CREDIT WITHIN THE FIRM*

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Abstract

We exploit time variation in the degree of development of local credit markets and matched workers-firm data with workers histories to asses the role of the firm as an internal loans market. By tilting the workers wage-tenure profile around their tenure-productivity profile the firm can generate borrowing flows from workers to the firm (when the earnings profile is steeper than the productivity profile) or vice versa from the firm to the workers (when the earnings profile is flatter) thus compensating for the imperfect functioning of the loans market. We find that firms located in less financially developed areas offer wages that are lower at the beginning of tenure and higher at the end than those offered by firms in more financially developed markets, which helps firms finance their operations by raising funds from workers. This effect does not reflect unobserved local factors that systematically affect wage tenure profiles, since we control for local market effects and only exploit variation time variation in the degree of local financial development induced by effects of exogenous liberalization. The credit generated by implicit lending within the firm is economically important and can be as large as 30% of bank lending. Implicit contracts help more those firms that have a problematic access to the loans market and funds come more from workers with a stronger willingness to lend. Consistent with credit market imperfections opening a trade opportunity within the firm we find that the internal rate of return of implicit loans lies between the rate at which workers savings are remunerated and the rate firms pay on their loans from banks.

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1 Introduction

In an economy with 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, for instance because of the intrinsic moral hazard that labor income risk entails. 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-tenure profile relative to its frictionless counterpart, the payment of wages over the life of an employer-employee relation can be front-loaded or back-loaded, thus making funds available to the party - the firm or the worker - that currently needs them the most.

This paper focuses on the role of the firm as an implicit credit market and tests how credit frictions in local credit markets are reflected in the wage contract that firms and workers agree upon. The key idea is that the relative easiness in the access to credit should be reflected in the shape (slope and location) of the wage-tenure profile. If firms have easier access to the loans market than their workers and/or are less in need of cash (e.g., because they are well endowed with collateral, can produce hard information, can - more easily than workers - establish repeated relationships with their lenders), they can lend implicitly to their workers by offering a wage profile that, over the workers' tenure with the firm, is flatter than the profile that the same workers would face in a frictionless world. In this case, thanks to the greater information that the firm has about workers' productivity compared to the market, it is as if the firm were borrowing on behalf of the worker and helping him smooth consumption over time. This is the case examined by Azariadis (1988), who studies a setting where, due to extreme adverse selection, workers are excluded from the loans market while firms have perfect access to it. Since wage promises, as reflected in the wage tenure profile, are not enforceable, what makes it possible for lending within the firm to take place is human capital specificity, which makes workers unlikely 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 too may have limited access to the financial market, as a large literature on firm borrowing constraints suggests (Hubbard 1998, 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 be paying their 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 too makes the contracts self-enforceable is worker-specific human capital, which limits firms' incentives to fire a worker that has lent implicitly to the firm.

To test the role of the firm as an internal credit market and establish in what direction implicit credit flows, we use two sources of data. First, we rely on matched Italian longitudinal firm-employees data. The data report workers' wages and employment histories over a long span of time (1974-1997) allowing to recover tenure and experience profiles. Second, we exploit systematic differences in financial development across local markets and exogenous changes in these differences induced by financial market liberalization during 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. Variation in the latter should then be reflected in the slope and location of the wage profile over the worker's tenure with the firm. In particular, 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 would face in the most developed local credit market at the start of the process of financial market liberalization and in each subsequent year. We then attach each worker-firm relation the degree of backwardness in their local credit market at time tenure with the firms starts and use a two-step estimation strategy to identify the shifts in the slope and intercept of the wage-tenure profile as the degree of financial development varies over time and spatially across local markets. 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 the

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 located in the *median* developed credit market is 36 percent lower than that of a (observationally equivalent) worker matched with a (observationally equivalent) firm located in the *most* developed local credit market. Moreover, we calculate that her wage would grow at a rate that is 0.66 percent faster for each month of tenure. This implies that a typical worker will be lending to the firm for about 55 months (4.5 years) 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 2 and 5 percent, depending on the degree of financial development. Interestingly, these rates sit always between the rate on deposits (an 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.

We argue that the source of variation that identifies the effect of financial frictions on the shape of wage contracts - differences across local markets in the *change* in financial development induced by the liberalization of the 1990s - is arguably exogenous. First, the liberalization process (prompted by the implementation of the II European Banking Directive, mandating free entry in the credit market) is itself exogenous, being an external shock imposed on the Italian credit market. Second, as argued by Guiso, Sapienza & Zingales (2006), the liberalization process affects local markets differentially, not by design but as a consequence of the different degree of financial development that existed in the initial period. Areas with more backward credit markets in 1990 naturally benefit more from financial liberalization than areas that were financially more developed. Consistent with this view, we find convergence in local financial development as liberalization runs its course. Furthermore, the initial disparities in local credit markets are not the reflection of different degrees of economic development but rather the reflection of the heterogenous impact of the 1936 banking regulation on local credit markets (Guiso et al. 2006).

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. In particular, we find that firms with plausibly more onerous access to the loans market offer steeper wage profiles than firms with easier access to loans - conditioning on being located in the same credit markets. This is consistent with the idea that the former needs to rely on implicit borrowing from workers more than the latter. Similarly, we find that workers who have presumably alternative means of consumption smoothing (such as self-insurance through asset accumulation), as measured by education and age at the time they start their tenure with the firm, face a steeper wage tenure profile in response to financial market frictions than younger workers. This is in line with the idea that more educated and older workers are less dependent on borrowing and are thus 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 Lazear (1981) and Azariadis (1975), that firms tied to workers by multiperiod relations can mediate financially when the latter cannot use human capital as collateral and are thus excluded from credit markets. 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 financial frictions shape the wage contracts.[1] More broadly, our paper is part of a literature that studies the interrelations between credit and labor market imperfections (Wasmer & Weil 2004).

The rest 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 estimation results

[1]Brandt & Hosios (1996), in a fascinating empirical contribution that uses data on wage/employers contracts for some villages in 1936 rural China, where presumably financial markets were absent, 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 their paper credit frictions are taken as given and are a realistic component of the environment. In contrast, our main contribution is to establish how wage contracts respond to observed and measured developments in the financial markets that firms and workers face in a modern economy.

and Section 6 uses them to obtain estimates of the size of implicit lending within the firm. Section 7 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, so here we use (1) just 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. Here $T_{ij(p,t_0)t}$ 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 imperfection 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 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, specific human capital investments. In a perfect credit market, individuals with the growing wage 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 limiting credit (in the extreme, denying access to it altogether). Azariadis (1988) and Bernhardt & Timmis (1990) where 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 formal borrowing.

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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 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" shape the wage-tenure profile is an empirical question. The answer depends primarily on the signs of δ and γ. We estimate these two parameters below using variation in access to credit in the location where the employment relationship takes place. The estimation procedure allows us to distinguish between the two hypotheses put forward in this section. Other confounding issues are discussed below.

2.2 Enforcement and Alternative Stories

What makes the contracts discussed above enforceable? Given that they involve implicit promises, they are clearly not legally enforceable. However, as remarked by Azariadis (1988) and Michelacci & Quadrini (2009), specific human capital investments can be enough to make these contracts self-enforceable, i.e., it is in all parties' interest to stick to them. In case I workers have little incentives to quit if they have made firm-specific human capital investments. In case II firms have little incentives to fire the workers if they have made worker-specific investments. In both cases, reputational concerns may also facilitate implicit contracts enforcement if the borrower's behavior is public information, a less obvious condition.

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 reduce shirking and induce workers to exert the desired amount of 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 (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. Here, a few remarks are in order. First, in Lazear's case specific human capital investments are absent, and are in fact not even needed to make the main point. Second, it is true that the firm implicitly borrows from its workers at the beginning of their relationship, but 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. Finally, in introducing liquidity constraints in the model, Lazear assumes that firms are unconstrained. As stressed by Lazear (1981), "if workers have utility functions which are time separable and concave in income, then the optimal [wage] path will remain upward sloping, even if all borrowing is prohibited, but will tend to be somewhat *flatter* than it is when no borrowing constraints are imposed [italics added]." We suspect that assuming that workers are unconstrained while firms are would give the opposite prediction.

While we cannot dismiss the idea that liquidity constrained firms may tilt the wage profile upward for both liquidity and incentive purposes, we find it unlikely that incentive considerations are the only ones that matter. As we shall, we can test whether the extent of liquidity constraints faced by the firm tilts the profile even further. If we find that it does, this provides *prima facie* evidence that borrowing frictions consideration are important.

3 Data

To identify the effect of credit market imperfections on wage contracts, one needs longitudinal data on workers' histories with the firms they have worked for, and local credit markets that differ in efficiency. Italy offers both. Administrative data from the Italian Social Security Administration allow us to obtain information on workers' earnings histories matched with their firms. Secondly, due to a number of "accidents of history" dating back to at least the 1930s, the development of the 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, the credit marker liberalization that has taken place over the 1990s has 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. We illustrate in detail both data sources

below.

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 one of two randomly chosen days of the year (March 1^{th} and October 1^{th}). Data are available on a continuous basis from 1974 to 2002. The INPS, which cover private sector employees (but not self-employment or public employment), derives from employer forms roughly comparable to those collected by the Social Security Administration in the US.[2] Mis-reporting is prosecuted. Besides providing information on workers earnings, the INPS data contain also some demographics. However, as is typical of administrative data, information on demographics is scant and limited to the age, gender, place of birth of the worker, as well as his job positions (blue collar, white collar or manager), which we take as a proxy for education.

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 given worker/firm/year observation. For each record, there is information about which month 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).

Our initial 1990-97 sample is composed of observations with non missing social security code, positive reported earnings, and consistent monthly employment codes. 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

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

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 513,624 records and 97,025 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 loose 35,759 records and 6,130 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 (7,642 records). Our final sample includes 454,627 records corresponding to 74,500 individuals.[3]

Since the INPS data provide us with the employer's tax code, we can match employees with employers data from the Company Accounts Data Service (*Centrale dei Bilanci*, or CB for brevity). The CB data span from 1982 to the most recent years 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, 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 larger firms: CB reporting firms account for approximately half of total employment and 7% of the number of firms in manufacturing. For our purpose perhaps the most important feature of the CB dataset is that it provides a credit score measure of the firm that banks use when screening firms and allocating credit. As we will discuss, 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. Apart from this, our main estimates do not need the merged sample and will thus be based

[3]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 1 uses only 379,785 observations. The wage growth regression uses only 328,656 observations because it conditions on staying with the same firm.

on the non-matched data. Obviously, since our INPS data contains information only on a sample of workers, when we merge them with the CB data we lose observations. The matched 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).

Table 1 reports summary statistics for the sample of workers before matching with firm information (the "Whole sample") and after matching (the "Matched sample"). The two samples are roughly comparable in terms of earnings and demographics (with the exception of location in the South, which is under-represented in the matched sample). Average firm size is slightly smaller in the matched sample, but this is due to a skewness effect. Median firm size in the matched data set is in fact almost five times as large as in the whole sample (145 vs. 32).

Table 2 reports summary statistics for the sample of firms [to be added].

3.2 Variation in Financial Development

To implement our test we need that firms and their workers, though located within the borders of the same country, have differential access to the loans market. Variation of this sort may arise because 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 local markets differ in their degree of development. There is ample evidence that firms, particular small businesses (and thus even more so, single individuals) are tight to their local credit markets. For instance, Petersen & Rajan (2002), show that lending to small businesses is a highly localized activity as proximity between the borrower and the lender facilitates acquisition of information.[4] Segmentation of local credit markets is thus very likely to occur. Due to a number of historical legacies surveyed 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 across regions. AsGuiso, Sapienza & Zingales (2004, 2006) argue, there are at least two factors that explain the different degrees of financial development of Italian local markets. First,

[4]Bofondi & Gobbi (2006) show direct evidence of the informational disadvantage of distant lenders in Italy. They find that banks entering in 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.

different historical legacies and traditions have resulted in different types of banks prevailing in different local markets. For instance, the Austrian influence until WWI, resulted in a relatively stronger expansion of Savings Banks and cooperative banks in the North-Eastern regions of the country, those under the domination of the Austrian Empire from where Savings banks originated. Similarly, two of the major national banks (Banca Commerciale and Credito Italiano) were the result of direct German investments in the most economically advanced regions at the time (Lombardia and Liguria). Second, in response to the 1930-31 banking crisis, in 1936 Italy introduced a new banking law, which imposed rigid limits on the ability of different *types* of credit institutions to open new branches and extend credit. Each type of credit institution was assigned a geographical area of competence based on its presence in 1936 and its ability to grow and lend was restricted to this area. For instance, national banks could open branches only in the main cities; cooperative and local commercial banks could only open branches within the boundaries of the province they operated in 1936; while Savings banks could expand within the boundaries of the region - which comprises several provinces - they operated in 1936. This regulation was maintained virtually unchanged until the late 1980s. Since at the time these regulations were enacted regions differed in the relative importance of the various types of credit institutions, regulation ended up having a differential byte across different local markets: some of them were de facto given more freedom to develop than others.[5]

3.3 The Deregulation Process

This regulatory system was maintained almost unchanged until the late 1980s perpetuating 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 a process of financial liberalization was 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. It is these differential geographical effects of financial liberalization that we will exploit to identify the

[5] As Guiso, Sapienza & Zingales (2004) argue, these differential geographical effects of banking regulation were unintentional and mostly the reflection of different degrees of political connections with the Fascist regime. For example, the Fascist regime favored Savings banks because they distributed a substantial amount of their net income to political organizations created by the Fascists, such as the Youth Fascist Organization (Opera Balilla) and the Women Fascist Organization (OMNI). A second reason was the belief that the 1930-33 disastrous banking crisis was mainly due to the insolvency of major national banks, which created in the legislator a natural bias against large banks.

effect of credit market imperfections on wage contracts. Before illustrating how we measure them, it is useful to illustrate the liberalization process.

What triggered change was the process of European integration and in particular the prospect of the application of the II European Banking directive, mandating free entry, scheduled to be introduced in 1992. In anticipation of this change entry was entirely liberalized in 1990. In 1993 a new banking law (incorporating the Banking European Directive) was approved. The separation between short and long-term lending (a feature of the 1936 regulation) was removed and all banks were allowed to underwrite security offerings and own equity. The same year the legal structure of Savings banks was changed. From mutual organizations, they were transformed into standard corporations, facilitating acquisitions and mergers. Finally, in 1994 the Government started to privatize all the major State-owned banks. This process has resulted into a massive increase in entry into local markets with a significant increase in competition (Angelini & Cetorelli 2003) which has resulted in a rapid increase in credit availability and a decrease in the cost of funds (Casolaro et. al. (2006)). At the same time and partly as a consequence of the lifting of limits to competitions, there has been a significant process of banking consolidation which, at least locally, sometimes may have resulted in an increase of banking market power, higher interest rates spreads and lower credit availability to small businesses (Sapienza 2002, Focarelli & Panetta 2003) which may have slowed down the effects of credit market liberalization.

3.4 Measuring Financial Development

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.

To obtain this measure at the local level we rely on the methodology set forth by Guiso et al. (2004, 2006). The central idea is to exploit geographic variation in access to the credit market or in its cost to estimate the easiness that, otherwise equal firms or workers, can obtain lending in two different local markets. Here we follow Guiso et al. (2006) and use variation across firms in the cost at which they can borrow to obtain a measure of the efficiency of the local credit market.[6] In particular, we merge the CB data with data from

[6]GuSaZi04a rely instead on information on households that where turned down by a bank to obtain a measure of financial development across Italian regions, which are larger geographical unites than the province. In spite of the difference in the left-hand side variable, they find that the two measures of financial

the Credit Register that we have access to[7], to obtain for each firm in the CB sample and for all the years from 1990 to 1997 information on the interest rate on credit lines charged by each bank that lends to the firm. We than 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, charge larger mark ups, are less financially developed. More formally, let s_{jbpt} denote the the interest rate spread paid by firm j to bank b, in market p in year t , F_{jpt} a vector of firm controls and B_{bpt} a vector of bank controls. We run the regression

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

where f_{pt} is a vector of province fixed effects that vary over time as a consequence of the process of financial liberalization that has taken place over the 1990s. We than estimate equation (2) for each year between 1990 and 1997, and retrieve the fixed effect f_{pt} for each one of the 95 provinces in which the country is divided. We than take f_{pt} as our indicator of financial backwardness. The implicit assumption is that the province is a proper proxy for the relevant local market where the firm (workers) can borrow. There are three reasons why this is so. First, this was the definition of local market that the Bank of Italy used until 1990, when entry in credit markets was still regulated, to decide whether to authorize the opening of new branches. Second, according to the Italian Antitrust authority the "relevant market" in banking for antitrust purposes is the province. Third, the idea that banking markets are defined by close geographical boundaries, such as the province, is very much consistent with distance being an important barrier to lending as reflected in the practitioners' view. As the president of the Italian Association of Bankers (ABI) declared in a conference, the Italian banker's rule of thumb is to never lend to a client located more than three miles from his office, that is typically within the boundaries of a province.

To make sure that these province fixed effects do not reflect borrowers' differences in riskiness or differences across banks in the cost of making loans, we insert a number of firms and bank controls. As measures of firms quality we insert the firm return on sales, its leverage (as a proxy for financial fragility), its size (measured by log assets) which captures the fact that smaller firms are more likely to fail, and the firm propensity score. For our

development are highly correlated, that is, in local markets where, ceteris paribus, it is more likely to be turned down when applying for loans, the cost of a loan is higher when granted.

[7]Details on the matched CB Credit Register dataset can be found in Panetta, Schivardi & Shum (2009).

purposes of controlling for firm riskiness, the latter is a particularly important variable which will also be used later. Firm score is directly computed by the CB in order to obtain a synthetic indicator of the firm probability of default. The important point is that this score is than used by the banks that belong to the CB consortium to decide whether to grant a loan and to price it. Thus, it is likely to capture most of the "hard" information on which banks condition when assessing firms' risk. Soft information is also probably relied upon but is not observed by us.

Besides controlling for these firm characteristics we also include several bank controls: 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. These variables may affect the loan rate as they capture differences across banks that are not picked up by the average deposit rate in a province. For example, state-ownership of banks affect the lending rate, as state owned bank subsidize loans Similarly, bank profitability and non-performing loans affect the bank's cost of raising funds. Since the same firm often borrows from multiple banks (see Detragiache et. al. 2000), as an alternative to these bank controls we insert a full set of bank dummies obtaining however, very similar results.

Finally for each year in our sample we redefine our indicator of financial backwardness by transforming the measure of market power in the provincial local market as $L_{pt} = f_{pt} - \min(f_{pt})$ so that the most developed (that is the most competitive local market) is standardized to zero and the units of the measure of financial backwardness are deviations of the interest rate spread from the province where it is smallest.[8]

Table 3 shows for each province in the sample 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.[9] This is more

[8]Notice that computing $f_{pt} - \min(f_{pt})$ for each year is effectively a way of detrending the data.

[9]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 regulation that prevailed in Sicily since the post war period, where 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 percent 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 an economic catching up but is consistent with the less stringent regulatory regime. At any rate,

clearly visible in Figure **??**, which reports the map of our average measure by province. While a North-South divide is a clear feature of the data, there is considerable variation in the degree of financial development within the Center-North and the South.

At the beginning of sample, 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 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 be using only 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 this 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 by 40 basis points. 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 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, constructed by Guiso et al. (2004). The IV regressions confirm the OLS estimates, showing convergence after liberalization.

excluding Sicily from our sample does not change the results.

4 Identification

To account for province effects both in the level of wage rates and in the returns to tenure we expand (1) and rewrite it as:

$$\ln w_{ij(p,t_0)t} = (\rho + \lambda_1) + X'_{ij(p,t_0)t}\alpha + Z'_i\phi + \sum_{s=2}^{T} (\lambda_s - \lambda_1) D_{is}^{(t)} \quad (3)$$

$$+\mu E_{it} + \beta T_{ij(p,t_0)t} + \delta L_{j(p,t_0)} + \gamma T_{ij(p,t_0)t} \times L_{j(p,t_0)} + \quad (4)$$

$$\eta T_{ij(p,t_0)t} \times h_p + h_p + \varepsilon_{ij(p,t_0)t} \quad (5)$$

where h_p is a vector of provincial dummies that capture differences in mean wages across local markets and differences in the return to tenure when intercated with $T_{ij(p,t_0)t}$.In particular, this formulation implies that any effect that differences in the average level of financial constraints have on the slope and the level of the wage contract are captured by these two variables. Suppose that the structure of the error term in (1) is as follows:

$$\varepsilon_{ij(t_0)t} = a_i + b_{ij(t_0)} + c_{it} \quad (6)$$

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 variables are likely correlated with the error term. For example, more able people (people with high realizations of a_i) may have stronger labor market attachment and hence longer overall labor market experience. Moreover, more experienced people 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 highly able 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 (1) will give biased and inconsistent estimates.

Our identification strategy is very similar to that originally proposed by Topel (1994). 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:

$$\Delta \ln w_{ij(p,t_0)t} = (\mu + \beta) + \Delta X'_{ij(p,t_0)t}\alpha + \sum_{s=2}^{T} (\lambda_j - \lambda_1) \left(D_{is}^{(t)} - D_{is}^{(t-1)} \right) + \gamma L_{j(p,t_0)} + \eta h_p + \Delta c_{it} \tag{7}$$

The advantage of this specification is that the sources of endogeneity (tenure and experience) have been removed. If Δc_{it} is independent of M_{it} (conditional on the observables), then an OLS regression is all is needed to consistently estimate the parameters of (7), 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 an exclusion restriction for identification. Our exclusion restriction is whether the current job is one found following exogenous displacement due to firm closure. The idea is the following. Those who are displaced must start searching for a new job "fishing" 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 "fished" from the conditional distribution. Hence, the probability of being a mover out of the current job must be higher for the displaced workers than for the others.

Note that in order to consistently estimate γ 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, what this assumption requires is 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.

Identification of γ is all coming from variation in $L_{j(p,t_0)}$ over time and the fact that over the sample workers start tenures 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 and both face financial constraints $L_{j(p,t_0)}$ and that of an otherwise equal worker who starts tenure with the same firm but at time t_1 when both face financial constraints $L_{j(p,t_1)} \neq L_{j(p,t_0)}$. [10]

[10]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 however consistent with our observation (see Section 3.2) that the structure of local banking market

To obtain an estimate of the other parameter of interest - δ, the intercept of the wage-tenure relation which turns out to be key for measuring the extent of borrowing that goes on within the firm - we use the estimates of γ and $(\mu + \beta)$ from (7) to construct the residual for individuals in their first job in the labor market: in this case, $E_{it} = T_{ij(p,t_0)t}$. We have:

$$\begin{aligned} e_{ij(p,t_0)t} &= \ln w_{ij(p,t_0)t} - X'_{ij(p,t_0)t}\alpha - \sum_{s=2}^{T} (\lambda_j - \lambda_1) D_{is}^{(t)} - \left(\widehat{\mu} + \widehat{\beta}\right) E_{it} - \widehat{\gamma} E_{it} \times L_{j(p,t_0)} \\ &= (\rho + \lambda_1) + Z'_i\phi + \delta L_{j(p,t_0)} + \eta h_p + \varepsilon_{ij(p,t_0)t} \end{aligned} \tag{8}$$

If $E\left(\varepsilon_{ij(t_0)t} | L_{j(t_0)}\right) = 0$, this regression can be estimated by OLS. However, one might worry about the endogeneity of $L_{j(p,t_0)}$.

5 Results

Table 5, panel A shows the results of the estimates of the parameters in the first difference wage regression on the sample of stayers, that is of equation (7). 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, in so far as financial development also spurs, as it should, average productivity, it could also capture differences in the latter on wage growth. This is not the case when using time differences across provinces in the bite of financial frictions as the source of the time 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.

has been frozen by the 1936 legislation, with little entry and expansion until the 1990s, with possibly the exception of Sicily.

The first column 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 areas with more backward financial markets firms and workers settle on steeper wage profiles over the job tenure. Ceteris paribus, this implies that in areas where 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 (second column) using the probit estimates shown in Panel B to compute the inverse Mills ratio results in a much smaller coefficient of the liquidity constraints indicator which however remains highly statistically significant (p-value less than 0.01). The economic effect is also far from being negligible: using this later estimate implies that moving a firm and his workers from the most to the least financially developed provincial market (using the 1997 estimates of L) would, ceteris paribus, result in the firm offering a wage-tenure profile characterized by about 1.32% higher monthly wage growth.

Hence, constraints in access to the financial market are partly compensated by firms and workers mutually agreeing to reshape compensation contracts so as to let funds flow to the agent that values their availability the most, in this case the firm.

To fully characterize the effect of financial market imperfections on the shape of the wage contract we also need to identify not only the effect on the slope but also its effect on the location (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 not only a higher slope coefficient and also a lower intercept. Table 6 shows the results of the estimates of equation (8); the first column uses the residuals using the estimates in the first column of Table 5 panel A and the second the selection adjusted estimates. Consistent with the previous finding that financial backwardness makes the wage profile steeper we find a negative and highly statistically significant effect on the intercept of the wage profile (the parameter δ in equation (8)). Its estimated value implies that at the beginning of tenure a worker matched with a firm located in the median financially developed province (as of 1990) receives a wage that is about 36% lower than that obtained by an otherwise equal worker matched with a firm in the most financially developed province. 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 among others

by 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. Using (**??**) this value (which later we will denote T^*) is equal to δ/γ, i.e., about a tenure of 55 months using our estimates in Tables 5 and 6, second column. Hence, during the first 4.5 years of tenure the worker is typically lending to the firm before starting being repaid back.

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 modulating the shape of compensation schemes to allow for intertemporal exchanges which are self-enforced thanks to human capital specificity.

While we have argued that the variation in access to external markets we rely upon stems from exogenous shocks, a skeptical reader may still 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 borrowing and lending within the firm. To wit, suppose that wage-tenure profiles vary systematically across areas because borrowing restrictions change the incentives to invest in human capital, 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. Realistically, if either workers or firms have a more difficult access to the loans market they will invest less in general and will also invest less in firm specific human capital. Hence, workers pay profiles should be flatter, not steeper, in less developed financial markets as less investment in specific human capital raises productivity and compensation today and depresses them in the future Azariadis (1988, p.517). Thus, in so far as variation over time in access to the loans market has also 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 to address this issue and at the same time put to a farther test our causal interpretation is to exploit compensation-relevant heterogeneity in workers and firms in their sensitivities to borrowing frictions. If a particular group of firms (workers) that we can identify is highly sensible to borrowing frictions - for instance because is highly dependent on outside finance or has no other source of external funds than bank borrowing - we should expect, ceteris paribus, the wage contract to be particularly steep (flat) for the workers (firms) in this group. 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 strengthen/weaken 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 three sources of heterogeneity.

Firm creditworthiness. Firms in the same location with easier access to their local credit market should be less in need of raising funds from their workers and thus be more willing to accommodate workers borrowing demands. Hence, we should expect that firms with better access to their credit market offer flatter wage profiles. We measure firms easiness in obtaining external funds with the firm credit score. 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), use of these variables was dictated more by lack of better alternatives rather than by their intrinsic merit. In fact, both these measures are likely to be poor indicators of creditworthiness as they pick up also may other features that are correlated with firm size and age and may also affect wage setting independently. This is particularly important in our context, as 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 to address this issue. This variable is directly available to the banks that belong to the CB consortium and they condition credit extension to a firm on its value. Hence, the score provides a measure of the creditworthiness of any firm on the same metric, whatever the age or size of the firm. Consistent with credit scoring measuring differences in firms creditworthiness, we find that, ceteris paribus, high-score

firms pay lower interest rates, as discussed in Section 3.4. Of course, since banks also rely on "soft information" (private information not easily transferable to third parties, such as the loan officer personal knowledge of the firm) when extending credit, the credit score is only a noisy indicator of the true firm creditworthiness, which may give rise to attenuation bias.

Finally, it is interesting to stress that under the skeptical view that financial frictions affect wage profiles because they affect directly the workers productivity profile, firms with bad scores should invest less in human capital and thus offer flatter profiles than good score firms; this is the opposite prediction of what we should find if our results reflect the firm counteracting credit market frictions by distorting wage profiles relatively to tenure-productivity profiles.

Worker differential access to the loans market. Following a similar logic we expect that workers that have a harder time in borrowing in the local 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 have thus to rely on a coarser indicator. We proxy it with a worker job type using the distinction between blue collars, white collars and managers and assume that access to the loans market is more problematic for blue collars than it is for white collars and managers. This assumption is backed 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 which shows that blue collars are significantly more likely to be denied credit than white collars and manager[11] Even so, we feel less comfortable in relying on this indicator than when using the firm score. Job qualification, in fact, may capture other variables that may give rise to heterogeneous reactions to financial market frictions. For instance, it may reflect differences in specific human capital, though it is unclear whether blue collars bear more specificity than white collars and managers. On the other hand, even if job qualification correctly reflects heterogeneity in access to the local market, it may affect the profile because it affects workers investment in specific human capital. In this case blue collars would have

[11]The Bank of Italy Survey of Households Income and Wealth, run biannually on a representative sample of 8,000 Italian households contains information on whether a loan application was accepted or turned down. We have pooled xx years of data and run probit regressions for whether an applications was turned down controlling for demographics, measures of workers endowment, geographic and time dummies and occupational dummies.

a flatter profile not because they are less willing to the lend to the firm, but because being able to borrow less in the market they are constrained in the amount of human capital investment they can undertake. Hence this type of heterogeneity would not be helpful in addressing the skeptical criticism.

Workers residual horizon. Workers with different horizons with the firm may have different incentives to enter into implicit intertemporal exchanges. Namely, workers who start with a firm but anticipate retirement very soon may be less willing to lend to the firm than workers with many years ahead before retirement. In fact, for close-to-retirement workers it may be difficult to obtain repayment of what has been lent to the firm at the beginning of tenure and thus prefer flatter profiles (smaller γ and larger δ) Alternatively, since borrowing needs vary over the life cycles and are stronger for the less experienced, younger workers with longer horizons these workers could be less willing to lend and thus obtain flatter profiles, a force that counteracts the horizon-length effect.To capture these incentives we construct two indicators; the first is the number of years of experience, the second the residual working horizon. Under our interpretation we expect that workers with longer residual working horizons have steeper profiles (more negative γ) and workers with longer experiences have flatter profiles (less negative γ) if the life cycle motive prevails over the of being unable to recoup the loan.

Table 7 shows the results of the estimates when these interaction effects are added to the estimates of the wage equation in first differences, i.e. equation (7). In each case we re-estimate (7) by adding an extra interaction term between the indicator of local financial frictions and the relevant measure of firm or worker heterogeneity, controlling for any direct effects that this heterogeneity may have on the wage setting. The first column shows the results when we interact financial development with firm credit score. We divide the latter into three categories identified by three dummies: bad, medium and high score (the excluded group). 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 high score firms in the same local market. This implies that they raise more funds from low-tenure workers in response to the imperfect working of their local credit market than high score firms. Quantitatively, a bad score firm would respond to a deterioration in the local credit market conditions by adjusting the steepness of the wage profile offered to its workers 1.2 times as strongly as an average score firm and 7.7 times

as a good score firms which would offer much flatter wage contracts. This result speaks in support of the firm-as-a credit market model and against the idea that our findings reflect effects of credit frictions on human capital accumulations.

The second column of Table 7 shows the results when the indicator of local credit market frictions is interacted with the blue collar and white collar dummies, as proxies of workers creditworthiness. Consistent with this interpretation we find that in response to financial friction firms offer less steep profiles to blue collars (deemed to face more difficult access to the local credit market) than to white collars, and the latter in turn obtain less steep compensation profiles of firms managers (deemed to rank high in terns of creditworthiness). For the three types of workers, the estimates of γ are 0.0006, 0.0037 and 0.0096 respectively, showing substantial differences in the way the firm designs the terms of the contract so as to obtain more funds from those workers who have a higher propensity to lend.

The third and fourth columns show results when we interact the financial frictions indicator with workers experience and residual horizon with the firm, respectively. We find that in both cases, workers with shorter horizons, either because they have longer experiences or because they are left with few years of work ahead, face steeper profiles than workers with longer horizons. [Gino: I think we should add also an interaction with age in these regressions; need to discuss this].

7 How large are credit flows?

In this section we assess the size of the credit flows within the firm. 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 $T < T^*$ (the tenure at which the worker begins being repaid his loan) compared to being located in the most developed local financial market. To construct a representative measure of credit flows, we pool observations over all available years to estimate the tenure distribution and average wages at each tenure within each province. In what follows, therefore, we drop the time and individual subscript.[12]

From equation (1), given tenure T and wage w_{jT}, in the most financially developed

[12]In fact, for many provinces we do not have enough observations to construct time-varying measures of average wage by tenure and of the tenure distribution. Financial development must be measured at 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: $L_{jT} = \sum_t \frac{n_{jtT}}{n_{jT}} L_{j(t0)t}$ where n_{jtT} is the number of workers with tenure T in year t and $n_{jT} = \sum_t n_{jtT}$ is the total number of workers with tenure T over the years.

region the firm would be paying the wage $e^{-(\delta+\gamma T_j)L_{jT}}w_{jT}$ so that borrowing from a worker with tenure T is:

$$B_{jT} = \left(e^{-(\delta+\gamma T_j)L_{jT}} - 1\right) w_{jT}$$

By construction, B_{jT} is positive as long as $T < T^*$. It represents savings on wage payments due to the different tenure profile compared to the province with the most developed financial market. To compute the total stock of debt towards a worker with tenure T, note that such worker has been lending to the firm B_{j0} in her first month with the firm, B_{j1} in the second and so on. The cumulative borrowing from such worker is therefore:[13]

$$CB_{jT} = \sum_{t=0}^{T} B_{jt}.$$

CB reaches a maximum at $T^* - 1$, after which the firm starts repaying the worker and B_{jT} turns negative. The maximum stock of debt that a firm can accumulate form a worker is therefore $MB_j = \sum_{T<T^*} B_{jT}$.

To obtain a measure of total gross borrowing, consider a hypothetical firm with a tenure distribution identical to that in its province and normalize the total labor force of such firm to one. We define average borrowing as:

$$AB_j = \sum_{T<T^*} \omega_{jT} \left(e^{-(\delta+\gamma T L_{jT})} - 1\right) w_{jT}$$

where ω_{jT} is the share of workers in province j with tenure T. AB measures flow borrowing from the "average" worker. To obtain a measure of the stock of borrowing, recall that the firm's borrowing from a worker with tenure T is CB_{jT}. The total stock of debt for the hypothetical firm with one "representative" worker is therefore:

$$TB_j = \sum_{T<T^*} \omega_{jT} CB_{jT}.$$

To obtain a comparable benchmark, we compute bank debt BD per employee. Given that TB is computed for a hypothetical firm with one (representative) worker, BD and TB are directly comparable. We obtain information on bank borrowing from the the CADS data

[13] Given that we do not have a measure of the interest rate, we compute flows without capitalizing them. This implies that the numbers we obtain are lower bounds of the amount of lending from the workers to the firms. We compute the implied rate of interest on credit flows below.

service.[14] 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 8 we report the results for the various statistics, focussing on 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 also report the cross-provinces average. For Cosenza, AB is almost 200 euros, approximately 28% of the average wage in the province. Borrowing from the worker reaches a maximum of almost 11,000 euros at tenure 54 months. CB is 2,676 euros, meaning that on average a firm has almost 3,000 euros of debt per employee. Given that average bank borrowing per employee is around 8,000 euros, this means that borrowing from workers is 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 the within firm borrowing flows and stocks decreases with financial development. For example, in Trento, at the 25^{th} percentile of the financial backwardness distribution, CB is 1,371 euros, less than 10% of loans from banks. The cross province average of CB is 1,604, around 10% of bank loans.

All the statistics computed so far only consider gross borrowing, that is lending from workers to firms over the tenure $T < T^*$. This does not consider "repayments" from the firm to the worker, which occur when tenure T^* is passed. If we impose the condition that flows to and from the firm are actuarially equal, we can compute the internal rate of return (IRR), that is the interest rate that makes the flow of borrowing and repayments implicit in the tenure profiles equal to zero in net present value. Formally, the IRR is the unique value such that:

$$\sum_T \frac{p_T}{(1+IRR)^T}\left(e^{-(\delta+\gamma TL_{jT}}-1\right)w_{jT}=0$$

where p_T is the survival probability, that is the probability that a worker is still attached to the firm at tenure T. This expression represents the NPV of the expected flows to and from the firm.[15] We find that the average IRR is 3.1%; but it varies across provinces: it is 3.7% in Cosenza, 4.9% in Lecce and 2.4% in Ragusa and Trento. Ideally, IRR should be

[14]The CADS 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 BD and TB is biased towards finding a more important role for BD.

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

above the interest rates that workers can obtain on their savings and below the interest rate that firms pay on bank loans.[16] In fact, in the 1990-97 period, the cross-country average real interest rate on loan was 10.1% and on deposit 0.6%; in Cosenza, they were 10.6% and -0.2%, in Trento 9.9% and 0.92%. Our values are exactly within these ranges: both workers and firms benefit from transacting. An IRR of 3-4% indicates that the surplus is split but the firms appropriate a slightly higher share.

8 Conclusions

I8t has long been theoretically recognized that the relations that are established within the firm between workers on the one hand and capitalists on the other can go a long way in tempering the effects of credit market and insurance market frictions - and even provide a basis for the existence of the firm (Bovenberg & Teulings 2002). Despite this, very little progress has been made in pinning down empirically the importance of the firm as an insurance provider and as a credit market. Our previous work (Guiso, Pistaferri & Schivardi 2005) shows evidence on the latitude of the firm as an insurance market; this paper shows how much credit can take place within the firm and establishes that, at least in the context of the Italian market, there is substantial lending flowing from workers to firms, with the size of the loans proportional to the degree of the credit market friction. This evidence is consistent with the assumption that the employment relation allows to overcome some of the frictions affecting credit markets.

While we have focused on lending between the firm and its workers, intertemporal exchanges within the firms are probably more general. Firms can act as an internal financial market not only by favoring exchanges across time and states between workers and capitalists but also among workers. In fact, the same repeated relation that facilitates financial exchanges between the firm and its workers, can promote borrowing and lending among workers with heterogeneous consumption needs. We leave the study of this issue for future research.

[16] 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 therefore underestimate the shadow value of credit for a firm.

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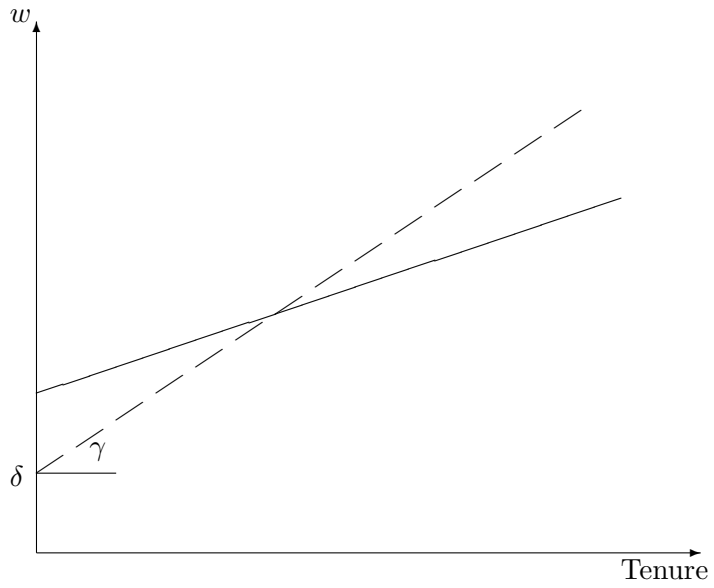
Figure 1: Wage-tenure profile: worker lending to the firm



ftbpF3.6824in4.2229in0inCredit Market Backwardness by ProvinceCMB$_m apFigure$

Figure 2: Wage-tenure profile: firm lending to the worker

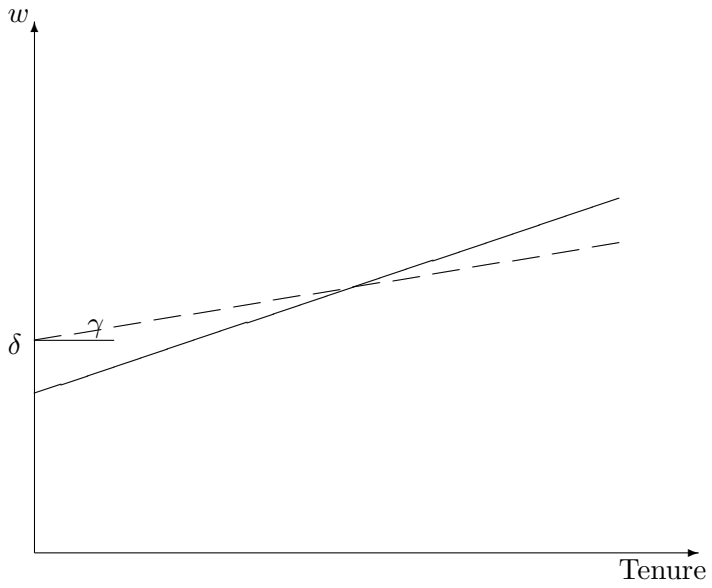


Table 1: Worker Characteristics

	Mean		Stand. dev.	
	Whole sample	Matched sample	Whole sample	Matched sample
Monthly earnings (euro)	1486	1665	1055	1026
Age	37	38	11	10
Male	0.65	0.72	0.48	0.45
Productions	0.60	0.14	0.49	0.49
Clericals	0.39	0.38	0.49	0.49
South	0.22	0.14	0.41	0.34
North	0.58	0.69	0.49	0.46
Experience (in months)	116	137	81	81
Tenure (in months)	65	78	71	75
Mover	0.11	0.09	0.32	0.29
Firm size	2508	1654	12207	8589

Table 2: Firm Characteristics

Table 3: Local Financial Market Backwardness

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

Table 4: The Convergence Process

Dependent variable: $L_{p,1997} - L_{p,1990}$	(1)	(2)
$L_{p,1990}$	−0.4633	−0.4081
	(0.0763)	(0.2078)
Constant	0.7358	0.6439
	(0.1412)	(0.3512)
N	95	95

Table 5: Wage growth

Panel A:
Wage growth equation, sample of firm stayers

	(1)	(2)
Liquidity constraint	0.0129	0.0033
	(0.0013)	(0.0013)
ΔWhite Collar	0.0102	0.0070
	(0.0029)	(0.0029)
ΔManager	0.0581	0.0587
	(0.0092)	(0.0092)
ΔYear dummies	Yes	Yes
Province dummies	Yes	Yes
Inverse Mills ratio		0.1438
		(0.0038)
Constant	−0.0004	−0.0166
	(0.0099)	(0.0099)
N	328,655	328,656

Panel B:
Probit equation for worker mobility

Tenure	−0.0024
	(0.0013)
Labor market experience	−0.0019
	(0.0000)
Liquidity constraint	0.0662
	(0.0094)
Liquidity constraint×Tenure	0.0003
	(0.0002)
White Collar	−0.1054
	(0.0059)
Manager	−0.0295
	(0.0262)
Male	0.0604
	(0.0060)
Year dummies	Yes
Province dummies	Yes
Province dummies×Tenure	Yes
N	379,785

Table 6: Wage levels (First job sample)

	(1)	(2)
Liquidity constraint	−0.1421	−0.1813
	(0.0090)	(0.0092)
Male	0.2309	0.2458
	(0.0058)	(0.0061)
Province dummies	Yes	Yes
N	51,343	51,343

Table 7: The effect of firm and worker characteristics

	(1)	(2)	(3)	(4)
Liq. constr.	0.0011	0.0096	0.0046	0.0086
	(0.0028)	(0.0050)	(0.0015)	(0.0017)
Bad score	−0.0144			
	(0.0049)			
Intermediate score	−0.0074			
	(0.0039)			
Liq. constr.×Bad score	0.0085			
	(0.0027)			
Liq. constr.×Medium score	0.0059			
	(0.0021)			
Blue collar		−0.0255		
		(0.0093)		
White collar		−0.0106		
		(0.0094)		
Liq. constr.×Blue collar		−0.0090		
		(0.0049)		
Liq. constr.×White collar		−0.0059		
		(0.0049)		
$\frac{Worker's\ experience}{100}$			−0.0151	
			(0.0015)	
Liq. constr.×$\frac{Worker's\ experience}{100}$			0.0016	
			(0.0006)	
$\frac{Worker's\ residual\ work\ horizon}{100}$				0.0128
				(0.0010)
Liq. constr.×$\frac{Worker's\ residual\ work\ horizon}{100}$				−0.0015
				(0.0005)
N	82,415	328,655	328,655	328,655

Table 8: Credit Flows

		AB	MB	CB	BB	CB/BB	IRR
Most backward	(Cosenza)	194.7	10928	2676	8120	0.33	3.7%
$75^{th} pct$	(Lecce)	120.6	6210	1670	5783	0.29	4.9%
Median	(Ragusa)	89.5	5047	1239	11176	0.11	2.4%
$25^{th} pct$	(Trento)	91.3	5286	1371	16007	0.09	2.4%
Average		100	6224	1604	15321	0.10	3.1%

Note: AB average borrowing, MB is maximum borrowing, CB is cumulative borrowing, BB is bank borrowing, IRR is the internal rate of return, that is, the interest rate that equalizes the expected flow of borrowing and lending.