constructed by Guiso et al. (2004). The IV regressions confirm the OLS estimates, showing convergence after liberalization.

Figure 4: The convergence process



4 Identification

We now discuss identification of the shift in the slope and intercept of the wage-tenure profile induced by local credit market imperfections. We expand (1) and rewrite it as:

$$\begin{aligned} \ln w_{ij(p,t_0)t} \quad &= \quad \rho + X'_{ij(p,t_0)t}\alpha + Z'_i\phi + \mu E_{it} + \beta T_{ij(p,t_0)t} + \delta L_{j(p,t_0)} \\ &\quad + \gamma T_{ij(p,t_0)t} \times L_{j(p,t_0)} + \eta T_{ij(p,t_0)t} \times h_p + h_p + \varepsilon_{ij(p,t_0)t} \qquad (3) \end{aligned}$$

where $X'_{ij(p,t_0)t}$ and Z'_i are two vectors of time varying and time invariant worker characteristics, respectively, E_{it} a measure of the worker overall labor market experience and h_p a vector of provincial dummies. This specification allows for province effects both in the level of wage rates and in the returns to tenure. In particular, this formulation implies that any effect that differences in the average level of financial backwardness have on the intercept and the slope of the wage contract are captured by the province fixed effects in the level and growth equations, respectively. The vector $X'_{ij(p,t_0)t}$ also includes year effects.

Assume that the structure of the error term in (3) is as follows:

$$\varepsilon_{ij(t_0)t} = a_i + b_{ij(t_0)} + c_{it} \qquad (4)$$

Here a_i is an individual fixed effect ("ability"), $b_{ij(t_0)}$ is a firm-worker match effect, and c_{it} is an i.i.d. shock. We could allow for the effect of time-varying firm-specific shocks (such as in Guiso et al. (2006)) by appropriately re-defining the term c_{it}. The experience and tenure variables are likely correlated with the error term. For example, more able people (i.e., with high realizations of a_i) may have stronger labor market attachment and hence longer overall labor market experience. Moreover, more experienced workers may be in better matches because they have had the opportunity to search longer while on the job. As for tenure, one might expect firms to fire less able workers more frequently than high ability workers. Moreover, firms are more likely to fire (or workers more likely to quit) when the value of the match is low. This discussion means that OLS applied to (3) will give biased and inconsistent estimates.

Our identification strategy is a variant of those proposed by Topel (1991) and Dustmann & Meghir (2005). Let M_{it} be an indicator variable denoting whether the worker moves (if equal to 1) or stays with the firm (if equal to 0) between period $t-1$ and period t. Consider the first differenced version of (1) for individuals who stay with the same employer between $t-1$ and t ($M_{it}=0$). For these workers:

$$\Delta \ln w_{ij(p,t_0)t} = (\mu + \beta) + \Delta X'_{ij(p,t_0)t}\alpha + \gamma L_{j(p,t_0)} + \eta h_p + \Delta c_{it} \tag{5}$$

The advantage of this specification is that the sources of endogeneity (the correlation between tenure/experience and the individual/match fixed effects) have been removed. If Δc_{it} is independent of M_{it} (conditional on the observables), then an OLS regression is all that is needed to consistently estimate the parameters of (5), in particular γ and $(\mu+\beta)$. Note that μ and β cannot be separately identified. If Δc_{it} depends on M_{it} (even after conditioning on the observables), then this creates a standard sample selection issue which can be addressed making distributional assumptions about the unobservable Δc_{it} and finding exclusion restrictions for identification. We use three exclusion restrictions. The first is whether the current job is one found following exogenous displacement due to firm closure. Those who are displaced must start searching for a new job sampling from the unconditional distribution of match values. Those who moved voluntarily to the current firm did it because they improved their match value, i.e., they sampled from the conditional distribution. Hence, the probability of being a mover out of the *current* job must be higher for the displaced worker than for the average worker (matches found after involuntary displacement are on average of lower quality than those found by voluntary moves). Since firm closure is an exogenous event affecting the entire work force of the firm, it is also likely to be independent of shocks affecting individual wages at some point in the future, i.e., of Δc_{it}, suggesting it is a valid exclusion restriction. The second exclusion restriction uses the time to earliest retirement date, taking into account not only age-based retirement, but also retirement based on the number of years one has contributed to the social security system.[11] In fact, mobility choices are taken trading off current mobility costs

[11] For a worker of age A we define the residual work horizon (in months) as min{360-E,$(R-A)\times 12$}, where E is

against future wage benefits. The longer the horizon, the higher the effect in net present value terms of a given wage increase following a job change and hence more likely is a move. Under the assumption that equation (5) is correctly specified, it is reasonable that residual horizon is orthogonal to Δc_{it}. However, if returns to tenure vary with tenure, as for instance suggested by Dustmann & Meghir (2005), this assumption might fail. We come back to this issue in section 7 where we discuss robustness and show that our results are robust to using only the displacement indicator as an exclusion restriction. Finally, given that mobility costs can differ substantially across workers because of differences in the thickness of their local labor market, to capture heterogeneity in mobility costs and thus in the effect of residual horizon on mobility decision, we let the latter vary across provinces by including an interaction between the horizon length and province dummies (as proxies for labor market thickness).

Identification of γ comes from variation in $L_{j(p,t_0)}$ over time and the fact that over the sample period workers start their tenures with a given firm in different years. Intuitively, we pin down γ by comparing the slope of the wage contract of a worker in province p who starts tenure with firm j at time t_0 (facing financial constraints $L_{j(p,t_0)}$) with that of an otherwise similar worker who starts tenure with the same firm but at time t_1 (facing financial constraints $L_{j(p,t_1)} \neq L_{j(p,t_0)}$).[12] Note that in order to consistently estimate γ (even controlling for selection into staying with the same firm), we need to assume that $E\left(\Delta c_{it}|L_{j(p,t_0)}\right) = 0$. Let us be clear about what this assumption entails. Since average wage growth in the province is absorbed by the province dummies h_p, it requires that shocks to the growth rate of individual wages, net of any common component, at any time *after* the worker starts its tenure with the firm are orthogonal to the degree of financial development in the province where the job is located at the time tenure starts, $L_{j(p,t_0)}$. We regard this as a very weak and reasonable requirement.

To obtain an estimate of the other parameter of interest - i.e., δ, the intercept of the wage-tenure relationship, which turns out to be key for measuring the extent of borrowing that goes on within the firm - we use the estimates of α, γ and $(\mu + \beta)$ from (5) to construct the residual for individuals in their first job in the labor market. For these individuals, $E_{it} = T_{ij(p,t_0)t}$. Define the error:

months of labor market experience, and R is the statutory retirement age (60 for males and 55 for females). This definition accounts for the fact that over the period spanned by our data workers could retire either because of seniority (30 years or 360 months of paid work) or because of old-age (60 for men, 55 for women).

[12] Since we can estimate the degree of local financial development only starting in 1990, for workers joining the firm before 1990 we assign the degree of financial development of the province in 1990. This assumption is consistent with our observation (see Section 3.2) that the structure of the local banking market had been frozen by the 1936 legislation, with little entry and expansion until the 1990s (possibly with the exception of Sicily, see footnote 10).

$$
\begin{aligned}
e_{ij(p,t_0)t} &= \ln w_{ij(p,t_0)t} - X'_{ij(p,t_0)t}\alpha - (\mu + \beta) E_{it} - \gamma E_{it} \times L_{j(p,t_0)} \\
&= \rho + Z'_i \phi + \delta L_{j(p,t_0)} + \eta h_p + \varepsilon_{ij(p,t_0)t}
\end{aligned} \tag{6}
$$

If $E\left(\varepsilon_{ij(t_0)t} | L_{j(p,t_0)}\right) = 0$, regression (6) can be estimated by OLS using the residual $\widehat{e}_{ij(p,t_0)t}$ from (5) in place of the unobserved error $e_{ij(p,t_0)t}$. What does this assumption entail? From (4), $\varepsilon_{ij(t_0)t}$ may be correlated with the level of financial development of the local market if more able workers sort into provinces that are on average more financially developed, or that have some other attractive features that happen to be correlated with financial development. Alternatively, $\varepsilon_{ij(t_0)t}$ may be correlated with financial development if average matches are of higher quality in more financially developed provinces. In both cases, OLS estimates will be biased downward. If these effects were permanent (plus an inconsequential random error), the province fixed effects h_p would capture them and no bias would emerge. That is, suppose there are only two periods (t_0 and t_1) and two provinces (p and p', with $L_{j(p,t_0)} > L_{j(p',t_0)}$ without loss of generality, so that province p is initially less financially developed than p'). Our assumption is that, with regard to ability, $E\left(a_i | L_{j(p,t_1)}\right) = E\left(a_i | L_{j(p,t_0)}\right) < E\left(a_i | L_{j(p',t_0)}\right) = E\left(a_i | L_{j(p',t_1)}\right)$ (and similarly for match effects). In this case province fixed effects would capture the (permanent) composition effects. These effects can be assumed permanent because the process of convergence across credit markets is slow or it takes time to attract talent so as to shift the distribution of ability or match values across provinces. In the absence of convincing instruments for $L_{j(p,t_0)}$, this will be our identifying assumption.

5 Results

Table 5 reports the estimates of equation (5) using only the sample of job stayers. Since the job staying/moving decision can be endogenous, we present estimates with and without controlling for selection into new firms (columns 2 and 3 respectively). In column 1 we report the probit estimates for firm mobility. These are used to construct an estimate of the inverse Mills ratio. The exclusion restrictions in the mobility probit have the expected effects: the plant closure indicator has a strong positive effect on mobility and so does the residual worker horizon in all provinces.[13] Jointly, the instruments are highly statistically significant (the value of the χ^2 test statistic is 17,269 with 96 degrees of freedom) suggesting that the estimates do not suffer from weak exclusion restriction problems.[14]

[13] The estimated effect of the residual work horizon varies between a minimum of 0.001 and a maximum of 0.005 and is statistically significant at the 5% confidence level in 74 out of 95 provinces.

[14] The value of the χ^2 test statistic for the interaction between the residual work horizon and province dummies is 450 (with 94 degrees of freedom).

In our regressions we control for worker job position (dummies for blue and white collar) and for year dummies. The latter, in particular, absorb any time variation in interest rate spreads over the sample period that is due to nation-wide movements in interest rates. Furthermore, since we can identify the effect of credit constraints out of province-specific time variation, we can insert a full set of province dummies as controls. Thus, any systematic differences across provinces (for instance in average productivity) that is reflected in wage growth is captured by these controls. Without province-specific time variation in financial development, identification of the effect of financial frictions on wage contracts using only cross sectional geographical variation in the *level* of financial development would be problematic; in fact, insofar as financial development also spurs average productivity growth, it would also capture differences in the latter on wage growth.[15]

Column 2 shows the results when no adjustment for sample selection is made. The financial frictions indicator has a positive and highly significant impact on a worker wage rate growth implying that in provinces with more backward financial markets firms and workers settle on a steeper wage profile over the tenure horizon. *Ceteris paribus*, this implies that when access to the credit market is more limited, workers will lend to the firm, consistent with the model of Michelacci & Quadrini (2009). Adjusting for selection (column 2) results in a substantially smaller coefficient of the liquidity constraints indicator - pointing to the importance of accounting for movers' decisions - but the coefficient remains highly statistically significant (a *p*-value of 1.5%).

To fully characterize the effect of financial market imperfections on the shape of the wage contract, we need to identify not only their effect on the slope but also on the intercept of the wage profile. In fact, as described in Figure 2, if in less developed financial markets workers lend to their firm, the wage profile should have a higher slope and a lower intercept. Table 6 reports the OLS estimates of equation (6). Column 1 uses the parameters estimated in column 2 of Table 5 to compute the left-hand side of equation (6), while column 2 uses those from the selection adjusted specification (column 3). We find a negative and highly statistically significant effect on the intercept of the wage profile (the parameter δ in equation (6)). It is important to stress that although we use some of the estimated parameters of the wage growth regression to compute the left-hand side of equation (6), there is nothing in our exercise that would mechanically produce a negative estimate of δ.[16]

[15] This is not the case when identifying the bite of financial frictions out of time variation within each province, because the source of variation is the exogenous liberalization imposed by the EU directive and because its heterogeneous effects across provinces are the consequence of the different initial levels of financial development, themselves the accidental reflection of the 1936 legislation as shown in Table 4.

[16] From (6), measurement error in $L_{j(p,t_0)}$ alone would generate a *positive* relationship between $e_{ij(p,t_0)t}$ and $L_{j(p,t_0)}$ (since $\widehat{\gamma} > 0$).

The wage profile shifts downward and tilts upward in provinces with less developed financial markets. This is consistent with the view that firms circumvent credit market constraints by borrowing implicitly from their workers (back-loading compensation). Economically, the values of γ and δ using the selection-adjusted estimates imply that the wage of a worker that begins tenure matched with a firm facing a local market that has an index of financial backwardness 50% above the median value in 1997 (roughly 100 basis points) is 17.8% lower than that of an otherwise equal worker in the median local market for financial development; but it grows at a rate that is 0.32 percent faster for each month of tenure (3.9% a year). Thus, by itself, heterogeneity in access to finance across firms is sufficient to generate significant cross sectional heterogeneity in observed wages paid by (otherwise) similar firms to (otherwise) similar workers. This helps address the wage heterogeneity puzzle documented by, among others, Krueger & Summers (1988), Abowd & Kramarz (2000) and Van den Berg (1999).

Of course, since the main effect of credit market imperfections is to twist the wage profile, this same worker will receive a higher wage at the end of his tenure. Hence, there exists a value of tenure at which the wage in a financially developed market equals that in a financially depressed market (where profiles cross). Using (1), this value, which we denote T^*, is equal to δ/γ, i.e., about 54 months using our estimates in the second column of Tables 5 and 6. Hence, during the first 4.5 years of tenure the worker is typically lending to the firm before being repaid.

6 Heterogeneous Effects as an Identification Device

The estimates in Tables 5 and 6 are consistent with the idea that the firm can (partially) circumvent imperfections in financial markets by appropriately altering the shape of compensation schemes. While we have argued that the time variation in access to external markets we rely upon stems from exogenous shocks, a skeptical reader may object that even exogenous differences in access to the loans market may result in differences in the workers' productivity profile and our regressions would be picking up the latter rather than changes in the wage tenure profile related to borrowing and lending within the firm. To wit, suppose that wage-tenure profiles vary systematically with borrowing restrictions because the latter change the incentives to invest in human capital which affect the tenure profile, as in Azariadis (1988). Even if firms pay workers their current productivity, so that there is no lending within the firm, we would be observing a correlation between our indicator of financial backwardness and workers' wage growth. We have two answers to this objection. First, in order for our results to reflect variation in productivity profiles induced by variation in access to the loans market, it must be that productivity profiles are steeper in less developed financial markets. We find this unlikely. If either workers or firms have more difficulty accessing the loan market they will invest *less* in general human capital and will also invest *less* in specific human capital. Hence, workers' pay profiles should be flatter, not steeper as we find, when financial development deteriorates. Thus, insofar as variation in access to the loan market also has a direct effect on workers productivity profiles, our estimates are a *lower* bound of the effect of financial frictions on wage contracts.

A second way of addressing this issue and at the same time putting to a tougher test our causal interpretation is to exploit compensation-relevant heterogeneity in workers' and firms' sensitivities to borrowing frictions. Suppose that we can identify a set of firms (or workers) that are highly sensitive to borrowing frictions, for instance because they are highly dependent on outside finance or have no source of external funding other than bank borrowing. For these firms (or workers) we should expect, *ceteris paribus*, the wage contract to be even steeper than for the average firm (or worker). This heterogeneity in the values of γ and δ is directly predicted by the firm-as-an-internal-credit-market model and can be used to assess its empirical validity. In some cases, what this model predicts is opposite to what one should find if the correlations in Table 5 were due to differences in financial frictions causing differences in workers productivity profiles and can thus be used to tell the two interpretations apart. Here we focus on two sources of heterogeneity that we can confidently measure.

Firm creditworthiness. The first source of heterogeneity is differences in access to credit *within* the same local credit market. Firms in the same location but with easier access to their local credit market should be less in need of raising funds from their workers than firms that have more trouble accessing the same local credit market. Hence, we should expect that firms with better access to their local credit market offer flatter wage profiles. We measure firms' ease of obtaining external funds locally with firms' credit scores. While often heterogeneity in creditworthiness has been measured by the size of the firm or its age (e.g., Kumar & Francisco (2005) and the references therein), the use of these variables is dictated more by lack of better alternatives rather than by their intrinsic merit. In fact, both of these measures are likely to be poor indicators of creditworthiness as they also reflect many other features that may affect wage setting independently. This is particularly important in our context as firm size and age may, *inter alia*, pick up differences in human capital specificity which may also affect the wage contract. In fact, there is a large literature addressing the empirical regularity that large firms pay higher wages even after controlling for observable characteristics (see Oi & Idson (1999) for a survey). The credit score allows us to deal with this issue. This variable is directly available to the banks that belong to the CB consortium and they condition their decisions about whether and how much to lend to a firm on its value. Hence, the score provides a measure of the creditworthiness of any firm on the same metric, irrespective of the firm's age or size. Consistent with credit scoring measuring differences in firms creditworthiness, we find that, *ceteris paribus*, good-score firms pay lower interest rates, as discussed in Section 3.4.[17]

Finally, it is interesting to stress that under the skeptical view that financial frictions affect wage profiles because they affect directly workers' productivity profiles, firms with bad credit scores - which suffer more than good score firms when markets become less financially developed - should invest *less* in worker-specific human capital and thus offer flatter profiles than good score firms. This is the opposite prediction of a model in which the firm counteracts credit market frictions by distorting wage profiles relative to tenure-productivity profiles.

Worker differential access to the loan market. Following a similar logic, we expect that workers facing borrowing constraints in the local credit market should be less willing to lend to their firm (and may even borrow from it) and hence have a flatter wage tenure profile, that is, smaller γ and (in absolute value) δ. For workers we do not have as good a measure of their creditworthiness as we have for firms and thus have to rely on a coarser indicator. We proxy for it with a worker's job type using the distinction between blue collar, white collar and managers and assume that access to the loan market is more problematic for blue collar workers than it is for white collar workers and managers. This assumption is backed up by evidence from estimates of the conditional probability that a loan applicant is turned down by an intermediary obtained using the Italian Survey of Households Income and Wealth (SHIW), which shows that blue collar workers are significantly more likely to be denied credit than white collar workers and manager, conditioning on a variety of controls.[18]

Table 7 shows the results of the estimates when these interaction effects are added to the estimates of the wage equation in first differences (equation 5) and in levels (equation 6). In each case we re-estimate (5) by adding an extra interaction term between the indicator of local financial

[17] One may wonder why workers are willing to lend more to bad-score firms in a less developed credit market. One answer is that the riskiness of the firm results in a higher compensating premium for risk that may not be appealing to a bank. In fact, workers have access to a cheaper monitoring technology than a bank, because for them information collection about the firm is a by-product of going to work. This makes workers' signals more precise, reducing conditional uncertainty and making them more willing to lend.

[18] The Bank of Italy SHIW, run biannually on a representative sample of 8,000 Italian households, contains information on whether a loan application was accepted or turned down. We pool the 1998 and 2000 waves and run probit regressions for whether an application was turned down controlling for demographics, measures of workers' economic resources, geographic, time, and occupational dummies. Relative to the sample mean, being a blue collar worker raises the probability of being denied access to the loan market by 8.75%; being a white collar worker and a managers lowers it respectively by 37% and 49%. Even so, we feel less comfortable when we rely on this indicator than when we use the firm credit score. Job qualification, in fact, may capture other forces that may give rise to heterogeneous reactions to financial market frictions. For instance, it may reflect differences in specific human capital.

frictions and the relevant measure of firm or worker heterogeneity, controlling for any direct effect that this heterogeneity may have on wage setting.[19] The first two columns show the results when we interact financial backwardness with firms' credit scores in the wage growth equation (first column) and in the wage level equation (second column), respectively. We divide the credit score into three categories identified by three dummies: bad, medium and good scores (the excluded group).[20] Controlling for any direct effect the score level may exert on workers wage growth, we find that medium score and, even more so, bad score firms offer significantly steeper wage profiles than good score firms in the same local credit market. Moreover, the estimate of the intercept becomes smaller for lower score firms as required for the change in the wage-tenure profile to be interpreted as an implicit credit contract. We want to stress again that this result is in no way an artifact of our two step estimator. These estimates imply that low-score firms raise more funds from low-tenure workers in response to local credit market imperfections than good score firms. Quantitatively, a bad score firm would respond to a deterioration in access to the local credit market by adjusting the steepness of the wage profile offered to its workers 1.5 times more than a medium score firm, and 6.9 times more than a good score firm, which would offer much flatter wage contracts. Moreover, at a level of financial backwardness of 1, low score firms pay a wage level at the beginning of tenure that is 9.4 percent lower than that paid by similar firms operating in the same local credit market but with a good credit score (7 percent lower for medium score firms). This result speaks in support of the firm-as-a credit market model and against the idea that our findings reflect the effects of credit frictions on human capital accumulation.

The last two columns of Table 7 show the results when the indicator of local credit market frictions is interacted with the manager and white collar dummies, as proxies for workers' creditworthiness (blue collar workers are the excluded group). Consistent with this interpretation we find that in response to financial frictions firms offer steeper profiles to managers (deemed to face easier access to the local credit market) than to white collar workers, and the latter in turn obtain steeper compensation profiles than blue collar workers (deemed to rank low in terms of creditworthiness). For the three types of workers, the estimates of γ are 0.0025, 0.0055 and 0.0115 respectively. The estimates of the intercept shift is always negative in this case as well and more so for the group of workers that are more willing to lend to the firm. The point estimates of δ for blue collar workers, white collar workers and managers are respectively -0.147, -0.226 and -0.448, respectively. These

[19] In each case, we re-estimate the mobility probit adding the extra variables that appear in the wage growth equation and construct a new Mills ratio to control for selection into staying with the same firm.

[20] The credit score is a number between 1 and 9 with higher values signaling lower creditworthiness. We assign firms with a number between 7 and 9 to the "bad score" category (19%); firms with a number between 4 and 6 to the "medium score" category (47%); the remainders are in the excluded category (34%).

estimates of γ and δ imply substantial differences in the way firms design contracts so as to obtain more funds from workers who have a higher propensity to lend.

7 Robustness

In this section we assess the robustness of the previous results along various margins. The key question we want to address is: does the finding of a downward shift and an upward tilt of the wage profile in more backward credit markets survive when we change the regression specification or sample?

A first issue is that our identification strategy relies on variation in financial development across local credit markets. Clearly local credit market conditions are binding for firms only if they cannot borrow outside the boundaries of the local market. This is less likely to be the case for large firms, which can raise funds outside the borders of the province where they are located (through, say, remote bank lending or issuance of corporate bonds). Though most firms in our sample are small (median employment is 30), the firm size threshold that qualifies a firm for borrowing outside its province is unobserved, and this introduces measurement error in the matching between a firm and the relevant credit market condition that it and its workers face. To account for this we repeat our estimation exercise restricting the sample to workers employed in firms with fewer than 30 employees at the beginning of the sample - a rather stringent criteria. The first two columns of Table 8 show the estimates. The first column reports the effect of credit market backwardness on the slope of the wage tenure profile, the second column reports the effect on its intercept using the same two-step methodology as in Tables 5 and 6 (to save on space we only report the estimates of the relevant coefficients in the robustness check at hand). Though we lose about 250,000 observations (and with them statistical precision), we still find that tenure profiles are steeper in less developed credit markets and wages are lower at the beginning of tenure and higher towards the end. Furthermore, consistent with local credit market conditions binding more for smaller firms, the effect on the slope and the intercept are stronger in this sample of very small firms than in the overall sample. The other columns use less stringent criteria to restrict the sample: columns three and four focus on firms with less than 100 workers, and the last two columns focus on firms with size below the mean. In this case results are closer to those for the whole sample.

Another issue, mentioned at the end of Section 4, is that returns to tenure may not be constant as implied by our main specification, but depend on attained tenure itself (Dustmann & Meghir 2005). To allow for non-linear returns to tenure we modify equation (1) to include a quadratic term in tenure and its interaction with our measure of financial market backwardness.

The estimation strategy remains unchanged. The wage growth equation, estimated only on the sample of firm stayers, includes two extra variables, a linear term in tenure and its interaction with the financial market backwardness variable (which identify the effect of the quadratic term in wage (log) level equation). Results for this specification are reported in Table 9. Because of the different specification, we report the full results for the wage growth equation and the wage level equation separately. The negative and significant effect of the linear term in tenure in the wage growth equation implies that the wage profile is concave in tenure, consistent with Dustmann and Meghir's findings (Panel A). However, this does not affect the previous conclusion that wage tenure profiles are steeper in firms facing more backward credit markets. In fact the effect of credit market imperfections on wage growth is positive at all levels of tenure (the quadratic term is small and insignificant). Furthermore, even for this specification the estimate of the wage level equation shows that the intercept of the wage tenure profile is lower in less developed local credit markets confirming the previous results (Panel B).

In Table 10 we check the robustness of our results vis-à-vis four additional issues. First, we need to consider a subtle form of non-random attrition. The estimates of (6) use a variable number of observations for each individual. Individuals who stay longer with the initial firm naturally contribute more observations. However, longer tenures are typically associated with higher match values or higher ability, creating a possible form of sample selection bias. One simple way of addressing this problem is to "balance" the panel artificially by using only the first year in the labor market for each individual. This is what we do in Panel A (the first difference results are the same as for the main sample, and reported for completeness). The results show that even when accounting for this type of attrition, and notwithstanding the substantially smaller sample, credit market inefficiency still results in a lower wage level at the beginning of tenure.

Second, one may wonder whether the results are robust to the exclusion restrictions imposed in the worker mobility selection equation. While we cannot test the exclusion restrictions directly, we can check informally whether the results are sensitive to adopting a more parsimonious strategy, and hence impose only the least controversial restriction. Specifically, we retain only the firm closure dummy as the identifying variable in the selection equation. Estimation results based on the restricted instrument set are shown in Panel B; the sign, size and significance of the effect on the slope and intercept are not much different from the estimates obtained in Tables 5 and 6.

Third, in Panel C we exclude from the regressions the Sicilian provinces. As mentioned in footnote 10, Sicily is anomalous because its credit market appears more competitive than other Southern regions due to a number of institutional factors. However, the results excluding Sicily are virtually identical to those obtained including it.

A final concern relates to the effects of the local business cycle conditions on the wage profile. Suppose that workers who join a firm during a weak local labor market receive lower initial wages, but later they experience faster wage growth due to a mean reversion effect. If the spread between the rates on loans and deposits increases when local labor market conditions are poor, due for example to an (uncontrolled for) increase in the risk premium, our specification may be capturing this effect rather than implicit borrowing. To allay this worry, we augment our regressions with the local unemployment rate at the time of hiring, $U_{j(p,t_0)}$, and its interaction with tenure.[21] If the effect we are describing is at play, we should find that $U_{j(p,t_0)}$ is positive in the wage growth equation and negative in the level equation and that the credit market backwardness variable becomes insignificant. In fact, the effect of $U_{j(p,t_0)}$ is negative (and significant) in the wage growth equation and in the level equation (but insignificant). Moreover, the estimates of γ and δ are robust to the introduction of this further control (Table 10, Panel D).

In sum, the results in Tables 5 and 6 display remarkably little sensitivity to exclusion of larger firms, allowance for non-linear wage tenure relations, non-random attrition, variations in the set of exclusion restrictions used for identification, and other confounding effects, such as wage effects induced by local business cycle conditions when starting a job. Across a large variety of samples and specifications, we confirm evidence of a lower initial wage and a steeper wage tenure profile in financially backward credit markets, consistent with the idea that firms borrow implicitly from their workers.

8 Assessing implicit interest rates and credit flows

We now assess the implied interest rate and the size of the implicit credit flows, comparing them with prices and quantities observed in the credit market. We pool observations over all available years to estimate the tenure distribution, average wages at each tenure within each province, and the degree of credit market imperfections faced by workers at the time they joined the firm. In what follows, therefore, we drop the time, firm and individual subscripts.[22] From equation (3), a

[21]Similar to what was done for $L_{j(p,t_0)}$, for people hired before 1990 we use the unemployment rate recorded in 1990.

[22]Ideally, we would construct time-varying measures of average wage by tenure and of the tenure distribution. Unfortunately, for many provinces we do not have enough observations to do that. Financial development must be measured as of the year when the worker entered the job. Given that we take the cross sectional average, for each province we construct financial development for those with tenure T as the weighted average of financial development in the province in the year they started the job: $L_{pT} = \sum_t \frac{n_{ptT}}{n_{pT}} L_{p(t-T)}$ where n_{ptT} is the number of workers with tenure T in year t, $n_{pT} = \sum_t n_{ptT}$ is the total number of workers with tenure T over our sample period, and $L_{p(t-T)}$ is the credit market backwardness index measured in the year the worker joined the firm.

firm located in province p pays a wage $w_{pT} = e^{(\delta+\gamma T)L_{pT}} w_{p^*T}$ to a worker of tenure T, with w_{p^*T} being the wage that the same firm would pay if located in the most competitive credit market (where $L_{pT} = 0$). It follows that the amount of implicit borrowing from a worker with tenure T in province $p \neq p^*$ is:

$$\textbf{Borrowing}_{pT} = \left(e^{-(\delta+\gamma T)L_{pT}} - 1\right) w_{pT} \tag{7}$$

By construction, $\textbf{Borrowing}_{pT}$ is positive as long as $T \leq T^*$ (the tenure at which the worker begins being repaid). It represents savings on wage payments due to the different tenure profile compared to the province with the most developed financial market. In terms of figure 1, $\textbf{Borrowing}_{pT}$ is the vertical distance between the baseline line and that for the case of firms borrowing from workers.

A first check of the implications of our estimates is based on comparing implicit borrowing and repayment flows. In fact, the worker lends to the firm up to T^* and is repaid after that. If we impose the condition that the expected flows to and from the firm are actuarially equal, we can compute the internal rate of return (IRR), i.e., the interest rate that makes the expected stream of borrowing and repayments implicit in the tenure profiles equal to zero in net present value. Formally, the IRR is the unique value that solves:

$$\sum_T \frac{\pi_T}{(1+IRR)^T} \left(e^{-(\delta+\gamma T)L_{pT}} - 1\right) w_{pT} = 0$$

where π_T is the survival probability, i.e., the probability that a worker is still attached to the firm at tenure T, computed from the actual tenure distribution (assuming for simplicity that all tenure spells are completed). This expression represents the expected net present value of implicit borrowing and repayments.[23] The first row of Table 11 reports the results of this exercise for the most backward province (Cosenza), the one at the 75^{th} percentile of the financial backwardness distribution (Lecce), at the 50^{th} percentile (Ragusa), at the 25^{th} percentile (Trento). We find that the average IRR is 2.9%, with considerable cross-province heterogeneity: it is 3.7% in Cosenza and Lecce, 1.2% in Ragusa, 2.4 in Trento.[24] Ideally, the IRR should be above the interest rate that workers can obtain on their savings and below the interest rate that firms pay on bank loans.[25] In fact, in the 1990-97 period, the cross-country average real interest rate on loans was 10.1% and on deposits 0.6%; in Cosenza, they were 10.6% and -0.2% and in Trento 9.9% and 0.92%. Our values are exactly within these ranges: both workers and firms benefit from transacting. An IRR of 2-4% indicates that the surplus is split but firms appropriate a larger share.

[23] We are implicitly assuming that firms and workers are risk neutral.

[24] Note that, due to differences in wages and in the tenure structure across provinces, the IRR need not be monotonic in the degree of credit market backwardness.

[25] Given that the repeated interaction between firm and workers might allow for transactions that, due to asymmetric information, do not take place in financial markets, the observed interest rate on loans might underestimate the shadow value of credit for a firm.

We have considered how the implied IRR changes with different values of the parameters γ and δ. We found that proportional parameter changes that leave $T^* = -\delta/\gamma$ unchanged affect the IRR only marginally. For example, increasing both δ and γ by 20% implies an average IRR of 2.3%, while decreasing both parameters by 20% implies an average IRR of 3.5%. Proportional changes in the estimates of the parameters do not affect our results dramatically, so that we can focus on T^* to assess the sensitivity of the IRR to parameter changes. As one should expect, the implied IRR is more sensitive to changes in T^*. Setting $T^* = 50$, approximately a 10% drop, implies an average IRR of 5.6%, while a $T^* = 45$ implies an IRR of almost 9%. In fact, moving the crossing point in Figure 1 to the left requires a higher interest rate to equate the implicit borrowing and repayment flows. On the other side, increasing the crossing point to $T^* = 60$ (approximately a 10% increase) implies an average IRR of 1.1%, while further increases lead to an average IRR of zero.

We next assess the size of the implicit credit flows between workers and firms, comparing it to bank borrowing to gauge the relevance of this financing channel. We describe the measures of borrowing briefly here and supply all the details in the appendix. We measure gross lending as the savings on wage payments that a firm facing a local market with financial frictions obtains from workers with tenure $T \leq T^*$ compared to being located in the most developed local financial market. We compute two measures of borrowing: first, maximum borrowing, that is, the stock of implicit debt that the firm has towards a worker of tenure T^*: in Figure 1, this is the area between the baseline and the case II line for $T \leq T^*$. Second, borrowing per worker, that is the average per worker stock of debt toward the workers with $T \leq T^*$, for an hypothetical firm with a tenure distribution equal to the actual tenure distribution at the provincial level. This measure can be directly compared with bank debt per employee. We obtain information on bank borrowing from the CB data service.[26] We take the average bank debt per employee at the provincial level, pooling observations over the 1990-97 years, to which the worker data refer.

In Table 11 we report the results for the various statistics described above. For Cosenza, the maximum borrowing is almost 12,000 euros. This means that a worker with tenure T^* has accumulated a credit towards the firm on the order of 1.5 years of earnings. The value decreases with financial development, but it still amounts to 5,700 euros for the province of Trento, at the 25^{th} percentile of the credit backwardness distribution. Implicit borrowing per worker is between 1,500 and 3,000 euros. In the most backward province implicit borrowing per worker is 2,762 euros while bank borrowing per worker is around 8,000 euros. This means that borrowing from the workers is

[26] The CB is likely to overestimate the amount of bank borrowing per employee, as only firms with a certain degree of credit-worthiness are included. This implies that, if anything, the comparison between bank borrowing and borrowing from workers is biased towards finding a more important role for bank borrowing.

approximately one third of that from banks. And since bank borrowing per employee in the most financially developed province is approximately twice as large that of Cosenza, around one third of the difference in bank borrowing between the most and the least backward province is made up by borrowing from workers. As expected, the magnitude of implicit borrowing tends to decrease with financial development. For example, in Trento, at the 25^{th} percentile of the financial backwardness distribution, implicit borrowing per worker is 1,432 euros, less than 10% of loans from banks. The cross province average is 1,645, 11% of bank loans.

All in all, we find that the financial sector is the main financing channel for firms even in underdeveloped markets, but implicit credit flows between workers and firms can supplement substantially explicit credit flows from financial intermediaries.

9 Conclusions

It has long been theoretically recognized that the repeated relationships established within the firm between workers, on the one hand, and entrepreneurs on the other can go a long way towards tempering the effects of credit and insurance market frictions. They can even go as far as providing a basis for the existence of the firm (Bovenberg & Teulings 2002). Yet, very little progress has been made in pinning down empirically the importance of the firm as an insurance provider and as an internal credit market. Our previous work (Guiso et al. 2005) shows evidence of the role of the firm as an insurance market against idiosyncratic shocks to a firm's productivity. This paper shows how much credit can take place within the firm and establishes that there is substantial lending flowing from workers to firms, with its size related to the degree of credit market frictions. Thus, the evidence we provide lends empirical support to the idea that the employment relationship allows reduction of the adverse consequences of poorly working credit markets.

While we have focused on financial trades between employees and employers, the same factor that makes these trades possible - the human capital specificity that ties workers to their company - might also facilitate intertemporal monetary exchanges between workers in the same firm. The literature has so far studied the first type of exchanges, but the latter may, quantitatively, also be relevant. Even more interestingly, the possibility of financial exchanges between workers may reinforce financial exchanges between employees and employers: knowing that she can borrow from her colleagues when facing an adverse shock, a worker may be more willing to lend to her employer. We regard this as an interesting topic for future research.

A Appendix

A.1 Data details

Our initial workers sample is composed of social security records for individuals aged 18 to 60 with non missing social security codes, positive reported earnings, and consistent monthly employment codes (642,361 records and 112,303 individuals). A worker may have multiple social security contribution records in a given year (if, say, she had multiple employers in that year). We drop those with multiple concurrent jobs (because moves are hard to identify), those who receive social security contributions from a firm after it goes bankrupt (because it may signal a merger or acquisition rather than a closure), and those who have spells at a given firm separated by intervening spells at other firms (because the concept of tenure is not very clear cut). These selections reduce our sample to 508,342 records and 96,444 individuals. We drop individuals who have one or more outlier monthly earnings records (a decline greater than 70% or an increase greater than 400%). We lose 35,759 records and 6,095 individuals. Since we need to estimate wage growth equations, we also drop workers observed for only one year (15,596 records). Finally, we eliminate records with missing information on the province of work, because we cannot match them to information about local credit market imperfections (3,010 records).[27] Our final sample consists of 454,675 records corresponding to 74,520 individuals.[28]

The firm data are collected by the Company Accounts Data Services, which was established in the early 1980s jointly by the Bank of Italy, the Italian Banking Association and a pool of leading banks to gather and share information on borrowers. Since the banks rely heavily on it in granting and pricing loans, the data are subject to extensive quality controls by a pool of professionals, so measurement error should be negligible. While the CB data are reasonably representative of the entire population in terms of distribution by sector and geographical area (Guiso & Schivardi 2007), the focus on level of borrowing skews the sample towards relatively larger firms: CB reporting firms account for approximately half of total employment and 7% of the number of firms in manufacturing.

A.2 Credit flows definition

To compute the total debt towards a worker with tenure T, note that the firm has been borrowing from such worker $\mathbf{Borrowing}_{p0}$ in the first month of employment, $\mathbf{Borrowing}_{p1}$ in the second month, and so on. Given the interest rate r, the present value of $\mathbf{Borrowing}_{p0}$ is (1 +

[27] We impute the province of work when we find clear coding errors.

[28] Note that, given that mobility requires knowledge about current *and* past employers, the first observation for each worker is lost and hence the probit regression in Table 5 uses only 380,125 observations. The wage growth regression uses only 329,545 observations because it conditions on staying with the same firm.

$r)^T_{p0}\textbf{Borrowing}_{p0}$ and similarly for subsequent flows. The cumulative borrowing from such worker is therefore:

$$\textbf{Cumulative Borrowing}_{pT} = \sum_{t=0}^{T} (1+r)^{(T-t)}_{pt} \textbf{Borrowing}_{pt}.$$

Following the results on the IRR, we will use an annual interest rate of 3%. Results are not very sensitive to alternative values of r, given that the average tenure (weighted by the share of workers at each tenure level) is about 6 years. $\textbf{Cumulative Borrowing}_{pT}$ reaches a maximum at T^*, after which the firm starts repaying the worker and $\textbf{Borrowing}_{pT}$ turns negative. The maximum stock of debt that a firm can accumulate form a worker is therefore $\textbf{Maximum Borrowing}_p = \textbf{Cumulative Borrowing}_{pT^*}$.

The basic idea we use to construct a measure of borrowing from the workers can be illustrated with a simple example. Consider a model in which workers work for two periods and define them as junior in the first and senior in the second period. Junior workers lend implicitly to the firm, which pays them back when senior. A firm born at time 1 hires a junior worker, from whom it borrows implicitly B; at time 2, the firm hires another junior worker, from whom it also borrows B, and pays back the "loan" to the former junior workers, now turned senior; from period 3 onward, the senior worker retires, the junior turns senior and is paid back and the firm hires another junior worker from whom it borrows. In this scheme, starting in period 2 the flows of borrowing and repayments are equal in NPV terms. Still, the firm has an outstanding stock of debt equal to B, because in the first period it received the implicit loan B without any repayment being made. This loan will be repaid when the firm stops hiring, in which case it will make the payment to the senior worker without borrowing from the junior one. Until then, the firm is borrowing from its workers the amount B. This idea can be generalized to a firm with a given steady-state distribution of workers' tenures. We consider an hypothetical firm with a unit mass of workers, with a tenure distribution equal to the actual tenure distribution at the provincial level. Recall that the firm's borrowing from a worker with tenure T is $\textbf{Cumulative Borrowing}_{pT}$. The total stock of debt for the hypothetical firm with one "representative" worker is therefore:

$$\textbf{Implicit borrowing per worker}_p = \sum_{T \leq T^*} \omega_{pT} \textbf{Cumulative Borrowing}_{pT}.$$

Implicit borrowing per worker represents the stock of debt that the firm has accumulated towards workers with seniority smaller or equal to T^*, where each seniority level is weighted according to the actual seniority distribution in the province. Given that this hypothetical firm has one representative employee.

References

Abowd, J. & Kramarz, F. (2000), Inter-industry and firm-size wage differentials: New evidence from linked employer-employee data. Unpublished manuscript, Cornell University.

Abowd, J., Kramarz, F. & Roux, S. (2006), 'Wages, mobility and firm performance: Advantages and insights from using matched worker-firm data', *Economic Journal* **116**, F245–F285.

Altonji, J. & Shakotko, R. (1987), 'Do wages rise with job seniority?', *The Review of Economic Studies* **54**, 437–459.

Altonji, J. & Williams, N. (2005), 'Do wages rise with job seniority? A reassessment', *Industrial and Labor Relations Review* **58**, 370–397.

Azariadis, C. (1975), 'Implicit contracts and underemployment equilibria', *The Journal of Political Economy* **83**, 1183–1202.

Azariadis, C. (1988), 'Human capital and self-enforcing contracts', *The Scandinavian Journal of Economics* **90**, 507–528.

Baily, M. (1974), 'Wages and employment under uncertain demand', *The Review of Economic Studies* **51**, 37–50.

Benmelech, E., Bergman, N. & Enriquez, R. (2010), Negotiating with labor under financial distress. Mimeo, Harvard University.

Bernhardt, D. & Timmis, G. (1990), 'Multiperiod wage contracts and productivity profiles', *Journal of Labor Economics* **8**, 529–563.

Bofondi, M. & Gobbi, G. (2006), 'Informational barriers to entry into credit markets', *Review of Finance* **10**, 39–67.

Bovenberg, A. & Teulings, C. (2002), Insurance and information: Firms as a commitment device. CEPR Discussion Papers 3441.

Brandt, L. & Hosios, A. (1996), 'Credit, incentives, and reputation: a hedonic analysis of contractual wage profiles', *Journal of Political Economy* **104**, 1172–1226.

Burdett, K. & Coles, M. (2003), 'Equilibrium wage-tenure contracts', *Econometrica* **71**, 1377–1404.

Casolaro, L., Gambacorta, L. & Guiso, L. (2006), Regulation, formal and informal enforcement, and the development of the household loan market: Lessons from Italy, *in* G. Bertola, C. Grant & R. Disney, eds, 'The Economics of Consumer Credit: European Experience and Lessons from the US', The MIT Press.

Degryse, H. & Ongena, S. (2005), 'Distance, lending relationships, and competition', *Journal of Finance* **60**, 231–266.

Detragiache, E., Garella, P. & Guiso, L. (2000), 'Multiple versus single banking relationships: Theory and evidence', *The Journal of Finance* **55**, 1133–1161.

Dustmann, C. & Meghir, C. (2005), 'Wages, experience and seniority', *The Review of Economic Studies* **72**, 77–108.

Guiso, L., Pistaferri, L. & Schivardi, F. (2005), 'Insurance within the firm', *Journal of Political Economy* **113**, 1054–1087.

Guiso, L., Sapienza, P. & Zingales (2006), The cost of banking regulation. Mimeo, Chicago GSB.

Guiso, L., Sapienza, P. & Zingales, L. (2004), 'Does local financial development matter?', *The Quarterly Journal of Economics* **119**, 929–969.

Guiso, L. & Schivardi, F. (2007), 'Spillovers in industrial districts', *Economic Journal* **117**, 68–93.

Hubbard, R. (1998), 'Capital-market imperfections and investment', *Journal of Economic Literature* **36**, 193–225.

Knight, F. H. (1921), *Risk, Uncertainty, and Profit*, New York: August M. Kelley.

Krueger, A. & Summers, L. (1988), 'Efficiency wages and the inter-industry wage structure', *Econometrica* **56**, 259–293.

Kumar, A. & Francisco, M. (2005), Enterprise size, financing patterns, and credit constraints in Brazil: analysis of data from the investment climate assessment survey. World Bank WP no. 49.

Lazear, E. (1981), 'Agency, earnings profiles, productivity, and hours restrictions', *The American Economic Review* **71**, 606–620.

Lerner, J. (1995), 'Venture capitalists and the oversight of private firms', *Journal of Finance* **60**, 301–318.

Michelacci, C. & Quadrini, V. (2005), 'Borrowing from employees: Wage dynamics with financial constraints', *Journal of the European Economic Association P&P* **3**, 360–369.

Michelacci, C. & Quadrini, V. (2009), 'Financial markets and wages', *Review of Economic Studies* **76**, 795–827.

Neal, D. (1995), 'Industry-specific human capital: Evidence from displaced workers', *Journal of labor Economics* **13**, 653–677.

Oi, W. & Idson, T. (1999), Firm size and wages, *in* O. Ashenfelter & D. Card, eds, 'Handbook of labor economics, Volume 3B', Elsevier.

Panetta, F., Schivardi, F. & Shum (2009), 'Do mergers improve information? Evidence from the loan market', *Journal of Money, Credit and Banking* **41**, 673–709.

Petersen, M. & Rajan, R. (2002), 'Does distance still matter? The information revolution in small business lending', *Journal of Finance* **57**, 2533–2570.

Stein, J. & Center, L. (2003), Agency, information and corporate investment, *in* G. Constantinides, M. Harris & R. Stulz, eds, 'Handbook of the Economics of Finance', North-Holland.

Topel, R. (1991), 'Specific capital, mobility, and wages: Wages rise with job seniority', *Journal of Political Economy* **99**.

Van den Berg, G. (1999), 'Empirical inference with equilibrium search models of the labour market', *Economic Journal* **109**, 283–306.

Wasmer, E. & Weil, P. (2004), 'The macroeconomics of labor and credit market imperfections', *American Economic Review* **94**, 944–963.

Table 1: Workers' characteristics

Variable	Mean (st.dev.)
Monthly earnings (euro)	766 (544)
Age	37 (11)
Male	0.65 (0.48)
Productions	0.60 (0.49)
Clericals	0.39 (0.49)
South	0.22 (0.41)
North	0.59 (0.49)
Experience (in months)	117 (81)
Tenure (in months)	66 (71)
Mover	0.11 (0.31)
Displaced due to firm bankruptcy	0.02 (0.15)
Firm size	2506 (12199)
Median firm size	32

Note: The table shows summary statistics for the workers in the whole sample used in estimation (454,675 records). Standard deviations in parenthesis. Data on firm size are available only for a subset of those (411,302). Monthly earnings are gross earnings, expressed in 1995 euros.

Table 2: Firms characteristics

Variable	Mean (st.dev.)
Employment	71.6 (608.5)
Assets	13402.7 (386991.2)
Turnover	14026.8 (95258.3)
Interest rate on loans	15.0 (3.9)
Bank debt	886.6 (14519.1)
Score	5.2 (1.8)
North	0.69 (0.46)
South	0.12 (0.33)
Manufacturing	0.54 (0.50)
Construction	0.08 (0.27)

Note: The table shows summary statistics for the firms used to compute the credit market backwardness variable (approximately 250,000 firm-year observations). Monetary values are expressed in 1995 thousand euros.

Table 3: Financial market backwardness

Province	$\overline{L}_p$	$L_{p,1990}$	Δ	Province	$\overline{L}_p$	$L_{p,1990}$	Δ	Province	$\overline{L}_p$	$L_{p,1990}$	Δ
Agrigento	1.21	1.14	0.38	Frosinone	1.87	1.63	0.24	Pistoia	1.78	1.63	0.10
Alessandria	1.08	1.36	-0.79	Genova	1.93	1.78	-0.14	Pordenone	1.97	1.64	-0.32
Ancona	1.65	0.59	1.42	Gorizia	2.18	2.32	-0.43	Potenza	2.21	1.98	0.45
Aosta	1.31	1.38	-0.16	Grosseto	1.22	1.47	0.45	Ragusa	1.69	1.62	0.29
Arezzo	2.45	2.14	0.07	Imperia	0.66	1.20	-0.54	Ravenna	0.42	0.00	0.36
Ascoli	2.69	2.55	0.04	Isernia	2.99	2.73	-0.38	Reggio C.	3.02	2.46	0.70
Asti	0.63	0.84	-0.55	L'Aquila	2.26	2.03	0.18	Reggio E.	1.23	0.79	-0.03
Avellino	3.04	3.31	-0.14	Laspezia	1.64	1.60	0.14	Rieti	2.38	2.26	-0.09
Bari	1.75	1.28	0.58	Latina	2.43	2.51	-0.89	Roma	1.78	2.06	-0.48
Belluno	1.72	1.92	-0.90	Lecce	2.40	2.10	1.32	Rovigo	2.02	2.40	-1.26
Benevento	2.89	3.74	-1.70	Livorno	0.79	0.73	0.41	Salerno	2.59	2.65	-0.18
Bergamo	1.25	1.65	-0.72	Lucca	1.74	1.79	-0.39	Sassari	1.66	1.63	0.30
Bologna	1.07	0.76	0.11	Macerata	1.64	0.60	1.79	Savona	0.61	0.74	-0.64
Bolzano	1.44	1.32	-0.63	Mantova	0.63	0.87	-0.43	Siena	1.53	1.50	-0.65
Brescia	2.42	2.51	-0.68	Massa	1.34	1.27	-0.15	Siracusa	1.65	0.99	1.30
Brindisi	2.42	2.24	0.49	Matera	1.79	2.14	-0.33	Sondrio	0.59	1.61	-1.28
Cagliari	1.75	1.58	0.08	Messina	1.32	1.41	0.07	Taranto	2.73	3.42	-1.11
Caltanisetta	1.39	0.96	1.41	Milano	2.06	1.84	0.21	Teramo	2.51	2.52	-0.52
Campobasso	1.42	1.49	-0.90	Modena	1.06	0.33	0.62	Terni	2.28	1.88	0.52
Caserta	3.33	3.57	-0.75	Napoli	3.31	3.30	-0.48	Torino	1.62	1.82	-0.67
Catania	1.98	1.79	0.73	Novara	1.69	1.59	0.17	Trapani	1.22	0.54	1.10
Catanzaro	2.18	3.05	-0.86	Nuoro	1.98	2.16	-0.13	Trento	1.65	1.06	0.58
Chieti	2.81	2.36	0.20	Oristano	1.71	0.61	0.83	Treviso	2.15	1.96	-0.46
Como	1.92	1.90	-0.26	Padova	2.20	2.17	-0.69	Trieste	1.54	1.59	-0.26
Cosenza	2.79	3.92	-1.74	Palermo	1.55	1.45	0.40	Udine	2.08	1.36	0.39
Cremona	1.64	1.41	0.21	Parma	0.41	0.20	-0.10	Varese	1.91	1.78	-0.05
Cuneo	0.40	0.85	-0.85	Pavia	1.43	1.46	-0.10	Venezia	1.95	1.92	-0.20
Enna	1.56	0.66	1.71	Perugia	2.23	1.76	0.60	Vercelli	2.23	2.37	-0.49
Ferrara	1.62	1.28	-0.05	Pesaro	1.48	0.04	1.86	Verona	1.98	2.05	-0.61
Firenze	1.74	1.40	0.73	Pescara	2.18	1.95	0.22	Vicenza	1.95	1.72	-0.18
Foggia	1.30	0.98	-0.36	Piacenza	0.81	0.54	0.10	Viterbo	0.57	0.21	0.39
Forlí	0.66	0.82	-0.29	Pisa	1.81	1.63	-0.65	Average	1.76	1.66	-0.35

Note: The table reports the time average of indicator of credit market imperfection in each Italian province ($\overline{L}_p$), its value in 1990, the first year of our sample just prior to the start of the liberalization ($L_{p,1990}$) and the change in the indicator between 1990 and 1997, the last sample year (Δ).

Table 4: The convergence process

Dependent variable: $L_{p,1997} - L_{p,1990}$	OLS	IV
$L_{p,1990}$	-0.4633	-0.4097
	(0.0811)	(0.2467)
Constant	0.7358	0.6465
	(0.1630)	(0.4165)
N	95	95

Note: This table shows regressions of the change in the indicator of local financial market imperfections following financial liberalization and the degree of credit market imperfection prevailing in a province before liberalization. The first column shows OLS estimates, the second reports IV estimates using as instruments for the initial level of the indicator the measures of banking local banking structure in 1936 used by Guiso et al. (2004). Robust standard errors are reported in parenthesis.

Table 5: Wage growth

	Probit	*Wage growth*	
	(1)	(2)	(3)
Liquidity constraint	0.2697 (0.0106)	0.0128 (0.0015)	0.0032 (0.0015)
ΔWhite Collar	0.1206 (0.0225)	0.0084 (0.0034)	0.0046 (0.0034)
ΔManager	0.5252 (0.0824)	0.0518 (0.0096)	0.0399 (0.0096)
ΔYear dummies	Yes	Yes	Yes
Province dummies	Yes	Yes	Yes
Inverse Mills ratio			0.0745 (0.0032)
Plant closure dummy	0.7598 (0.0081)		
Residual Horizon	0.0033 (0.0010)		
Province dummies* Residual Horizon	Yes		
N	380,125	329,545	329,545

Note: The table shows the estimation results of the wage growth equation for the sample of workers that stay with the firm. Column (P1) shows the results of the probit estimates for the workers that have moved. Columns (WG1) and (WG2) report the estimates of equation (3). Robust standard errors are reported in parenthesis.

Table 6: Wage levels (first-job workers sample)

	(1)	(2)
Liquidity constraint	−0.1479	−0.1789
	(0.0090)	(0.0090)
Male	0.2300	0.2441
	(0.0059)	(0.0058)
Province dummies	Yes	Yes
N	51,341	51,341

Note: The table shows the estimation results of the wage level equation for the sample of workers in their first job. The left-hand side variable is computed using the parameters estimates from Table 5 as in equation (6). Estimates in column 1 use parameters from column 1 in Table 5, Panel A to construct the left-hand sid variable; estimates in column 2 use parameters from column 2 in Table 5. Robust standard errors are reported in parenthesis.

Table 7: The effect of firm and worker characteristics

	First diff.	Levels	First diff.	Levels
Liq. constr.	0.0011 (0.0032)	−0.0940 (0.0178)	0.0025 (0.0016)	−0.1465 (0.0092)
Liq. constr.× Bad score	0.0083 (0.0028)	−0.0934 (0.0209)		
Liq. constr.× Medium score	0.0056 (0.0021)	−0.0712 (0.0151)		
Bad score	−0.0142 (0.0050)	0.0375 (0.0437)		
Intermediate score	−0.0052 (0.0039)	−0.0167 (0.0302)		
Liq. constr.× Manager			0.0090 (0.0041)	−0.3017 (0.0872)
Liq. constr.× White collar			0.0030 (0.0010)	−0.0791 (0.0084)
Manager			0.0220 (0.0078)	1.3448 (0.1671)
White collar			0.0127 (0.0019)	0.2520 (0.0171)
N	83,088	9,312	329,545	51,341

Note: The table shows the estimation results of the wage growth equation (3) and the wage level equation (6) allowing for the response in the slope of the tenure profile to credit market frictions to differ across different types of firms and workers. Robust standard errors are reported in parenthesis

Table 8: Robustness Analysis: Using small firms

	Initial size < 30		*Initial size < 100*		*Initial size < 2,500*	
	First diff.	Levels	First diff.	Levels	First diff.	Levels
Liquidity constraint	0.0042	−0.4355	0.0028	−0.4942	0.0025	−0.5292
	(0.0031)	(0.0222)	(0.0027)	(0.0222)	(0.0022)	(0.0208)
N	67,297	29,878	84,515	35,542	114,410	45,025

Note: The table shows the estimation results of the wage growth equation (3) and the wage level equation (6) restricting the sample to workers employed by "small" firms. Firm size is defined using the number of workers employed by the firm as of the first time we observe the match in the 1990-97 period. Robust standard errors are reported in parenthesis.

Table 9: Robustness Analysis: Quadratic tenure profile

Panel A: Wage growth equation

Liquidity constraint	0.0038 (0.0016)
ΔWhite Collar	0.0058 (0.0034)
ΔManager	0.0456 (0.0096)
ΔYear dummies	Yes
Province dummies	Yes
Inverse Mills ratio	0.0424 (0.0037)
Tenure/100	−0.0052 (0.0006)
Liquidity constraint*Tenure/100	0.0002 (0.0003)
N	329,545

Panel B: Level equation, first job sample

Liquidity constraint	−0.0925 (0.0079)
Male	0.2377 (0.0050)
Province dummies	Yes
N	51,341

Note: The table shows the estimation results of the wage growth equation (3) and the wage level equation (6) allowing for a quadratic in tenure in the level equation. Robust standard errors in parenthesis.

Table 10: Robustness Analysis: Other concerns

	Panel A: Using a first-job, first-year sample		*Panel B: Reducing the set of exclusion restrictions*		*Panel C: Excluding Sicily*		*Panel D: Controlling for local unempl. rate at start*	
	First diff.	Levels	First diff.	Levels	First diff.	Levels	First diff.	Levels
Liq. constr.	0.0032	−0.0755	0.0175	−0.1240	0.0039	−0.1755	0.0030	−0.0717
	(0.0015)	(0.0138)	(0.0016)	(0.0114)	(0.0015)	(0.0091)	(0.0015)	(0.0082)
N	329,545	17,410	329,545	51,341	315,432	48,217	329,545	51,341

Note: The table shows the estimation results of the wage growth equation (3) and the wage level equation (6) for four different samples or specifications. In Panel A we estimate the level equation for a sample of individuals in their first year in the labor market (i.e., with zero labor market experience). In Panel B we use only the firm bankruptcy dummy as an exclusion restriction in the mobility probit. In Panel C we exclude Sicilian provinces. In Panel D we add to our regression the unemployment rate and its interaction with tenure (with the same timing of the financial market backwardness variable). Robust standard errors in parenthesis.

Table 11: Size of the Credit Flows

	Degree of credit market backwardness:				
	Max (Cosenza)	75^{th} pct (Lecce)	Median (Ragusa)	25^{th} pct (Trento)	Average
Internal rate of return	3.7%	3.7%	1.2%	2.4%	2.9%
Maximum borrowing	11,832	6,729	5,473	5,732	6,747
Implicit borrowing per worker	2,762	1,739	1,290	1,432	1,645
Bank borrowing per worker	8,120	5,783	11,176	16,007	15,321
Borrowing from workers/from banks	0.34	0.30	0.12	0.09	0.11

Note: The table reports the estimates of the internal rate of return and of the dimension of implicit borrowing for different values of the degree of local credi market development. The internal rate of return is the interest rate that equalizes the expected flow of borrowing and lending; Maximum borrowing is the cumulated debt towards a worker of tenure T^*, when it reaches the maximum. Implicit borrowing per worker is the average implicit debt per worker.