Financial Market Imperfections and Investment in Human Capital: Implications for Firm Size Distribution and Market Structure

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Abstract

This paper analyzes a differentiated product market model, in which the accumulation of human capital through on-the-job training is the sole engine of productivity growth. With training costly and some firms financially constrained by the amount of physical assets accumulated and the extent of their nepotism potential, investment in workers' training is inversely related to the tightness of the constraint. The equilibrium observed is one in which constrained firms have a less educated workforce and are smaller. Also, for the same physical capital intensity, tighter credit constraints for the entrants in a human capital intensive industry result in a higher degree of industry concentration and a firm size distribution less skewed to the right. Using data from the Business Environment and Enterprise Performance Survey by the EBRD and the World Bank, it is shown that the key dynamic relations between financial constraints, on-the-job training, firm size and industry structure are fully supported by the empirical evidence.

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1. INTRODUCTION

The fact that large firms have a better trained workforce is a well-known empirical regularity. Barron, Black and Leowenstein (1987), Holtman and Idson (1991) and Frazis, Herz and Horrigan (1995), using a variety of data sources, all find that larger firms provide more training than their smaller counterparts. The most popular explanation is the existence of internal labor markets in larger firms, as argued by Idson (1993), who shows that larger firms provide their employees with greater opportunitites for intra-firm job mobility. However, Baldwyn, Gray and Johnson (1995) find that when controlling for technology, the relationship between firm size and training becomes negative, implying that there are important underlying factors besides the size of the firm, which determine the level of human capital accumulation inside the firm.

As far as the relationship between the industry structure and human capital is concerned, there are conflicting theories. Tse (2000) argues that as monopoly restricts the job mobility of workers, it decreases their incentives to pay for human capital. Thus, Tse expects to find lower levels of human capital accumulation in less competitive markets. However, a simple and powerful consequence of standard human capital theory in Becker's seminal work (1964) is that the return to investment in workers' human capital is higher the larger the firm's scope of operation is, and so a monopolist will be expected to invest more in on-the-job training than a competitive firm of a similar size.

In this paper, I offer an alternative explanation for the observed variations in training by firm size, and extend its implications for the equailibrium market structure in a human-capital intensive industry. Specifically, I argue is that in a dynamic setup, where workers' human capital is the only engine of productivity growth, and the cost of training is high enough, then financial market factors in the initial stages of the firm's life can cause underinvestment by small and politically less connected firms, and result in their higher shakeout rates, and hence in a more concentrated industry.

In general, the view that emerges from the financial literature is that smaller firms in competitive markets face higher financial contraints, either in the form of higher cost of funds, or in the form of lower availability of credit. In spite of these empirical regularities, the role played by financial market imperfections in generating the human capital/firm size relation and the human capital/industry structure relation has not been studied in the theoretical literature.

I first develop a simple two-period model in which firm size is given and firms invest in the human capital of their workers, which raises both the firm's and the worker's productivity. I show that in this simple set-up, credit constraints are sufficient to generate variations in human capital by firm size. I next assume that investment in human capital raises the good's quality and thus consumers' utility, and allow for entry and exit, with entering firms drawing a project capacity before entering, and credit constraints inversely related to physical assets and project capacity. As firms operate on a sub-optimal scale, until they become unconstrained, and as the firm's producticity determines its ability to accumulate assets, in equilibrium firms with less trained employees will be smaller and will have a shorter life. Therefore, the model generates a positive relation between investment in human capital and firm size and a negative relation between investment in human capital and the extent of industry competition.

I use data from 5704 firms from 24 countries in Eastern and Central Europe and Central Asia, taken from the 2002 Business Environment and Enterprise Performance Survey (BEESP) by the World Bank to evaluate some of the predictions of the model. I test whether access to external finance is correlated with firm size, investment in workers' human capital, and the industry concentration. I find that firms which report tighter access to external finance are smaller, operate in a more competitive environment and have a lower probability of running a formal on-the-job training program. The same results hold for the human capital intensive industries when instead of self-reported access to external finance I use a measure of private credit over GDP, taken from Djankov, McLiesh and Shleifer (2005), and and index of bank sector freedom, taken from the World Bank's Development database. Finally, I find that industries which have a higher level of external financial dependance given their human capital instensity, are more concentrated in countries with lower level of financial development.[2] These results imply that where firm created human capital is the most important determinant of productivity growth and is costly, access to finance at the firm, industry or country level is a major determinant of firm size and industry concentration. This is exactly what our model predicts.

It is important to emphasize the distinction between human and physical capital made throughout the paper. While human capital is assumed to be the engine of productivity growth, and thus a variable of choice at the firm level, physical capital is assumed to be a mere necessity for the firm in terms of providing a collateral, and thus it doesn't enter the production function. Consequently, in the empirical analysis the interaction between financial development and human capital is examined at the firm level, while physical assets are used as a control for the industry capital intensity and capital/labor ratio. This is done for three reasons. First, investment in human capital is tied to the dissemination of knowledge in the economy, and so we believe that it is has important growth and welfare implications. Second, the modern era has seen exogenous increase in the return to human capital through decreased mortality and the advance of general education, which have been arguably larger than the increase in the return to physical capital. As I show, if the return to investment increases without accompanying financial development, unconstrained firms force in time constrained ones out of the market by outinvesting them in quality, and so the firm size distribution in time becomes less skewed to the right. Finally, the BEESP dataset used in this study has extensive information on firm-level training, but no information whatsoever on firm-level physical capital.

The paper proceeds as follows. Section 2 present s a review of the main theoretical and empirical studies of the relationship between financial market imperfections, cost

[2]For this purpose, I use an industry measure of external financial dependence, constructed in the spirit of Kumar, Rajan and Zingales (2002),

of training, investment in human capital, firm size and industry structure. Section 3 describes the theoretical model and derives the basic relation between firm size and investment in human capital in a constrained regime. Section 4 performs a simulation in the broad spirit of Ericsson and Pakes (1992) in order to show that in a dynamic setup with entry and exit, price setting and product quality dependent on investment in human capital, constrained firms on average train less, are smaller, and live shorter. Appendices 1 and 2 contain the proofs of the paper's propositions, and Appendix 3 presents the results from the empirical analysis.

2. EXISTING THEORIES AND EMPIRICAL REGULARITIES

The theory suggested in this paper argues that access to financial constrained is instrumental in determining equilibrium firm size and market structure through the channel of costly investment in human capital, and thus it borders on three different bodies of theories: the determination of investment in human capital, the determination of firm size, and the effects of financial constraints. At the same time, it utilizes a set of empirical facts and regularities, which have led to sometimes ambiguous intepretations in previous empirical reserach. Below I summarize those regularities and the theories which have tried to explain them.

2.1. Economic facts and regularities

1. The cost of investment in human capital is substantial. There is plentiful evidence that the cost of investment in human capital to employers is indeed not trivial, even when general training is examined. Von Bardelelben et al. (1995) put the gross annual costs of training in a German apprenticeship program at DM 30,000 (about \$21,000). Ryan (1980) and Jones (1986) report numbers of similar magnitude for the US and UK respectively. And Dockery et al. (1997) calculate an average annual cost of training of \$22,000 over a four-year period for a sample of 59 employers in a variety of trades in Australia. It is necesary to emphasize, however, that the cost of training born by employers is not merely monetary. The OECD Employment Outlook report from 1997 reports a mean length of a training program for an adult worker of 1288 hours (or the equivalent of 30 weeks of full employment) in a sample of 11 OECD countries, with a high of 2627 hours in New Zealand. This evidence suggests that the combined monetary and time cost for the firm of training one worker is indeed substantial. Given that any increase in the worker's productivity is not immediate, the necessary up-front investment in human capital can easily put the firm in a position where it cannot fully finance it internally.[3]

2. Investment in human capital affects the firm's productivity. That the accumulation of human capital constitutes, along with R&D, the main engine of macroeconomic growth is more or less agreed upon in economic theory (see, for example, Lucas [1993]). More interesting is the evidence which points to the knowledge and skills of the employees as a major source of competitive advantage for the individual firm. Bartel (1994) finds that firms which implemented new training programmes for specific groups of employees experienced productivity gains of about 19%. Lynch and Black (1995) report a 20% increase in firm productivity as a result from computer training. And Boon and Van der Eijken (1997) measure a 0.07 elasticity of a firm's value added with respect to investment in human capital.

3. Firm size and amount of training are positively correlated. A variery of empirical studies - Barron, Black and Leowenstein (1987), Holtman and Idson (1991), Knocke and Kallenberg (1994, Frazis, Herz and Horrigan (1995), etc. - all find that larger firms invest more in their employees' human capital. As a matter of fact, of all determinants of training suggested in the literature, firm size and industry type are the only unambiguous ones, whereas studies into age, race and gender, for instance, have produced ambiguous results.[4] The only exception is the already mentioned

[3]As long as it is the firm that finances this cost. See Section 2 for an extensive treatment of the different cases of cost sharing between the firm and the workers.

[4]See, for example, Veum (1996), Frazis, Gittleman and Joyce (2000), Swaim (1995) and Knocke and Kalleberg (1994), among others, for conflicting evidence.

study by Baldwyn, Gray and Johnson (1995), which finds that firm size may be uncorrelated or even negatively correlated with training, controlling for technology.

4. Financial development affects firm growth. The argument that the availability of external funds is important for firm growth has been forcefully made. Aghion and Bolton (1997) and Beck, Demirguc-Kunt, Laeven and Levine (2004), among others, show that financial development accelerates economic growth by removing growth constraint on small firms, and thus disproportionately affects the growth of small firms. Evans and Jovanovic (1989) and Greenwood and Jovanovic (1990), however, suggest that most small firms, especially in poor countries, cannot afford financial services, and so financial development disproportionately affects big firms. In a sort of a compromise, Rajan and Zingales (1998a) find that financial development affects growth in both existing establishments and in the number of new establishments, with the effect on average firm size being ambiguous - new firms enter driving average size down, but old firms grow driving it up.

5. The relationship between firm size and debt is not clear cut. Nickell and Wadhwani (1991) and Cooley and Quadrini (1999) document a negative relationship between debt and employment at the firm level. However, the already quoted Greenwood and Jovanovic (1990) argue that this is a feature of developed countries, whereas in underdeveloped countries small firms may have limited access to credit and thus not be able to accumulate the optimal amount of debt. Their view seems to be supported by the BEESP database which I'm using in this paper. As Figure 1 shows, the debt-over-assets ratio decreases for the bins 1-4, 5-19 and 20-49, but then increases again for bin 50-199 and is highest for bin 200+ workers.

6. The relationship between industry structure and human capital is not clear. This is the least well documented piece of evidence, and the relations between industry concentration and investment in human capital *per se* has hardly been studied. For example, Syverson (2004) finds that in the concrete industry, local monopolies are associated with lower productivity and product quality, which could be extrapolated to mean that if the purpose of investment in human capital is to raise productivity

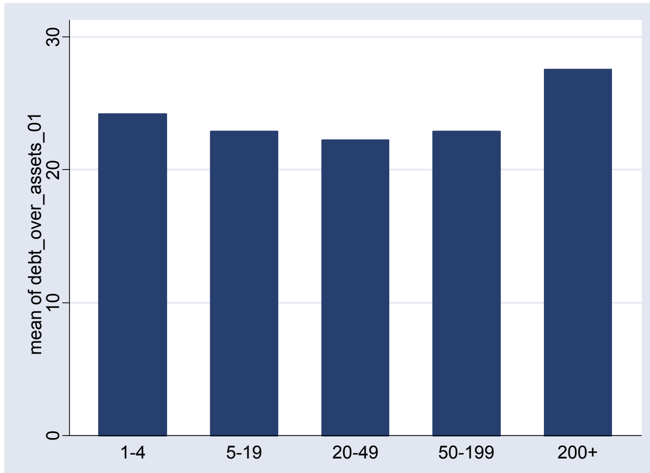

Fig. 1.

and quality, then monopolies should be associated with lower such investment. Bucci (2001) seems to agree by finding that more competition in the market for intermediate goods is associated with higher demand for human capital. However, Becker (1964) suggests that the return to investment in human capital is directly driven by the firm's market share, and thus monopolists should invest more than firms in a competitive market of the same size. The BEEPS dataset used seems to forcefully confirm Becker's intuition. As Figure 2 shows, in th pooled sample a monopolist has on average a 50% probability of running a formal training program for the largest worker group (skilled workers), while for firms with 1-3 competitors this probability is 42%, and for firms with 4+ competitors - only 33%.

2.3. Existing theories

A number of studies have addressed empirical observations 3 through 6, but few have attempted to link them with observations 1 and 2. The correlation between human capital and firm size has received numerous static interpretations. Rosen (1982) argues that in a hierarchical organizational structure, the people with the

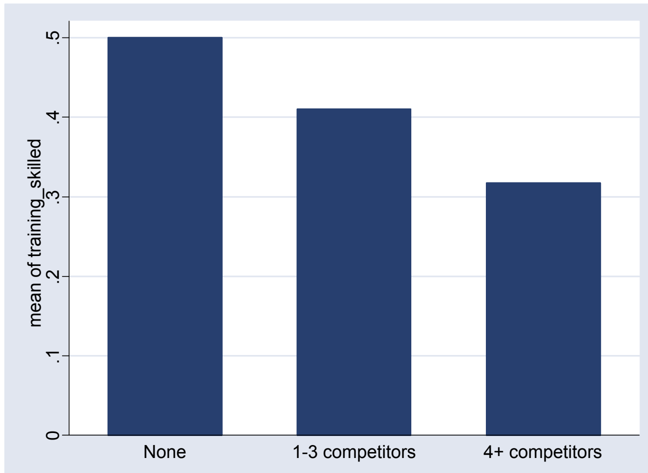

Fig. 2.

highest skills will end up in the highest positions of the largest and deepest firms. Kramer (1993) models human capital as the probability that a worker will successfully complete a task, and finds that firms, whose production process involves more tasks, will employ more highly skilled workers becuse mistakes are more costly. Both theories, however, assume that firm size is given, and the amount of human capital is given rather than generated. With training instead of talent, the most widely accepted theory of the correlation between size and human capital is the existence of larger internal markets in larger firms (for example, Idson [1993]). Lynch and Black (1998) hypothesize that smaller firms may be providing less training because "smaller employers face higher per-unit costs in the provision of formal training due to the high initial set-up costs or that they may be more concerned about losing trained employees to their competitors". This argument is explicitely addressed in Section 3.3.

Critical resource theories of the firm (like Grossman and Hart [1986]) argue that a critical resource, valuable in the production process, is attached through a variety of non-contractual mechanisms to the right agent in a way which maximizes the creation of surplus. For example, ownership over the workers' human capital (long-term labor contracts) should result in a human-capital intensive industry having larger firms. However, in this class of theories, albeit the firm size is allowed to vary, the amount of the critical resource available is static.

Financial development theories have provided the best attempts to link firm size growth, human capital accumulation and access to external finance. Fazzari et al. (1988) convincingly show that financial constraints are a significant determinant of the firm's investment decision, but do not extend the analysis into firm growth. Rajan and Zingales (1998a) contend that individual firm growth should be positively correlated with financial development, as firms are able to finance the difference between optimal investment and internal funds available through credit. The authors consider investment generally, which could include investment in human capital as well. However, they do not address the question of why controlling for size, firms should exert vastly different investment levels. Michellaci and Quadrini (2005) model the firm's choice of employment, wages and debt in a setting in which firms are credit constrained by the amount of collaterizable physical capital, which is complementary to employment along with an investment in training. Financial imprefections results in constrained firms having to cut on labor costs, so larger firms are able to pay higher wages through debt, but investment in human capital per worker is identical for firms of all sizes. And in the IO literature, Povel and Raith (2004) show that in a duopoly with one firm financially constrained and output unobservable, the constrained firm ends up underproducing in order to minimize the probability of liquidation.

Finally, the relationship between industry structure and human capital accumulation has been virtually left unadressed, and when addressed, it has mostly been analysed in a static environment. Bucci (2001) has argued that in a market with final goods and a monopolistic market for intermediary goods, in which human capital is the only factor input and the only source of innovation is R&D, higher market power of the final goods producers is associated with lower profits for the intermediate producers, less investment in R&D and lower demand for human capital. However, this is a model in which the industry structure is given. Syverson (2004) argues that there could be demand-driven diferences in productivity, and a more dispersed industry will be associated with a higher productivity, but the analysis is again carried out in a static environment. Similar conclusion is reached by Tse (2000). The closest economic theory has come to analysing investment and industry dynamics is the literature spurreed by models like Ericsson and Pakes (1992) and Hopenhayn (1992), who analyse the equilibrium distribution of firms in a dynamic model with entry and exit, where general investment is the sole source of productivity. They find that higher entry costs result in a less competitive industry, however, the possibility that the cost of investment could be externally financed is not explored. Still, the branch of literature started by models like the ones already quoted provides a valuable roadmap for the analysis of indystry dynamics with externally financed costly investment in productivity enhancing human capital, which our paper will later undertake.

3. A SIMPLE 2-PERIOD MODEL

Here I start to describe the theoretical framework and to illustrate the basic dynamics, necessary to generate the observed relationship between firm size and on-the-job training. In this simplest version of the model a risk-neutral entrepreneur faces a deterministic maximization problem, has an initial physical asset level $a_0 = km$, where m is the size of the workforce, and lives for two periods. We think of k as non-productive physical assets (land, or non-productive workers' equipment), whose sole purpose is to serve as (potentially) collateral. Her problem is to maximize

$$y_0 + \beta E_0 [y_1]$$

where β denotes the intertemporat discount factor and y_0 and y_1 denote per-worker output in periods 0 and 1, respectively.

In period 0 the entrepreneur hires new workers (I assume the number of workers is not a choice variable) and trains them at a level $\alpha \in R_+$. Investment in human capital is the sole engine of productivity growth, thus in the second period the entrepreneur generates revenues $y_1 = [1 + g(\alpha)] \cdot N$, and initial productivity has been normalized to 1. There is a set of skills necessary to work on the project, which the newly employed workers do not possess.[5] Depending on the nature of the skills necessary for production - namely, whether those skills are perfectly general, perfectly specific, or some combination of the two - the cost of investment in them is shared by the firm and the worker differently.

Workers are 2-period lived and risk neutral over their consumption, with lifetime utiliy

$$E_0\left[U\left(c_0,l_0\right)+\beta U\left(c_1,l_1\right)\right]$$

where β is the rate of time preference, so that entrepreneurs and workers discount the future equally, c_t is consumption and l_t is leisure, with $l_t\in\left\{0,\overline{L}\right\}$. Assume, for simplicity that $l_t=\overline{L}$ and $U\left(c_t,\overline{L}\right)=U\left(c_t\right)$, for $t=\{0,1\}$.

There are no positive externalities in labor, that is, for a given level of human capital a worker has the same marginal product regardless of the size of the firm. This condition is important to ensure that the same investment is needed in order for a worker to produce one efficiency unit of output, so that differences in investment by firm size are not driven by economies of scale.

There are two types of firms in the economy defined by the size of the workforce, N and n, where $N>n$. In this simplest two-period model, we assume firm size is given. Firms of size N have enough internal funds to finance any necessary investment, while firms of size n need to at least partially finance their expences externally.

External funds are provided by investors who are risk neutral. We assume that credit market are competitive, so that economic profits are zero. We also assume that the firm's earning are unobservable to the investor, so that firms can easily divert or hide cash flows. This captures the empirical observation that as small firms usually cannot afford auditing services, banks are naturally suspicious of the veracity of their reported earnings. Thus the investor can threaten to liquidate the firm if it fails to repay, in which case its owner forfeits future profits. As shown by Diamond

[5]We can think of those as not being provided by the educational system.

(1984) and Hart and Moore (1998), in this setting a debt-like contract is optimal: the firm induced to repay its debt and it minimizes the probability of liquidation, while the investor on average breaks even.

Finally, we show that what makes investment in human capital different from every other investment is the possibility that the workers rather than the firm pay for it, so that variation in investment by firm size need not arise even in the presence of imperfect credit marekts, and that given a fixed cost of training, in some cases variations in investment by firm size can arise even without credit constraints. The last observation poses additional econometric problems, which we suggest a way of circumventing by accounting for the possibility of outsourcing the fixed cost component to the educational sector.

3.1. Investment in a constrained regime

In this section we show how credit constraints for small firm can generate variation in the volume of training by firm size. In order to be perfectly precise about the different situations that can arise in theory, we distinguish between general and specific skills, as well as between competitive labor markets and monopsony.

In the first period, the firm hires the worker and offers her training at level α and a wage schedule $\{W, w(\alpha)\}$, where W is the wage in period 0 and $w(\alpha)$ is the wage at period 1. The worker accepts the offer, receives the period-0 wage and training, and then in period 1 with probability η the worker and the firm separate. We can think of η as the probability of the worker's death, or of her retiring. There is also an outside option, $\overline{w}(\alpha)$, which increases with the level of training.

As noted before, investment in human capital α is mapped into production y using a function $g(\alpha)$, where $g'(\cdot) \geq 0$ and $g''(\cdot) \leq 0$. The cost of training is $c(\alpha)$ such that $c'(\alpha) \geq 0$ and $c''(\alpha) \geq 0$. This ensures that the first-best[6] training level is given by

[6] We use the term "first best" to describe the condition for the unconstrained firm, as opposed to "second best", which describes the condition for the constrained firm. More precisely, 'first best" would describe the training level in the absence of a separation probability.

the equation $(1-\eta)\beta g'(\alpha^*) = c'(\alpha^*)$, and that $\alpha^* > 0$.

A worker produces 0 units of output during the period of training, so we can normalize her period-0 product to 0. In the period 1, the worker produces $g(\alpha)$, where $g(0) = 0$, so with no training the worker is as productive in the second period as she is in the first one.

Small firms are assumed to operate in a constrained regime, where it may not be possible to get access to the full amount of external credit required to finance the optimal investment in human capital. In the cases where it's the workers who pay for the full amount of investment, we assume that the workers are credit constrained, while it's the firms that are constrained in the cases when it's them who bear the cost. In this second case, credit constraints can be correlated to firm size in a variety of ways. For example, one way to think about it is in a underdeveloped country with corruption environment, where bigger firms can face lower costs of credit because they are better politically connected (for example, state-owned), and thus variations of credit constraints by firm size will simply signal variations in the entrepreneurs' nepotism potential. A second way to think about it would be to make use of the renegotiation idea in Hart and Moore (1994) and Kiyotaki and Moore (1997) and argue that larger firms have more physical assets and thus more collaterizable capital to offer against credit. We will be using a combination of the two arguments in Section 3.5 when we discuss the empirical implications of our model.

A constrained small firm is assumed to have initial assets $a_0 = 0$, so that it needs to finance all of its expences externally. Profits are a function of a state θ, where θ is defined over the support $[\underline{\theta},\overline{\theta}]$; we could think of θ as the state of demand, which we will later model explicitly. Crucially, neither the realized state $\widetilde{\theta}$ nor the second-period output $(1-\eta)\beta g'(\alpha, \widetilde{\theta})$ are observed by the investor. A feasible contract specifies that the firm borrows ω and promises to repay D in the second period. If the firm repays less than D, it is liquidated with probability $1-\gamma$, in which case the investor obtains its revenue plus nk, where k is the firm's per-worker non-productive collaterizable physical capital. If it continues to operate, it earns a fixed additional profit $n\pi_1$. The last assumption is important: if $\pi_1 = 0$, the firm would have no incentive to repay the debt.

The maximization problem of the size-n firm can be written as:

$$\begin{array}{c} \max\limits_{\alpha_1} n(1-\eta)\beta\left\{\int\limits_{\widehat{\theta}}^{\overline{\theta}} g\left(\alpha_1,\theta\right)dF(\theta)+\left[\Pr ob(\theta>\widehat{\theta})+\gamma\Pr ob(\theta<\widehat{\theta})\right]\pi_1\right\}- \\ -n(1-\gamma)\Pr ob(\theta<\widehat{\theta})k-\Pr ob(\theta>\widehat{\theta})D \end{array} \tag{1}$$

s.t.

$$W_1+(1-\eta)\beta w\left(\alpha_1\right)\geq\overline{w}\left(\alpha\right) \tag{2}$$

where workers are risk-neutral over consumption and we allow for the outside alternative to be a function of the volume of training. This is especially relevant in the cases when the worker can switch firms after the first period.

The maximization problem of the size-N firm can be written as:

$$\max_{\{\alpha_2,W_2\}} N\left[(1-\eta)\beta\{\int_{\underline{\theta}}^{\overline{\theta}} g\left(\alpha_2,\theta\right)dF(\theta)-w(\alpha_2)\}-W_2-c(\alpha_2)\right] \tag{3}$$

s.t.

$$W_2+(1-\eta)\beta w\left(\alpha_2\right)\geq\overline{w}\left(\alpha\right) \tag{4}$$

Finally, the investor's zero-profit condition can be written as

$$\begin{array}{c} n\left\{(1-\eta)\beta\int\limits_{\underline{\theta}}^{\widehat{\theta}} g\left(\alpha_1,\theta\right)dF(\theta)+(1-\gamma)\Pr ob(\theta<\widehat{\theta})k+\Pr ob(\theta\geq\widehat{\theta})D\right\}= \\ =n\left[W_1+(1-\eta)\beta w\left(\alpha_1\right)+c(\alpha_1)\right] \end{array} \tag{5}$$

Thus, in the general problem the firms solve (1) and (3), subject to (2), (4) and (5).

3.1.1. General training in competitive labor markets.—

If markets are competitive, then workers can quit at no cost after the first period and take their training to a firm which offers them a higher period-1 wage. Firms thus offer in the first period a combination $\{W, w(\alpha)\}$ such that the workers receive the highest life time utility, but at the same time firms pay none of the cost. In this Beckerian benchmark case, the first best amount of training α^* is achieved and the workers pay the full cost of training $c(\alpha^*)$ by accepting a wage schedule $\{1 - c(\alpha^*), 1 + g(\alpha^*)\}$, where α^* is the first-best level of training.

If there are credit constraints in the economy, they apply to the workers only, as the firms don't pay for the training. Then the workers will not be able to borrow optimally, and hence the amount of training financed will be lower, thus the workers will face a flatter wage-schedule $\{1 - c(\alpha^{**}), 1 + g(\alpha^{**})\}$, where $\alpha^{**} < \alpha^*$. In this setup, credit constraints by size at the firm level are irrelevant, and we will observe the same training and wage schedule in all firms regardless of size.

3.1.2. Training in monopsonic labor markets.—

If labor markets are monopsonic, firms are not concerned that their workers may leave and that their investment may be lost, so they bear the full cost of training. We can think of those as firms being the sole employer in small towns. In this situation, even general skills become specific. Becker (1964) alludes to this by writing that "in extreme types of monopsony [...] job alternatives for trained and untrained workers are nil, and all training, no matter what its nature, would be specific to the firm" (p. 50, 3rd ed.), and Acemoglu and Pischke (1998) carry out a full analysis of this situation. In this setup, although skills can in theory be used in a variety of other firms, in practice they cannot be used outside of the firm because there are no alternative employers. As firms have all the bargaining power in the labor marekt, workers are offered contracts which give them their reservation utility so that

$$W_i + (1 - \eta)\beta w(\alpha_i) = \overline{w},\ i = 1, 2 \tag{6}$$

where $\overline{w}$ is independent of α as there are no alternative employers. Assume that

$w'(\alpha) = k$. Using Povel and Raith (2004), we can define $D = n(1-\eta)\beta g\left(\alpha_1, \widehat{\theta}\right)$, where $\widehat{\theta}$ is the bankruptcy state: if the realized state is $\theta < \widehat{\theta}$, the firm is in default, otherwise it can repay D in full.

We can rewrite the maximization program as

$$\max_{\left\{\alpha_1, \widehat{\theta}\right\}} \quad n(1-\eta)\beta \left\{ \int_{\widehat{\theta}}^{\overline{\theta}} g\left(\alpha_1, \theta\right) dF(\theta) + \left[\Pr ob(\theta > \widehat{\theta}) + \gamma \Pr ob(\theta < \widehat{\theta})\right] \pi_1 - \Pr ob(\theta > \widehat{\theta}) g(\alpha, \widehat{\theta}) \right\} - $$
$$-n(1-\gamma) \Pr ob(\theta < \widehat{\theta}) k \tag{7}$$

$$\max_{\alpha_2} N \left\{ (1-\eta)\beta \int_{\underline{\theta}}^{\overline{\theta}} g\left(\alpha_2, \theta\right) dF(\theta) - \overline{w} - c(\alpha_2) \right\} \tag{8}$$

s.t.

$$(1-\eta)\beta \int_{\underline{\theta}}^{\widehat{\theta}} g\left(\alpha_1, \theta\right) dF(\theta) + (1-\gamma) \Pr ob(\theta < \widehat{\theta}) k + \Pr ob(\theta > \widehat{\theta})(1-\eta)\beta g\left(\alpha_1, \widehat{\theta}\right) = \overline{w} + c(\alpha_1) \tag{9}$$

The right-hand side of (9) specifies the per-worker amount the investor lends to firm 1. The left-hand side is the expected per-worker payoff: D if the firm is solvent and $g\left(\alpha_1, \widetilde{\theta}\right)$ if the firm is in default (where $\widetilde{\theta}$ is the realized state of demand, $\widetilde{\theta} < \widehat{\theta}$), plus the expected return of liquidating firm 1's assets.

Appendix 2 shows that the optimal α_1 solves

$$(1-\eta)\beta \left\{ \int_{\underline{\theta}}^{\widehat{\theta}} g_\alpha\left(\alpha_1, \theta\right) dF(\theta) + \frac{\lambda - 1}{\lambda} \Pr ob(\theta > \widehat{\theta}) g_\alpha\left(\alpha_1, \widehat{\theta}\right) + \frac{1}{\lambda} \int_{\widehat{\theta}}^{\overline{\theta}} g_\alpha\left(\alpha_1, \theta\right) dF(\theta) \right\} = c'(\alpha_1) \tag{10}$$

where $\lambda > 1$. Compared to an unconstrained firm, firm 1 places additional weight on lower (default) states of demand, which are also states of lower marginal product, and it therefore underinvests in human capital. Hence, $\alpha_1 < \alpha_2$, thus large unconstrained firms train more and offer a steeper wage profile. Differently put, because firm 1 may lose future profits (π_1), it has an incentive to underinvest and underproduce in order to decrease the probability of default.

3.1.3. Specific training in competitive labor markets.—

Unlike the general training case, now firms are not reluctant to invest in their workers as training is specific to the firm, and so the worker couldn't bring loss to the firm by taking her human capital to a different firm. The worker, on the other hand, has no incentive to invest in her training, as she cannot use it anywhere else. Thus the unconstrained firm bears the full cost and invests optimally so that $(1-\eta)\beta g'(\alpha^*) = c'(\alpha^*)$. The only difference is that now the worker rather than the firm receives all the returns to training, and so the zero-profit condition must hold for the firms as well as for the credit market. Apart from that technicality, the analysis in 3.1.2 then goes with full force, and credit constraints by firm size are sufficient to generate variations in training by firm size.

3.2. Financial development

We have shown that with unobservable output and verifiable repayment, small financially constrained firms underinvest as they try to minimize the probability of losing profit as a result from being liquidated in low states of nature. Constrained firms end up investing in human capital α^{**} such that $E_0\{(1-\eta)\beta[g_\alpha(\alpha^{**},\theta)]\} > c'(\alpha^{**})$. This wouldn't be the case if output was perfectly observable, as firms and investors would agree to some sharing of the residual profit. To show that formally, assume that rather than sign a debt contract, firms could borrow against the market interest rate r, so that one unit of period-zero credit results in a $R = (1+r)$ units of repayment tomorrow. Then, constrained small firms would be investing an amount $\widehat{\alpha}$ such that $E_0\{(1-\eta)\beta[g_\alpha(\widehat{\alpha})]\} = \beta R c'(\widehat{\alpha})$, where $\alpha^{**} < \widehat{\alpha} < \alpha^*$. Now small firms would be making an additional revenue

$$\Delta = E_0 \left[n \left\{ (1-\eta)\beta \left[g\left(\widehat{\alpha}\right) - g\left(\alpha^{**}\right) \right] + c(\alpha^{**}) - \beta R c(\widehat{\alpha}) \right\} \right] > 0.$$

Assume in addition that firms have in disposition some costly technology, which can provide a verification of their ex-post output for the investor. The technolgy costs δ per worker, so its full cost is $n\delta$. Then, as long as $n\delta > \Delta$, firms choose not to use it and we are in the setup of Section 3.1. If, however, financial development lowers the cost of monitoring, so that $n\delta < \Delta$, then firms will choose to pay for it, or split both the cost and the difference $n\delta - \Delta$ with the investor. Thus, if financial development represents inventing a monitoring technology which lowers the cost of monitoring, then it will result in smaller difference in per-worker human capital between large and small firms. [7]

There is sufficient evidence that, really, there are gains from credit for both banks and small firms. More credit to small and middle enterprises (SMEs) can, of course, come as a result from political pressure (the Community Reinvestment Act in the US in 1977), but it can rather be a bank initiative (the Basel II Framework for efficient risk management endorsed by the European Central Bank in 2004). Alternatively, in competing for large creditors or for private savings, banks may have to prove their strong ties to the community by engaging in community-level crediting. All this makes investing in better monitoring technology necessary and thus may - in terms of our model - essentially lower the cost δ and result in more per-worker investment in human capital.

This is an important departure from Rajan and Zingales (1998a) in that financial development benefits first big firms and then small firms, rather than both types of firms simultaneously.

[7] Indeed, there will be no difference if large firms are also constrained and have to apply for external credit.

3.3. Changing the cost structure

Now we will show that even in a simple set-up, in which we take no account of labor laws, unions or internal labor markets, credit constraints are not necessary to generate variations in human capital by firm size. Indeed, something as simple as a fixed cost of training does the trick, and hence we have to be careful to account for this possibility.

Assume that instead of a per-worker cost of training α, the cost has a fixed component Q and a variable component $c(\cdot)$ with the properties from before.[8] We can think of the fixed cost of training as the cost of paying for facilities and for an instructer regardless of the number of workers trained. Alternatively, we can think of Q as the cost of setting-up a training program. Now the firm's problem becomes:

$$\max_{\{\alpha, W\}} \quad 1 + (1-\eta)\beta\left[1 + g\left(\alpha\right)\right] - c(\alpha) - W - Q - (1-\eta)\beta w(\alpha) \tag{11}$$

s.t.

$$W + (1-\eta)\beta w\left(\alpha\right) \geq \overline{w}\left(\alpha\right) \tag{12}$$

There are various explanations as to why the fixed component of the cost of investment in human capital may be more important, or, alternatively, why the variable component may be of less importance. For example, there could be economies of scale in training: as long as the firm trains part of the workforce and workers interact with each other, the necessary information will be disseminated and utilized without having to train everyone. Alternatively, if we think about the set-up costs of a training process, involving the construction of expensive training facilities, these costs may truly be quite high, especially for a firm operating on a small scale. Later on we will argue that because for most human capital intensive industries, a crucial component of training is production foregone, the variable part of the cost structure

[8]The analysis is unchanged if the variable component is a fixed per-unit cost.

may still be the more important one. However, we need to make sure that the case with a high fixed cost is properly understood so that we make sure that our empirical results, concerning the effect of financial development on the accumulation of human capital, are not contaminated by the properties of the cost structure.

Appendix 3 shows that in the case when human capital is perfectly general and labor markets are perfectly competitive and $\alpha_n > \alpha_N > \alpha^*$, the equilibrium training/wage bundle must satisfy

$$[c'(\alpha_N) - (1-\eta)\beta g'(\alpha_N)]\,(\alpha_n - \alpha_N) + \frac{1}{2}\,[c''(\alpha_N) - (1-\eta)\beta g''(\alpha_N)]\,(\alpha_n - \alpha_N) < 0 \tag{13}$$

which is a contradiction as $c'(\alpha_N) \geq (1-\eta)\beta g'(\alpha_N)$. And, if $\alpha^* > \alpha_n > \alpha_N$, a size-$N$ firm can strictly increase the utility of the worker by offering her $\alpha_N = \alpha_n$, so $\alpha^* > \alpha_n > \alpha_N$ is not an equilibrium. Hence, it must be that $\alpha_N > \alpha_n$, thus larger firms invest more in human capital and offer a steeper wage schedule.

However, if human capital is specific, or labor markets are monopsonic, the fixed cost component doesn't change the above analysis. The intuition for the first case scenario is that as firms pass the full cost to the workers, the same amount of training is associated with a higher per-worker cost for a small firm, which is not an equilibrium anymore, so small firms have to train less.

3.4. Accounting for higher education

We have showed that in the case when labor markets are perfectly competitive and firm-provided human capital is perfectly general, a fixed cost of setting up or running a training program may in itself produce variation of training by firm size. Thus, if we observe empirical variations in training by firm size in this setting, we can no longer fully attribute them to observed credit constraints. We will now argue that we can eliminate this source of contamination by accounting for the higher education sector. Specifically, assume that the company can pay for the graduate education of its employees instead of running its own training program. Then, the firm does not need to pay the set-up cost anymore, thus it essentially outsources the fixed component of the cost to the educational institution, for which the costs of building the training facility is long sunk.[9] Thus by doing so firms only face the variable component of the cost of general training and our analysis from before of how credit constraints affect investment goes through. Specifically, we shouldn't observe anymore variation in training by firm size absent firm credit constraints.

Alternatively, some big firms may decide to take advantage of their cost advantage and specialize in training. If they do so, they become universities; if they don't, then there are some complementarities between training and labor which our simple model doesn't capture. Also, if there is a working higher education sector, even very big firms will have non-zero contribution of the fixed component to training costs, while for an existing university the fixed cost will be long sunk, which may explain why even very big firms don't specialize as training enterprises.

It needs to be added that the case of "perfectly competitive markets" and "perfectly general human capital" is a very theoretical one, and in practice we will most probably observe some kind of market monopsony or some kind of knowledge that is specific to the firm. A departure from this Beckerian benchmark pushes us back into the part of the analysis which leads to variations in the degree of credit constraints causing variations of training by size. However we have to be clear about this: if firm-provided human capital is part general and part specific, and we observe an empirical correlation between credit constraints and the variation of investment in human capital by firm-size, it may be partly due to the fixed cost component affecting variations in investment in the general skills portion of skills acquired. If we make sure, however, that we are operating in an environment with a developed educational system, to which firms can outsource the fixed component of the cost of training, then

[9] This may be the case, for example, when consulting firms pay for the MBA of their employees, which is usually considered a pretty general type of education (see Acemoglu and Pischke [1998] for an exposition of other examples of firms paying for general training).

variations in the levels of financial development will be sufficient to explain variations in firm-provided human capital by firm size.

3.5. Implications

3.5.1. Firm debt and financing.—

The cornerstone of our model is that the borrowing limit is less binding for some firms than for others. As we already discussed, we assume that larger firms are less credit constrained per worker for an objective reason (they have a reputation capital and verifiable profits) and for a subjective one (they are better politically connected). Thus, if either political influence is not an issue but reputation is, or size is not an issue but political connectedness is, our model predicts that an exogenous increase in the return to human capital will widen the difference in investment in human capital between large and small firms. We will then expect to, first, observe lower levels of investment in human capital for smaller and politically less connected firms. And second, controlling for firm size, firms will tend to invest less in their workers' production-specific human capital in countries where access to external finance is more difficult in general.

Regarding financial development, we also argued that in contrast to Rajan and Zingales (1998b), in our model it comes in two stages. First it disproportionately benefits large firms, as they can acquire any external credit necessary, while banks are suspicious of small firms. Next, as cheap technologies for monitoring output and evaluating risk are developd, it disproportionately affects small firms. Empirically, we would expect to find a concave effect of financial development on the difference between average investment by unconstrained (big) and constrained (small) firms.

Finally, we also argued that observed differences in human capital by firm size could be contaminated by the general component of skills in the presence of a fixed cost of training, which will be eliminated if there is a developed terciary educational sector to which the fixed cost component can be transferred. Thus, our model predicts that in countries with better development of the higher education sector, we should observe smaller differences in training by firm size, controlling for industry.

3.5.2. Mortality, turnover and labor laws.—

In this section we assume that there is an exogenous decrease in the probability that the firm and the worker will separate, η. This situation can arrise in different instances: if workers' mortality risk declines (for example, a cure against a AIDS or malaria is discovered), or if mandatory retirement age is increased, or it stricter labor laws exogenously reduce turnover.[10] The intuition is that although the return to investment in human capital will increase for every firm, only the unconstrained ones will take advantage of it as the constrained ones are already investing the maximum they can afford given their borrowing limit.

Formally, in the unconstrained regime the optimal investment in human capital for a firm of any size is determined by the equation $(1-\eta)\beta\int_{\underline{\theta}}^{\overline{\theta}} g_\alpha(\alpha^*,\theta)dF(\theta) = c'(\alpha^*)$. Immediately, by the concavity of $g(\cdot)$ and the convexity of $c(.)$, an exogenous increase in $(1-\eta)$ must lead to an increase in α^*. Assume now that for some firms the constraint binds and for others it does not. As $\eta \to \eta'$, where $\eta' < \eta$, unconstrained firms will find themselves investing at $\alpha' > \alpha^*$, so that $(1-\eta')\beta\int_{\underline{\theta}}^{\overline{\theta}} g_\alpha(\alpha',\theta)dF(\theta) = c'(\widetilde{\alpha})$, while constrained firms still invest α^{**} as their borrowing limit continues to bind. Then an exogenous increase in the return to human capital will widen the difference in investment in human capital between connected/big (unconstrained) and not connected/small (constrained) firms.

The testable implication of this observation is that lower worker mortality should be associated with a higher increase in training for the bigger firms and for the better connected firms, controlling for size.

Second, in a setting where there is a mandatory retirement age and it is being enforced, worker's retirement will have the same effect as mortality. Hence, we would

[10]The first case is obviously more applicable to developing countries, while the second one is more applicable to developed ones.

expect to see more investment in human capital in countries with a higher mandatory retirement age, but again the increase in training will be more pronounced for less constrained firms.

Finally, consider a union regulation which artificially reduces turnover by forcing employers and employees to enter in a more strict contractual relationship, thus reducing the risk for an entrepreneur of losing the training provided to a competitor firm. This is exactly like the case of reduced mortality, so the testable implication of this observation is that for firms of the same size in the same industry in two countries with different level of unions' ability to affect labor regulations, there will be lower turnover and a bigger difference in average investments in human capital between unconstrained and constrained firms in the country with stronger unions (as an unconstrained firm has more resources to invest in training).

A possible criticism to the last prediction is that unions may also reduce the ability of employers to pass the cost of training to workers by forcing them to pay higher initial wages, which will tend to decrease training, and thus we should observe smaller, not bigger differences in training between constrained and unconstrained firms in countries with stronger unions. However, as Acemoglu and Pischke (1998) argue, it is governments that are usually concerned with minimum wage regulations, while modern unions are mostly concerned with signing long-term employment contracts.

4. ADDING ENTRY AND EXIT IN A DIFFERENTIATED PRODUCT MARKET: FIRM SURVIVAL AND INDUSTRY STRUCTURE

4.1. Industry structure and firm life: simulation

So far we have shown that in a setup in which potential managers draw a project, fully determined by initial productivity and firm size, investment in human capital is costly, training is the sole engine of productivity growth, and financial markets are imperfect, constrained firms will end up investing less in human capital. However, up to now we always took the industry structure as given and competitive, so that all firms were price-takers. Now we turn to the dynamic implications of credit constraints for the industry structure in a setup where firms are free to enter the market, invest, produce, and exit. We preserve some of the main assumptions of the original Ericsson and Pakes (1992) model (EP from now on), on which the simulation is broadly based: price and shares of each firm are determined by a continuum of consumer tastes for product quality; firms decide whether to enter based on expected lifetime firm value and cost of entry, and decide whether to exit based on remaining firm value and value of outside alternative; consumer taste increases in quality, and quality increases in investment; output is stochastic. However, we have simplified the model in that we are departing from the Markovian nature of productivity, and here productivity will be deterministic in investment in human capiatl. Every firm receives an i.i.d. output shock in each period, and thus exiting will not be a result of an extended period of low productivity, as in EP, but from too high a shock to current output. Firms have to pay a fixed cost of per-unit training, and small and politically ill-connected firms are more constrained in the amount they can borrow as before. Thus, intuitively, the firms with the smaller project capacities will be more prone to exiting as a result from a productivity shock, as they will underinvest in human capital, face lower consumer taste for their product, generate lower profits and accumulate less physical assets, and hence will have a higher probability of their value falling under the value of the outside opportunity.

Formally, an entrepreneur draws a project of size $\overline{N}$ from a distribution of projects $\Gamma(\overline{N})$, and has to employ $\overline{N}$ workers immediately. Next, the entrepreneur chooses the level of investment in human capital, α for the group of workers, where the price of a unit investment is c.[11] Each entering firm has a marginal cost of producing mc. Thus, the size of the project and the degree of credit constraint are the only sources of heterogeneity in the economy.

The market consists of M consumers, each with a preference structure for firm j's

[11] I assume, for simplicity, that no wages are paid in this economy. Thus the entrepreneur's only expenses are related to training.

product

$$U_{ijt} = v_{jt} - p_{jt} + \varepsilon_{ijt}, \tag{14}$$

where v_{jt} is a quality index, p_{jt} is the price charged by firm j, $i = 1, ..., M$ indexes different consumers, and $\varepsilon_{ijt}\tilde{}N(0, s^2)$, all at time-$t$. Consumer i chooses good j only if it is preferred to all other alternatives. Hence, for $k = 1, 2, ..., j-1, j+1, ..., N$,

$$\varepsilon_{ijt} - \varepsilon_{ikt} \geq v_{kt} - v_{jt} + p^*_{jt} - p^*_{kt} \tag{15}$$

or, assuming a reference taste v_0,

$$\varepsilon_{ijt} - \varepsilon_{kjt} \geq [v_{kt} - v] - [v_{jt} - v_0] + p^*_{jt} - p^*_{kt} \tag{16}$$

Note that the EP setting implies that consumer choices are determined entirely by the good's price and quality, relative to the price and quality of the alternatives.

Denote by σ_{jt} the probability that a random consumer will choose good j, where

$$\sigma_{jt}[v, p, N] = \frac{e^{v_{jt} - v_0 - p_{jt}}}{1 + \sum_{k \neq j} e^{v_{kt} - v_0 - p_{kt}}} \tag{17}$$

It can be shown (Caplin and Nalebuff [1991]) that with a constant marginal cost mc and no fixed cost of production, the prices p_{jt} and shares σ_{jt} of the firms in the market are derived from the vector of first-order conditions

$$[p_{jt} - mc]\, \sigma_{jt}(1 - \sigma_{jt}) + \sigma_{jt} = 0, \tag{18}$$

for $j = 1, ..., N_t$, where N_t is the number of firms in the market at time t. Per-worker profits can now be written as

$$\pi_{jt}\left[v_{jt}, N_t\right] = \left\{p_{jt}\left[v_{jt}, N_t\right] - mc\right\} M\sigma_{jt}\left[v_{jt}, N_t\right], \tag{19}$$

where the price and the shares vectors are calculated from the spot-market equilibrium conditions (15) and (16).

Each period, the firm decides how much to invest in human capital. We will treat this investment as an investment in the quality of the good produced, which is reflected next period in the relative consumers taste for the good produced by the respective firm. Thus, at each period t the taste of consumer i for product j is equal to $v_{ijt} = v_{ijt-1} + \lambda x_{jt-1}{}^{\delta}$, where x_{jt-1} is the investment by firm j in human capital at time t.

The firms's problem can now be written as:

$$V_{jt}(v_t, N_t) = \max \left\{ \Phi, \sup_{\alpha \geq 0} \left[\pi_{jt}[v_{jt}, N_t] - c\alpha + \varepsilon_t + \beta \int_{\varepsilon} V_{jt+1} dF(\varepsilon_{t+1}) \right] \right\} \tag{20}$$

where Φ is the scrap value, and $\varepsilon_t \tilde{} N(0, \sigma^2)$.

For simplicity, we assume that we are in a monopsonic labor market regime, where $\overline{w} = 0$ so that the only operational expenses are investment-related.

The crucial assumption is that in each period the profit may not be enough to finance internally the optimal investment, so the firm may need to borrow. I allow the firm to borrow in order to finance investment in human capital, but the amount that can be borrowed (the per-period debt b_t) is proportionate to the size of the project, $b_t \leq \xi \cdot N^{\rho}$. Also, to make use of the empirical prediction that big firms should be less constrained, I set $\rho > 1$. Then,

$$\alpha_{jt} = \max \begin{cases} \alpha_{jt}^{*}, \text{ if } \alpha_{jt}^{*} < \frac{\pi_j[v_j, N]}{\overline{N}} + \xi \cdot N^{\rho-1} \\ \frac{\pi_j[v_j, N]}{\overline{N}} + \xi \cdot N^{\rho-1}, \text{ if } \alpha_{jt}^{*} \geq \frac{\pi_j[v_j, N]}{\overline{N}} + \xi \cdot N^{\rho-1} \end{cases} \tag{21}$$

Finally, in order to enforce the borrowing constraint, a sufficiently small threshold for the borrowing limit parameter ζ must be chosen.[12]

Table A presents the results of a simulation for a market with a maximum of 1 firm for different values of fixed cost of training and tightness of the borrowing constraint.

[12] In this set-up, as before, absent credit constraints, the optimal investment is the same for firms of all sizes.

The following values for the rest of the primitives of the model are used: $\beta = 0.90$, $v_0 = 3$, $v = 30$, $c = 0.5$, $mc = 0.3$, $M = 5$, $\Phi = 50$, $\delta = 0.3$, $\rho = 1.9, \sigma^2 = 10$. A firm enters and stays in the market until the outside alternative is higher than the remaining value, without facing competition. As can be seen, both the amount of human capital per worker invested and the average firm lifetime grows with the value of the project capacity. Decreasing the tightness of the constraint results in both higher investment and longer firm life for all firm sizes. Thus, this simple simulation implies that in such a market, firms of all small and medium sizes will have a higher chance of surviving and thus being observed if credit constraints are relaxed. However, financial development doesn't affect big firms (size 300+) as they have already become unconstrained (for instance, they have already received all the credit they needed in the past). This is a modification to Rajan and Zingales' (1998b) in that the second stage of financial development disproportionately affects small and medium firms, and should thus lead to a decrease in average firm size. The results in the table are averages from 1000 simulations, and are for two different degrees of the coefficient of financial constraint ζ.

Table A. A one-firm market

$\zeta = 0.9$

N	average firm life	average investment in HC per worker
50	1.12	0
120	69.12	7.63
300	100	17.34
500	100	17.34

$\zeta = 1$

N	average firm life	average investment in HC per worker
50	1.16	0
120	84.32	10.73
300	100	17.34
500	100	17.34

Next, we consider the case where there could be only 2 firms in the market. The market starts as a temporary monopoly - with one incumbent, whose size is chosen to be sufficiently big. In each period, if there is only the incumbent in the market, a potential entrepreneur draws a project size from the distribution $\Gamma(N)$ and decides whether to enter or not. If she decides to enter, then both firms invest optimally in human capital. After producing, the firm receives an output shock and exits if its current value falls below the value of the outside option.

Unlike EP, the values of the primitives are chosen in such a way as to ensure that there the firm's and the competitors' entry and exit decisions don't enter in next-periods value function. That is, there is no cost of entry, and the value of the outside alternative is chosen to be low enough so that exit can only be a result of a negative output shock, not of persistent low productivity. Thus, in each period the firm optimizes over one control - the amount of human capital invested, and whether to stay or not. The two state variables are the vector of consumers' tastes and the number of firms in the market, and as we are considering relative taste, the sum of the consumer tastes for goods j and k is fixed; what changes is $\frac{v_{ij}}{v_{ik}}$, all $i \in M$.

Table B1 describes the results of a simulation where an incumbent firm has a size 250, and an entering firm draws its project size from a uniform distribution $\Gamma(N)$. The values of the primitives are as in the previous case, and all I vary is the support of $\Gamma(N)$. The table testifies to the fact that, depending on the size of the competitor, the equilibria we observe are either a market, which has 1 firm most of the time, which invests more in human capital, with a short-lived small competitor, which invests close to nothing, or a solidly duopolistic market with a long-lived competitor, in which both firms invest an amount which is in between the investment of a monopolist and the investment of a short-lived firm. The market functions for 100 periods, and the results in the table are the average of 1000 simulations. S denotes the number of periods out of the 100-period maximum market life, during which the market is a monopoly.

Table B1. A two-firm market, heterogenenous project size

	$\Gamma(N_2) = [40, 60]$		$\Gamma(N_2) = [140, 160]$		$\Gamma(N_2) = [190, 210]$		$N_2 = 250$	
firm	lifespan	inv	lifespan	inv	lifespan	inv	lifespan	x
1	100	9.9	100	9.7	100	8.2	100	7.4
2	1	0	1.2	0.3	24	4.6	100	7.4
S	50		49.7		5.3		0	

In Table B2 we take a different approach to examining the simulated firm size/investment distribution by varying the coefficient for the nepotism potential, ρ_l, $l = 1, 2$. Each firm enters the market at period 0 with a size $N_{l0} = 10$. Here we will explicitly take into account the possibility of the firm growing in size by making the increase in employment proportionate to the increase in investment in human capital, so that $H_{l,t+1} = H_{l,t} + \gamma(\alpha_{l,t} - \alpha_{l,t-1})^{\nu}$. Here we allow for v_{ij} and v_{ik} to grow indefinitely. Table B2 gives the results from the simulation for the above values of the primitives, $\gamma = 2$, $\nu = 0.5$ and different support for the uniform distributions of $\Gamma(\rho_l)$. "Size" and "market firm size" are averages for all periods. The reported values are averages from 1000 simulations.

Table B2. A two-firm market, heterogeneous nepotism potential

	$\Gamma(\rho_1) = [1.5, 1.9]$ $\Gamma(\rho_2) = [1.2, 1.6]$			$\Gamma(\rho_1) = [1.5, 1.9]$ $\Gamma(\rho_2) = [1.4, 1.8]$			$\rho_1 = 1.9$ $\rho_2 = 1.9$		
firm	lifespan	inv	size	lifespan	inv	size	lifespan	inv	size
1	100	13.77	949.2	11.3	12.2	844.9	100	11.5	867.6
2	2.02	0.27	11.6	1.91	5.94	416.3	100	11.5	867.6
market firm size	716.87			728.9			867.6		

In Table C1 we extend the analysis to a market in which there can be a maximum of 3 firms at each point in time. The values of the primitives are as before. A firm with market power finds itself investing on average more in human capital (as the return to the investment is higher), and firms which are less constrained (thus, better politically connected) than the competition grow to be on average larger and have a higher average investment in human capital throughout their life-span. Table C2 gives the industry dynamic for different support of the nepotism potential coefficients. A firm which is better politically connected (a higher coefficient of nepotism potential) finds itself more often in a situation in which it is a monopolist or a duopolist, thus a monopolist invests on average more than a duopolist, and both invest more than a firm in a triopoly, hence confirming that better connections result in higher investment in human capital than the competition, and in a higher degree of market concentration.

Table C1. A three-firm market, heterogeneous nepotism potential

	$\Gamma(\rho_1) = [1.5, 1.9]$ $\Gamma(\rho_2) = [1.3, 1.7]$ $\Gamma(\rho_3) = [1.0, 1.4]$			$\Gamma(\rho_1) = [1.5, 1.9]$ $\Gamma(\rho_2) = [1.3, 1.7]$ $\Gamma(\rho_3) = [1.3, 1.7]$			$\rho_1 = 1.9$ $\rho_2 = 1.9$ $\rho_3 = 1.9$		
firm	lifespan	inv	size	lifespan	inv	size	lifespan	inv	size
1	76.69	4.95	214.7	76.69	4.97	221.6	100	4.90	235.8
2	62.12	4.45	186.0	55.11	4.57	196.1	100	4.90	235.7
3	27.86	2.56	74.7	71.14	4.87	205.2	100	4.90	235.7
market firm size	158.1			207.2			235.7		

Table C2. Market structure statistics for the three-firm market

	$\Gamma(\rho_1) = [1.5, 1.9]$ $\Gamma(\rho_2) = [1.3, 1.7]$ $\Gamma(\rho_3) = [1.0, 1.4]$			$\Gamma(\rho_1) = [1.5, 1.9]$ $\Gamma(\rho_2) = [1.3, 1.7]$ $\Gamma(\rho_3) = [1.3, 1.7]$			$\rho_1 = 1.9$ $\rho_2 = 1.9$ $\rho_3 = 1.9$		
firm	Monop	Duop	Triop	Monop	Duop	Triop	Monop	Duop	Triop
1	1	30	69	1	11	88	0	0	100
2	0	23	69	0	6	88	0	0	100
3	0	7	69	0	5	88	0	0	100

4.2. Empirical implications

As we showed, credit constraints, while not prevented entry (we assume a zero cost of entry) will make it more difficult for the entrants to pay the cost of training and hence remain competitive. Thus the equilibrium industry structure will be more concentrated. However, as we already noted, the effect must be more pronounced for human capital-intensive industries, while in the extreme case an industry that is not human capital intensive at all, is in no need of financing training and thus the necessity to pay for the costs of training should have no effect on the level of industry concentration. Of course, empirically we know that apart from the cost of human capital, there is the cost of physical capital and labor that we need to take into consideration. Thus, the empirical implication of this observation is that for two industries with the same capital/labor ratio, where one is more human capital intensive than the other, there should be bigger industry concentration across countries that are in the opposite ends of financial development in the human capital intensive industry.

Another result from the previous section was that as the industry structure and the level of investment in human capital are determined simultaneously, in equilibrium we will expect to observe a firm with big market share and few competitors investing more in human capital than a firm with few competitors but a small market share. However, the exact levels and the difference across firms will, as shown, depend on the level of financial development in the country. Thus, we expect to observe in the data a twofold phenomenon: first, there would be higher average level of investment in human capital in both types of firms in countries with higher level of financial development; and second, there will be a bigger difference in the level of capital invested by the above two types of firms in a set of countries with a lower level of financial development than in a set of countries with a more developed financial sector.

Finally, we also argued that in contrast to Rajan and Zingales (1998b), financial develoment should first disproportionately benefit large firms, and next small firms, rather then benefit both types of firms equally and simultaneously. Hence, we would expect to see, in a human capital intensive industry, the skew of the firm size distribution increasing while the median firm size staying the same in the early stages of financial development, and the median firm size decreasing in the second stage of financial development.

Appendix 3 contains the description of the data and the empirical investigation into the predictions made in the paper.

APPENDIX 1

Let the Lagrange multiplier on (9) be λ. The first order conditions for the program with respect to α_1, α_2 and $\widehat{\theta}$, respectively, are

$$(1-\eta)\beta \left\{ \begin{array}{c} \int_{\widehat{\theta}}^{\overline{\theta}} g_\alpha(\alpha_1,\theta)\, dF(\theta) - \Pr ob(\theta > \widehat{\theta}) g_\alpha\left(\alpha_1, \widehat{\theta}\right) + \\ +\lambda \left[\int_{\underline{\theta}}^{\widehat{\theta}} g_\alpha(\alpha_1,\theta)\, dF(\theta) + \Pr ob(\theta > \widehat{\theta}) g_\alpha\left(\alpha_1, \widehat{\theta}\right) \right] \end{array} \right\} = \lambda c'(\alpha_1) \qquad (1.1)$$

$$(1-\eta)\beta \int_{\underline{\theta}}^{\overline{\theta}} g_\alpha(\alpha_2,\theta)\, dF(\theta) = c'(\alpha_2) \qquad (1.2)$$

$$(1-\eta)\beta \left\{ \begin{array}{c} -g\left(\alpha_1,\widehat{\theta}\right) f(\widehat{\theta}) - f(\widehat{\theta})\pi_1 + \gamma f(\widehat{\theta})\pi_1 - \Pr ob(\theta > \widehat{\theta}) g_\theta\left(\alpha_1,\widehat{\theta}\right) + g\left(\alpha_1,\widehat{\theta}\right) f(\widehat{\theta}) + \\ +\lambda \left[g\left(\alpha_1,\widehat{\theta}\right) f(\widehat{\theta}) + \Pr ob(\theta > \widehat{\theta}) g_\theta\left(\alpha_1,\widehat{\theta}\right) - g\left(\alpha_1,\widehat{\theta}\right) f(\widehat{\theta}) \right] \end{array} \right\} - \\ -(1-\gamma) f(\widehat{\theta}) k + \lambda(1-\gamma) f(\widehat{\theta}) k = 0 \qquad (1.3)$$

(1.2) gives the solution for α_2^* directly. Cancelling and rearranging, (1.3) implies that

$$\lambda = \frac{(1-\gamma) f(\widehat{\theta}) k + \Pr ob(\theta > \widehat{\theta}) g_\theta\left(\alpha_1,\widehat{\theta}\right) + (1-\gamma) f(\widehat{\theta})\pi_1}{(1-\gamma) f(\widehat{\theta}) k + \Pr ob(\theta > \widehat{\theta}) g_\theta\left(\alpha_1,\widehat{\theta}\right)}, \qquad (1.4)$$

or

$$\lambda = 1 + \frac{(1-\gamma) f(\widehat{\theta})\pi_1}{(1-\gamma) f(\widehat{\theta}) k + \Pr ob(\theta > \widehat{\theta}) g_\theta\left(\alpha_1,\widehat{\theta}\right)} \qquad (1.5)$$

Notice that as long as $\pi_1 > 0$ (there is a non-zero loss to the firm from being liquidated in terms of additional profit) and $(1-\gamma) > 0$ (there is a non-zero liquidation probability), then $\lambda > 1$.

Dividing (1.1) by λ and rearranging yields:

$$(1-\eta)\beta\left\{\int_{\underline{\theta}}^{\widehat{\theta}} g_\alpha\left(\alpha_1,\theta\right)dF(\theta)+\frac{\lambda-1}{\lambda}\Pr ob(\theta>\widehat{\theta})g_\alpha\left(\alpha_1,\widehat{\theta}\right)+\frac{1}{\lambda}\int_{\widehat{\theta}}^{\overline{\theta}} g_\alpha\left(\alpha_1,\theta\right)dF(\theta)\right\}=c'(\alpha_1) \tag{1.6}$$

If $\widehat{\theta}=\underline{\theta}$, $f(\widehat{\theta})=0$, so $\lambda=1$ and (1.6) reduces to $(1-\eta)\beta\int_{\underline{\theta}}^{\overline{\theta}} g_\alpha\left(\alpha_1^*,\theta\right)dF(\theta)-c'(\alpha_1^*)=0$, which is identical to the condition for the unconstrained firm (1.2). However, as long as $\widehat{\theta}>\underline{\theta}$, compared to the condition of the unconstrained firm (1.2), firm 1 places a larger weight on the states of the world with positive probability of default ($\theta<\widehat{\theta}$), which are characterized by lower marginal product. Hence, in order for (1.6) to hold, the firm should invest strictly less than if unconstrained. ■

APPENDIX 2

A firm in a competitive product market maximizes

$$\max_{\{\alpha,W\}} \quad (1-\eta)\beta g\left(\alpha\right)-c(\alpha)-W-Q-(1-\eta)\beta w(\alpha) \tag{2.1}$$

s.t.

$$W+(1-\eta)\beta w\left(\alpha\right)\geq\overline{w}\left(\alpha\right) \tag{2.2}$$

2.1. General training in competitive labor markets with fixed cost of training.—

As in the case when there is only a per-unit cost of training, the firm passes on to the worker the full cost of her training, which in this case is $c(\alpha^*)+\frac{Q}{i}$, where $i=\{n,N\}$. Hence, a firm of size n offers an amount of training α_n and a wage structure $\left\{1-c(\alpha_n)-\frac{Q}{n},1+g(\alpha_n)\right\}$, and a firm of size N offers an amount of training α_N and a wage structure $\left\{1-c(\alpha_N)-\frac{Q}{N},1+g(\alpha_N)\right\}$. In equilibrium, the two wage structures should yield the same expected utility, thus the following must hold:

$$-c(\alpha_n) - \frac{Q}{n} + (1-\eta)\beta g(\alpha_n) = -c(\alpha_N) - \frac{Q}{N} + (1-\eta)\beta g(\alpha_N) \tag{2.3}$$

(2.3) can be rewritten as

$$c(\alpha_n) - c(\alpha_N) - (1-\eta)\beta\left[g(\alpha_n) - g(\alpha_N)\right] = \frac{Q}{N} - \frac{Q}{n} < 0 \tag{2.4}$$

We need to show that $\alpha_N > \alpha_n$. We will do that by contradiction. Assume that $\alpha_N < \alpha_n$, and that $\alpha_N > \alpha^*, \alpha_n > \alpha^*$. We can take a Taylor approximation to (2.4), yielding

$$\begin{gathered} c'(\alpha_N)(\alpha_n - \alpha_N) + \tfrac{1}{2}c''(\alpha_N)(\alpha_n - \alpha_N) - \\ -(1-\eta)\beta g'(\alpha_N)(\alpha_n - \alpha_N) - \tfrac{1}{2}(1-\eta)\beta g''(\alpha_N)(\alpha_n - \alpha_N) < 0 \end{gathered} \tag{2.5}$$

Rearranging, we get

$$\left[c'(\alpha_N) - (1-\eta)\beta g'(\alpha_N)\right](\alpha_n - \alpha_N) + \frac{1}{2}\left[c''(\alpha_N) - (1-\eta)\beta g''(\alpha_N)\right](\alpha_n - \alpha_N) < 0 \tag{2.6}$$

The above cannot hold as $c'(\alpha_N) \geq (1-\eta)\beta g'(\alpha_N)$. Contradiction.

Now assume that $\alpha_N < \alpha_n$, and that $\alpha_N < \alpha^*, \alpha_n < \alpha^*$. This implies that

$$(1-\eta)\beta g'(\alpha_N) - c'(\alpha_N) > (1-\eta)\beta g'(\alpha_n) - c'(\alpha_n) \tag{2.7}$$

This cannot be true as the size-N firm can increase the utility of its workers by paying them α_n.

Hence, it must be that $\alpha_N > \alpha_n$, thus larger firms invest more in human capital and offer a steeper wage schedule.

2.2. Specific training in competitive labor markets.—

Adding the fixed cost component changes nothing to the optimal investment in training, so the condition $(1-\eta)\beta g'(\alpha^*) = c'(\alpha^*)$ from before still holds, which in itself implies that the optimal α^* should be achieved again regardless of firm size. We can show this mathematically using the method from before: the zero-profit condition now implies that

$$(1-\eta)\beta g\left(\alpha^{*}\right)-c(\alpha^{*})-W^{*}-\beta(1-\eta)w(\alpha^{*})=\frac{Q}{i} \tag{2.7}$$

where in our economy $i=\{n,N\}$. We can show as before that

$$\begin{aligned} &(1-\eta)\beta g\left(\alpha_{N}\right)-c(\alpha_{N})-W_{N}-\beta(1-\eta)w(\alpha_{N})- \\ -&(1-\eta)\beta g\left(\alpha_{n}\right)+c(\alpha_{n})+W_{n}+\beta(1-\eta)w(\alpha_{n})=\tfrac{Q}{N}-\tfrac{Q}{n}<0 \end{aligned} \tag{2.8}$$

Let $\alpha_n > \alpha_N$. Assuming $w'(\cdot)$ is linear and taking a Taylor approximation, we can rewrite as

$$\begin{aligned} c'(\alpha_N)\left(\alpha_n-\alpha_N\right)+\tfrac{1}{2}c''(\alpha_N)\left(\alpha_n-\alpha_N\right)-(1-\eta)\beta g'(\alpha_N)\left(\alpha_n-\alpha_N\right)- \\ -\tfrac{1}{2}(1-\eta)\beta g''(\alpha_N)\left(\alpha_n-\alpha_N\right)+W_n-W_N<0 \end{aligned} \tag{2.9}$$

Or:

$$\begin{aligned} \left[c'(\alpha_N)-(1-\eta)\beta g'(\alpha_N)\right]\left(\alpha_n-\alpha_N\right)+ \\ +\tfrac{1}{2}\left[c''(\alpha_N)-(1-\eta)\beta g''(\alpha_N)\right]\left(\alpha_n-\alpha_N\right)+\left(W_n-W_N\right)<0 \end{aligned} \tag{2.10}$$

We can fully contradict the last identity only as long as $c'(\alpha_N)-(1-\eta)\beta g'(\alpha_N)>0$ and $W_n > W_N$. The first one is the standard condition from before, however, the second one cannot hold as a higher investment should be associated with a lower first-period wage. Thus, unlike in 3.2.1, it is not the case that the fixed cost component results in differences in training by firm size.

2.3. Specific training in monopsonic labor markets.—

In this case, the firms solves the same maximization problem as before, subject to $W^{*}+(1-\eta)\beta w(\alpha^{*})=\overline{w}$ instead of the zero-profit consition. Now the firms collect all the returns from investment in human capital and consequently make profit. In this case, introducing a fixed cost component will only result in the firm making less profit, and the reduction in profit will be inversely related to its size. However, similar to the previous sub-section, the optimal training-wage bundle is unaffected, and thus we still need credit constraints to achieve the empirical result of training varying by firm size.

APPENDIX 3: EMPIRICAL EVIDENCE

3.1. Data: nature and summary

The dataset for this paper was taken from the Business Environment and Enterprise Performance Survey (BEEPS), published by the World Bank (WB) in 2002. The original survey covered 9328 firms from 50 countries in 5 regions of the world: Central and Eastern Europe and Central Asia (ECA), Asia Pacific (AP), Sub-Saharan Africa (SSA), Middle East and North Africa (MENA), and Latin America (LAC). By far the largest portion of the countries (24) and firms (5704) covered was in the ECA region, and unlike the other regions, for which in most cases a different questionnaire (thus, different types of questions) was used for each country, the same questionnaire was used for each country/firm. Apart from that, it is important to note that the primary purpose of the project was to collect information on the firm's opinion of the legal environment, government performance and overall corruption in the country of operation. Thus, questions on the firm's parameters (like - importantly for our paper - firm size, number fo competitors, and probability of running a formal training program) were in many cases never included in the questionnaire. This is true for every other region but ECA. For these reasons, for the purpose of this paper, only the ECA dataset was used in the empirial analysis.

Thus, the final dataset used in the paper, includes 5704 firms from 24 countries from Central and Eastern Europe and Central Asia. The firms included in the survey come from 7 different branches of the economy: mining; construction; manufacturing; transportation, storage and communication; wholesale and retail; real estate, renting and business services; and hotels and restaurants. Table 1 gives full statistic of the number of firms per country and the percentage of firms in each business sectors included.

The positive thing about the dataset is that all information is firm-level, thus it enables us to control for a variety of otherwise unobserved characteristics. For example, in Kumar, Rajan and Zingales (2002) the investigation in the determinants of firm size as carried out at the country/industry level. In our case, we are able to look at training decisions at the firm level while paying attention to firm-level growth, firm-level debt, etc. Also, unlike other firm-level datatsets available, this one is not focused on one particular thing (for example, wage structure), but has a multitude of information reported, from investment decisions, to industry structure, financial health, interaction with banks, workforce's education level and structure, etc. Of course, for the particular purpose of this paper, the most important pieces of information for us are the labor force and financial data, but we also have valuable data on perceived corruption of government officials, turnover, bank attitude and labor regulation. This is particularly important given that one of the underlying assumptions of the theoretical model is that access to finance and treatment by banks and credit institutions is heterogeneous.

The most valuable feature of the so constructed database remains the fact that it is a sample drawn completely from countries in transition. Given that all firms are observed mere 10 years after the start of market economies in Central and Eastern Europe and Central Asia, it is a pretty good glimpse of young markets with diverse financial market setting. Thus, it presents the possibility for important empirical discoveries that can challenge any empirical work done with samples of firms from mature markets.

The main drawbacks of the dataset are two-fold: the information is self-reported, and it is not employee-specific. The first one means that the data is as it was reported by the owner/general manager/CEO/CFO of the company, and has not been verified by an independent observer, so it is prone to systematic measurement error if some managers were more informed than others, or if some pieces of information were judged more sensitive and thus misreported. The second one means that we are unable to observe employee-specific training, educational levels, wage structure, etc. While we are not able to say anything on the interaction between an employees wage structure and his level of firm-provided human capital, it is the purpose of the paper to investigate distributionals effects on firm size and human capital investment rather than individual effects, and this we are still able to investigate with the information available.

Table 1 gives the number of firms in each industry in each country. The most represented industry is retail and wholesale, ranging from 21.4% of the firms in Slovenia to 45.1 in Latvia, while the least represented industry is mining, ranging from 0% in Moldova to 2.8% in Tajikistan. The number of firms per country is proportionate to the size of the market, with the three biggest countries, Turkey, Russia and Poland, boasting the highest representation (514, 506 and 500 firms respectively), while five countries (Albania, Azerbaijan, Estonia, Macedonia and Slovakia) contribute to the sample with 170 firms each.

Table 2 gives the correlation between the variables used in the empirical investigation. Investment in human capital in any of the five categories of workers (managers, professionals, skilled, unskilled, and support) is proxied by the probability of running a formal on-the-job training program for the respective category. We utilize three measures of finance: a firm-level binary measure of how difficult it is to obtain credit equal to 1 if the firm evaluated it as "impossible" or "very difficult" (corresponding to a credit constrained firm), and to 0 if it evaluated it is "very easy" or "fairly easy" (a credit unconstrained firm); Djankov et al's (2005) measure of country-wide ratio of private credit over GDP, ranging from 0.04 in Kyrgyzstan to 0.44 in Croatia; and the World Bank's country-wide index of bank sector freedom, ranging from 1 (not free) to 5 (perfectly free). The index of property rights protection is proxied by the number of procedures necessary to enforce a contract, ranging from 17 in Lithuania (fairly easy enforcement) to 46 in Kyrgyzstan (fairly difficult enforcement). Firm size is measured by employment, a firm-level variable, ranging from 2 to 9950. More than half of the firms covered have less than 20 employess, while only about 5% have more than 500 employees. Country population is also used for robustness tests, concerning the effects of financial development on the firm size distribution. It has been argued (Rajan and Zingales [1998b], Beck et al. [2004]) that market size could be one of the main determinants of the log-normality of firm size distribution. Union influence on laws enacted is measured as a binary variable, equal to 1 if the firm evaluated the union influence on laws enacted as "major" or "decisive", and to 0 if unions are thought to have "no impact" or "minor impact". Data on worker mortality risk is taken from the World Bank Development database, and is measured as deaths of workers yonger than 35 per 100000 active workers. Mandatory retirement age is for males in the state sector, and has a minimum of 55 years in Turket and 65 years in Estonia and Poland. Physical capital per worker is a country-industry level variable, which is constructed using COMPUSTAT data on average physical assets per worker in the respective country for the respective industry (where the 6-digit NAICS industry codes have been appropriately aggregated to correspond to the 7 industry types from the BEEPS database). Finally, the index of industry concentration is calculated as the within industry/country average of the self-reported number of competitors. Obviously, it is a very crude proxy, given that far from all existing firms are included in the database, and the industries are aggregated.

3.2. Credit constraints, financial development and human capital

Table 3 provides the estimates of whether our hypothesis that there is a high fixed cost associated with running a formal training program is true. Column I gives the estimates of the probit regressions of the probability of the firm's running a formal training program for each category of employees (managers, professionals, skilled, unskilled and support) on the firm's self-reported difficulty in obtaining external credit. The effect of a unit change in the independent variable is given by the partial derivative $\frac{\partial P}{\partial x}$ of the probit function $\Pr ob(I = 1) = \Pr ob(\epsilon < X\beta) = \Phi(X\beta)^{13}$. For the

[13] As in all probit regressions from now on.

three categories of human-capital intensive employees (managers, professionals and skilled), becoming constrained is associated with a 15% to 20% decrease in the probability of running a training program. However, conditional on running a training program, becoming constrained decreases the share of workers trained only for the first two categories, and the effect is hardly significant at the 10%. This supports our hypothesis that there may be large fixed costs associated with running a formal training program, which may be more important than the marginal cost of training 1 worker when the managers take the decision whether to invest in their employees' human capital or not. However, this hypothesis is not confirmed for the most important group - skilled workers.

Our model's first main prediction is that both firm size and the nepotism potential of the entreprenenur will tend to raise investment in human capital by either reducing the cost of credit or by securing more units of effective credit per worker (controlling for whether property rights are generally protected in the economy[14]). Tables 4, 5 and 6 give the results of the investigation into to what extent we can claim that access to credit is correlated with investment in human capital. Columns I through V give the estimated of the probit regressions of the probability of running a formal training program on each of the five categories of workers (managers, professionals, skilled, unskilled, and support) on self-reported difficulty obtaining a bank loan, the ratio of country-wide private credit over GDP, and the World Bank's country-wide index of bank sector freedom. Access to external credit, measured in all three ways, has a significant effect on the probability of training all groups of workers, and financial development uniformly raises the probability of training any of the three skilled categories more than the probability of training any of the two unskilled categories. At the firm level, becoming constrained decreases the probability of training by between 13% to 19% for the three human-capital intensive categories, while the same effect

[14]The last point is important in that if investment in human capital is understood as an investment in productivity, then it will be proportionately related to an index of protection of the rights to those productivity rents.

is achieved by increasing the number of employees by around 1000, implying that the ability to raise external credit affects the ability to train independently of firm size. 10% more country-wide credit over GDP increase the probability of training by between 2% for the group of support workers to 9% for the group of skilled workers, while increasing bank freedom by 1 unit raises the probability of training skilled workers by 8%. The effects are less pronounced, but still significant when the same analysis is performed on the top half of the countries in terms of $\frac{\text{Population}}{\text{University professors}}$ ratio, implying that the previous results may be partially contaminated by the existence of a fixed cost of training compenent in competitive labor markets.

Table 7 examines the validity of our hypothesis that financial development affects first big firms and then small firms through their ability to rasie external credit in order to finance human capital related investments in productivity. A simple OLS procedure is used to evaluate the effect of the country-wide credit/GDP ratio and its square on the within country/industry difference between average probability of running a formal training program for skilled workers between unconstrained and constrained firms. The regressions controll for the effect of the size of the market (proxied by the logarithm of population) and the industry physical capital intensity (proxied by the within industry/country amount of physcial assets per worker), and instrument financial development by legal origin and a dummy equal to 1 if the country underwent a financial crisis in the 1990s, and to zero otherwise. It trully seems that financial development has a concave effect on the difference in human capital accumulation, implying that the difference initially widens (thus, big/unconstrained firms invest more) and than narrows (thus, small/constrained firms invest more). As mentioned before, this is a departure from Rajan and Zingales (1998b), where financial development affects all firms simultaneously.

The next three tables give the estimates of our hypothesis that credit constraints have an effect on training independent of all other determinants of training, and that exogenous increases in the return to human capital are associated with an increase in investment, but mostly for unconstrained firms. Table 8 presents a simple comparsonin-means between constrained and unconstrained firms in two different regimes, under minor and major union influence. While with weak unions unconstrained firms have on average a 20% larger probability of running a training program, with strong union influence the difference is 45%. Also, going from a "weak union" to a "strong union" regime increases the probability of a constrained firm running a training program by 6% only, but by 25% for unconstrained firms, implying that really mostly unconstrained firms can afford to take advantage of the increase return to human capital through reduced turnover. Table 9 shows that controlling for firm size and all factors that the model argues exogenously increase the return to human capital (union influence, mandatory retirement and worker mortality), becoming constrained still decrease the probability of training skilled workers by about 13%. Finally, Table 10 looks at the interaction effect between human capital intensity (measured as the percentage skilled workers) and credit constraints on training. For the same level of human capital intensity and controlling for the industry's physical capital intensity (calculated using averaged country/industry-wide data on physical assets per worker from COMPUSTAT), an increase in credit constraint from 0 to 1 is associated with a decrease of 12% of the intercartile range of the probability of training skilled workers.

3.3. Financial development, firm size distribution and market structure

In the second part of the paper, we argued that monopolists should invest in human capital more than competitive firms, that there should be higher average level of investment in human capital by monopolists and competitive firms alike in countries with higher level of financial development, and that there should be a bigger difference in the level of human capital invested by monopolists and competitive firms in a set of countries with a lower level of financial development than in a set of countries with a more developed financial sector. Table 11 shows a simple comparison in means in the probability of running a formal training program for the skilled workers by the two types of firms in two different setups: row 1 compares the above for the countries in the bottom 20% of the private credit/GDP distribution, and row 2 does the same for the top 80% of the private credit/GDP distribution. In accordance with the prediction in our model, the probability of investing in human capital is higher for both types of firms in the countries with a more developed financial sector, but the difference is only 0.06 and it is barely significant at the 10% level (0.48 versus 0.42). For for the set of countries with a less developed financial sector, the probability of investing in human capital is smaller for both types of firms, and the difference in this probability between the two types of firms is larger (0.12, or more than half bigger for the firms facing less competition) and it is statistically significant at the 1% level (0.33 versus 0.21).

Our next prediction is that for two industries with the same physical capital/labor ratio, where one is more human capital intensive than the other, there should be bigger difference in the industry concentration across countries that are in the oppoiste ends of financial development in the human capital intensive industry. The BEEPS dataset, as already mentioned, doesn't contain a division of the industries by a SIC code, but has them in general categories, and it is difficult to determine the capital intensity in the so defined industries. Nevertheless, it is at last easy to determine the level of human capital intensity by the share of skilled labor employed, as reported by the firms, and calculate the physical capital intensity using COMPUSTAT data as before. Table 12 reports the level of industry concentration across two types of countries, where the "Low private credit over GDP" type are all the countries in the bottom 20% of the private credit/GDP distribution, while the "High private credit over GDP" type are all the countries in the top 20% of the private credit/GDP distribution. The level of concentration is measured as the average score on a scale on which a score of 1 means the firm has "no competition", a score of 2 means the firm has "1, 2 or 3 competitors", and a score of 3 means the firm has "4 or more competitors". Two industries with similar physical capital intensity, but different human capital intensity are compared. The human capital non-intensive industry (wholesale and retail) is slightly more competitive in the countries with a better financial development, but the difference is undistinguishable from zero (2.90 versus 2.85). However, the human-capital intensive industry (transportation and communication) has a competitive score almost a fifth higher for the countries with better financial development, and the difference is significant at the 1% level (2.89 versus 2.46).

Table 13 takes a different approach in order to answer the same question as Table 12 by controlling for the industry's physical capital intensity explicitly. In Panel A, the dependant variable is the index of industry competitiveness, ranging from 1 (perfect monopoly, duopoly or triopoly) to 2 (more than 4 competitors in the industry). Controlling for physical assets per worker (which, as we argued, affect the ability of the firm to raise credit by providing collateral), an increase in human capital intensity * bank freedom from its 25th to its 75th percentile is associated with a decrease in industry concentration of approximately 26% of the interquartile range. Put differently, in countries with more independent banks, there are smaller differences in the level of concentration between the consulting and the wholesale industry. Controlling for property rights protection doesn't change the basic result.

Table 13 however in itself doesn't tell us whether this negative interaction effect between human capital intensity and better financial development comes from more human capital intensive industries becoming more competitive, or from human capital non-intensive industries becoming more concentrated. Our model argued the former, but we need another approach in order to confirm our intution. In Panel B , I replace the interaction variable with the index of bank freedom multiplied by indicators of whether an industry is in the highest or lowest tertile of industry human capital intensity. Most of the action (especially when we control for property rights protection) comes from the highest tertile indicator being negative and significant. This suggests that the effect of improvement in the credit institutions results primarily in human capital intensive industries becoming more competitive - which is exactly what our model predicts.

Finally, we examine the effect of financial development on industry firm size distribution, measured by the within country/industry average firm size, median firm size, and firm size distribution skew. The results suggest that financial development causes human capital intensive industries to become more skewed while decreasing median firm size and hardly changing average firm size. This implies that as banks become more independent, they promote policies (possibly, as argued in the paper, more efficient monitoring) which enable small firms to raise more credit, become more competitive, and stay longer in the marketplace. This result is less pronounced for low human capital industries, where financial development mostly causes big firms to grow.

Table 1. Number of firms per industry and country

Country	Firms	Mining	Constr	Manuf	Commun	Sales	Real Est	Hotels
Albania	170	1.2	11.9	34.8	8.2	25.6	5.2	7.8
Armenia	171	1.7	6.6	37.0	5.6	27.5	5.8	9.2
Azerbaidjan	170	1.8	14.4	28.5	6.0	34.0	4.9	5.5
BiH	182	1.5	6.8	35.1	7.0	32.2	4.0	7.7
Bulgaria	250	0.9	7.3	20.2	9.8	36.7	9.2	8.2
Croatia	187	1.3	12	19.8	7.9	32.9	14.0	5.6
Czech Republic	268	1.1	14.9	24.9	7.4	26.1	12.2	8.5
Estonia	170	1.4	11.8	16.5	9.9	28.5	16.8	9.1
Georgia	174	0.3	5.1	19.9	9.3	34.4	11.5	6.3
Hungary	250	1.3	14.2	20.4	6.1	31.6	11.4	7.0
Kyrgyzstan	173	2.7	11.7	27.4	8.2	30.7	8.3	4.6
Latvia	176	0.1	6.3	15.8	8.3	45.1	14.2	5.2
Lithuania	200	1.6	13.9	19.4	11.8	24.2	11.2	13.6
Macedonia	170	0.9	7.6	27.3	8.0	38.1	6.1	8.2
Moldova	174	0	2.4	26.7	6.2	45.2	1.7	5.1
Poland	500	0.1	15.0	21.8	10.4	33.6	9.8	3.1
Romania	255	0.1	9.0	31.7	7.6	27.3	10.0	6.3
Russia	506	1.2	14.7	24.3	7.6	28.5	8.0	3.7
Slovakia	170	0.1	9.8	17.6	8.6	26.5	22.1	7.4
Slovenia	188	1.4	13.6	25.1	8.1	21.4	17.4	7.3
Tajikistan	176	2.8	9.9	27.5	6.6	26.7	11.2	6.1
Turkey	514	1.5	6.2	28.7	5.4	32.6	6.6	14.2
Uzbekistan	260	2.1	14.9	20.7	7.5	34.3	9.7	6.7
Yugoslavia	250	1.7	7.2	26.1	8.9	31.4	10.1	7.2

Table 2. Summary statistics and corelations

A detailed description of the variables and their sources was given in Appendix 3, Section 3.1.

Panel A: Summary statistics

Firm variable	Mean	Median	St. Dev.	Min	Max	N
Probability training skilled	0.33	0	0.47	0	1	5224
Difficulty obtaining credit	0.39	0	0.49	0	1	3763
Permanent employment	141.42	17	497.25	2	9950	5673
Union influence on laws	0.23	0	0.42	0	1	5099
Industry variable						
Share skilled workers	0.77	0.79	0.11	0.24	1	162
Physical assets per worker	9116	1567	16255	1.7	60431	142
Average firm size	187.57	87.97	280.73	5.64	2062.25	162
Median firm size	78.72	6	262.59	2	2200	162
Firm size distribution skew	2.69	2.32	1.76	-0.70	10.22	161
Industry concentration	0.19	0.15	0.15	0	0.67	162
Country variable						
Adult mortality risk	239.97	213	72.27	163	464	24
Mandatory retirement age	60.49	60	2.05	55	65	22
Private credit / GDP	0.22	0.18	0.14	0.04	0.44	22
Log population	15.80	15.48	1.14	14.10	18.78	24
Professors per 100,000	1980	1727	943	539	4167	22

Panel B. Correlations across firm variables

Firm variables	1	2	3	4
1. Probability training skilled	1.00			
2. Difficulty obtaining credit	-0.46	1.00		
3. Permanent employment	0.32	0.20	1.00	
4. Union influence on laws	-0.03	-0.10	0.20	1.00

Panel C. Correlation across industry variables

Industry variables	1	2	3	4	5	6
1. Share skilled workers	1.00					
2. Physical assets per worker	-0.55	1.00				
3. Average firm size	0.24	-0.27	1.00			
4. Median firm size	0.02	-0.12	0.25	1.00		
5. Firm size distrbution skew	-0.21	0.43	-0.34	-0.03	1.00	
6. Industry concentration	-0.06	-0.23	0.57	-0.05	-0.21	1.00

Panel D. Correlation across country variables

Country variables	1	2	3	4	5
1. Adult mortality risk	1.00				
2. Retirement age	0.06	1.00			
Credit / GDP	-0.41	0.16	1.00		
Log population	-0.22	-0.32	0.04	1.00	
Professors per 100,000	0.32	0.29	-0.08	-0.26	1.00

Table 3. Cost of training and financial constraint

The explanatory variable is how difficult the firm finds obtaining a bank credit. The variable is binary, with a value of 0 if the firm answered that problematic external finance is "no obstacle" or "minor obstacle", and to 1 if it was answerd to be a "moderate obstacle" or "major obstacle". The dependent variable in column I is the probability of running a formal training program for the respective group of employees. The probability of running a formal training program is calculated as a binary variable. The coefficients are estimated using a probit procedure, and include indsutry fixed effects. The dependent variable in column II is the share of wokers in the respective category trained, conditional on the firm running a formal training program for the respective category, and also includes firm and industry fixed effects.

Type of workers trained	I. Probability of training	II. Share trained
Managers	-0.20	-5.37
	$(0.02)^{***}$	$(3.07)^{*}$
Professionals	-0.20	-4.51
	$(0.02)^{***}$	$(2.70)^{*}$
Skilled	-0.15	-1.05
	$(0.02)^{***}$	(2.59)
Unskilled	-0.05	0.22
	$(0.01)^{***}$	(6.07)
Support	-0.08	-3.64
	$(0.01)^{***}$	(5.22)

Tables 4, 5 and 6. Training, credit and the banking sector

The dependent variable in Tables 3 through 5 is the probability of running a formal training program for each of the five category of employees. In each table, the explanatory variable is a measure of credit, and we are controlling for firm size. Difficulty obtaining a bank loan is a binary variably, which equal 0 if the firm said it is "Fairly easy" or "Very easy", and to 1 if the firm said it is "Very difficult" or "Impossible". Credit over GDP is taken from Djankov et al (2004). The index of bank freedom is taken from the World Bank "Doing Business" database (2004). The later is measured on a scale of 1 to 5, with 1 being the lowest and 5 being the highest. The index of property rights protection (PRP - proxied by the number of procedures necessary to enforce a contract) is taken from the World Bank "Doing Business" database (2004). Firm size is self reported. Panel A of each table reports the estimates from the regression for the full sample, and Panel B reports the estimates from the regression on the top half of the $\frac{\text{University professors}}{\text{Population}}$ distribution. All probit regressions include fixed effects for firm and industry. Heteroskedasticity robust standard errors are reported in parentheses.

Table 4, Panel A

Variable	I	II	III	IV	V
Difficulty obtaining loan	-0.19	-0.19	-0.13	-0.05	-0.08
	(0.02)***	(0.02)***	(0.02)***	(0.01)***	(0.01)***
Firm size * 1000	0.14	0.16	0.02	0.06	0.06
	(0.03)***	(0.04)***	(0.01)***	(0.01)***	(0.01)***
Property Rights * 100	0.05	0.17	0.91	0.13	0.36
	(0.44)	(0.45)	(0.49)*	(0.37)	(0.40)
Observations	3372	3288	3293	2817	2862
R^2	0.14	0.16	0.13	0.13	0.12

Table 4, Panel B

Variable	I	II	III	IV	V
Difficulty obtaining loan	−0.23 (0.02)***	−0.22 (0.02)***	−0.14 (0.02)***	−0.05 (0.02)***	−0.09 (0.02)***
Firm size * 1000	0.20 (0.06)***	0.20 (0.06)***	0.20 (0.05)***	0.07 (0.02)***	0.07 (0.02)***
Property Rights * 100	0.78 (0.27)***	0.67 (0.27)***	1.51 (0.30)***	0.43 (0.23)*	0.98 (0.26)***
Observations	2049	2016	2002	1726	1780
R^2	0.15	0.13	0.13	0.13	0.10

Table 5, Panel A

Variable	I	II	III	IV	V
Credit over GDP	0.59 (0.06)***	0.53 (0.06)***	0.93 (0.06)***	0.38 (0.04)***	0.46 (0.05)***
Fim size*1000	0.15 (0.03)***	0.17 (0.04)	0.13 (0.03)***	0.06 (0.01)***	0.07 (0.01)***
Property Rights * 100	−0.12 (0.09)	−0.23 (0.09)***	−0.29 (0.09)***	0.00 (0.07)	0.04 (0.07)
Observations	4434	4331	4337	3698	3779
R^2	0.06	0.06	0.08	0.07	0.05

Table 5, Panel B

Variable	I	II	III	IV	V
Credit over GDP	0.42 (0.08)***	0.31 (0.09)***	0.86 (0.09)***	0.39 (0.06)***	0.21 (0.07)***
Fim size*1000	0.31 (0.07)***	0.32 (0.07)***	0.26 (0.06)***	0.08 (0.03)***	0.09 (0.03)***
Property Rights * 100	−0.44 (0.12)***	−0.84 (0.12)***	−0.57 (1.24)	−0.12 (0.09)	0.08 (0.09)
Observations	2641	2603	2582	2214	2312
R^2	0.07	0.07	0.07	0.07	0.03

Table 6, Panel A

Variable	I	II	III	IV	V
Bank freedom index	0.01	−0.02	0.08	0.05	−0.01
	(0.02)	(0.02)	(0.02)***	(0.01)***	(0.01)
1000*Fim size	0.17	0.17	0.12	0.07	0.09
	(0.05)***	(0.05)***	(0.04)***	(0.02)***	(0.02)***
Property Rights * 100	−0.29	−0.63	−0.35	0.15	0.06
	(0.13)***	(0.13)***	(0.13)***	(0.11)	(0.11)
Observations	3272	3169	3193	2693	2713
R^2	0.04	0.05	0.04	0.05	0.03

Table 6, Panel B

Variable	I	II	III	IV	V
Bank freedom index	0.02	0.02	0.09	0.04	0.00
	(0.02)	(0.02)	(0.02)***	(0.02)***	(0.02)
1000*Fim size	0.39	0.37	0.28	0.09	0.11
	(0.12)***	(0.13)***	(0.09)***	(0.03)***	(0.05)***
Property Rights * 100	−0.32	−0.83	−0.34	0.11	0.02
	(0.16)***	(0.16)***	(0.16)**	(0.12)	(0.02)
Observations	1962	1920	1923	1682	1711
R^2	0.06	0.07	0.06	0.06	0.03

Table 7. Human capital accumulation and financial development

The dependent variable is calculated as the within-industry/country difference between the average probability of running a formal training program for skilled workers by unconstrained and constrained firms. The independant variables are the country-level ratio private credit/GDP and the logarithm of country population. Columns I is estimated by OLS and column II by a 2SLS procedure, where financial development has been instrumented by the dummy "legal origin", where legal origin equals 1 if the country has Socialist legal origin, and 0 otherwise, and by the dummy "financial crisis" which equal one if the country went through a financial crisis in he 1990s, and to 0 otherwise. Columns III and IV repeat columns I and II for the top half of the $\frac{\text{University professors}}{\text{Population}}$ distribution. All regressions also include fixed effects for country and industry. Heteroskedasticity robust standard errors are reported in parentheses.

Variable	I	II	III	IV
Credit over GDP	1.50	3.76	2.15	2.92
	(0.89)*	(1.89)**	(1.06)**	(1.42)**
(Credit over GDP)ˆ2	−2.50	−7.00	−3.58	−5.04
	(1.81)	(3.78)*	(2.06)*	(2.74)*
Log population	−0.01	−0.03	0.03	0.02
	(0.03)	(0.03)	(0.03)	(0.03)
Physical assets per worker*10,000	0.16	0.09	−0.03	−0.10
	(0.43)	(0.47)	(0.39)	(0.45)
Observations	119	119	71	71
R^2	0.07	0.07	0.05	0.04

Table 8. Mean comparison between constrained and unconstrained firms, by union influence on laws.

In both rows, the dependent variable is the average probability of running a formal training program for skilled workers for the two types of firms, constrained and unconstrained. In the first row, those firms were compared which answered that unions had "no impact", "minor influence" or "moderate influence". In the second row, those firms were compared, which answered that unions had "major influence" or "decisive influence". The number of observations for each group is given in brackets.

Variable	Constrained firms	Unconstrained firms	Difference	$T-$stats
Minor union influence	0.32 (714)	0.39 (234)	0.02	1.04
Major union influence	0.34 (1233)	0.49 (296)	-0.10	-2.31***

Tables 9. Unions and worker mortality

The dependent variable is the probability of running a formal training program for professional and skilled workers. All probit regressions include fixed effects for firm and industry. As before, how difficult firms find obtaining bank credit, as well as firm size are self-reported. Union influence is self reported, and it equals 0 if the firm said unions have "no imact" or "minor impact", and 1 if the firm said unions have "major impact" or "deciseve impact" on laws enacted. Adult mortality risk is taken from the World Bank Development Database, and is measured as the number of younger-than-35-years-old workers per 100,000 dying from natural causes. Mandatory retirement age reported is for males. All, columns report the probit for the subsample of skilled workers. The regressions include fixed effects for firm and industry. Heteroskedasticity robust standard errors are reported in parentheses.

Variable	I	II
Difficulty obtaining loan	-0.13	-0.13
	(0.02)***	(0.02)***
1000*Firm size	0.15	0.16
	(0.03)***	(0.04)***
Union influence on laws		0.05
		(0.02)***
Retirement age		0.07
		(0.01)***
Adult mortality risk*100		-0.03
		(0.02)
Observations	3404	2752
R^2	0.12	0.14

Table 10. Human capital and physical capital intensity

The dependent variable is the probability of running a formal training program for the group of skilled workers. Capital expenses per worker is a country-industry level variable, which is constructed using COMPUSTAT data on average capital expenses per worker in the respective country for the respective industry (where the 6-digit NAICS industry codes have been aggregated to correspond to the 7 industry types from the BEEPS database). The variable Human Capital * Credit is constructed by multiplying the share of managers+professional+skilled workers by the firm-level self-reported difficulty of obtaining a bank loan. The regression includes firm and industry fixed effects. Heteroskedasticity robust standard errors are reported in parentheses.

Variable	I
Firm size*1000	0.11 (0.02)***
Union influence on laws	0.06 (0.02)***
Capital expenditures per worker*10,000	0.06 (1.12)
Human capital * Credit*100	−0.12 (0.02)***
Observations	582
R^2	0.16

Table 11. Investment in human capital by rating of competition and financial development.

Table 11 compares the probability of running a formal training program for the group of skilled workers across firms with considerable market power (with 0-3 competitors) and firms with small market power (4+ competitors), for two sets of countries according to the level of financial development. Financial develoment is proxied by the private credit / GDP ratio, while the number of competitors and whether the firm is running a formal training program is self-reported.

Type of countries	0-3 competitors	4+ competitors	Difference	T-stats
Low $\frac{\text{Private credit}}{\text{GDP}}$ ratio	0.33 (223)	0.21 (614)	0.12	3.66***
High $\frac{\text{Private credit}}{\text{GDP}}$ ratio	0.48 (294)	0.42 (1358)	0.06	1.87*

Table 12. Mean comparison in industry concentration by financial constraint and human capital intensity

Table 12 compares the level of industry concentration for the most human capital intensive industry (transport and communication) and for the least capital intensive industry (wholesale, retail and repairs) across countries from the bottom 20% and the top 20% of the private credit/GDP distribution. The level of concentration is measured as the average score on a scale on which a score of 1 means the firm has "no competition", a score of 2 means the firm has "1, 2 or 3 competitors", and a score of 3 means the firm has "4 or more competitors".

Industry	Low $\frac{\text{Private credit}}{\text{GDP}}$ ratio	High $\frac{\text{Private credit}}{\text{GDP}}$ ratio	Difference	T-stats
Wholesale, retail and repair	2.85 (277)	2.90 (194)	-0.05	-1.52
Transport and communication	2.46 (70)	2.89 (55)	-0.43	-4.41***

Table 13. Human capital, bank credit and industry structure

The dependent variable is the index of industry concentration. The variable "-physical assets per worker" is constructed at the country-industry level by taking the information from COMPUSTAT on average volume of physical assets per worker, weighted by employment, for the respective industry for the respective country. The indicators in Panel B equal 1 if the country industry is in the highest/lowest tertile of industry human capital intensity. The regression includes industry fixed effects. Heteroskedasticity-robust standard errors are reported in parentheses.

Panel A.

Variable	I	II
Physical assets per worker*10,000	−0.015	−0.013
	(0.020)	(0.023)
Human Capital * Bank Freedom * 100	−0.055	−0.041
	(0.022)***	(0.019)**
Property rights protection * 100		0.143
		(0.161)
Observation	87	80
R^2	0.52	0.50

Panel B

Variable	I	II
Physical assets per worker*10,000	-0.026	-0.028
	(0.036)	(0.037)
High Human Capital Intensity*Bank Freedom	-0.031	-0.029
	(0.009)***	(0.010)***
Low Human Capital Intensity*Bank Freedom	-0.016	-0.012
	(0.008)**	(0.008)
Property rights protection * 100		0.291
		(0.124)***
Observation	87	80
R^2	0.57	0.60

Table 14. Firm size distribution and financial development

The dependent variables are the within industry/country measures of average firm size, median firm size, and firm size distribution skew. The variables "Low human capital intensity * Bank freedom" and "High human capital intensity * bank freedom" are calculated by multiplying the index of bank fredom by a dummy, which is equal to 1 if the industry is in the bottom tertile of human capital intensity and zero otherwise, for the first variable, and by a dummy which is equal to 1 if the industry is in the top tertile of human capital intensity and zero otherwise, for the second variable. Physical assets per worker are calculated as country/industry averages from COMPUSTAT, and the index of property rights protection is a country-level variable taken from the World Bank "Doing Business" database. The regressions include fixed effects for industry. Heteroskedasticity-robust standard errors are reported in parentheses.

Variable	Average firm size	Median firm size	Skew
Physical assets per worker	-0.01	-0.01	0.00
	(0.01)	(0.01)	(0.00)***
High HCI * Bank Freedom	-4.17	-45.46	0.17
	(20.61)	(22.60)**	(0.11)*
Low HCI * Bank Freedom	51.24	15.01	0.22
	(21.00)***	(23.04)	(0.11)**
Property rights protection	0.44	1.58	0.01
	(3.75)	(4.12)	(0.02)
Observations	80	80	80
R^2	0.40	0.15	0.51

Note: HCI stands for Human capital intensity

Table 15. Firm size distribution, training and financial development

Dependent variable: Firm size multiplied by a dummy equal to 1 if the firm runs a formal training program for skilled workers, and to 0 otherwise.

Variable	St. Dev. I	St. Dev. II	Skew I	Skew II	Mean I	M
Credit over GDP	2,235.1	2,385.1	8.9	11.2	1,066.3	1,
	(1,082.7)**	(1,114.7)**	(3.8)***	(3.8)***	(522.5)*	(54
(Credit over GDP)ˆ2	−3,817.4	−4,033.5	−18.3	−22.3	−1,818.0	−1
	(2,253.4)*	(2,297.3)*	(7.8)***	(7.8)***	(1,087.6)*	(1,
Flexibility of firing		−6.2		−0.03		−
		(3.1)**		(0.01)***		(
Property Rights protection		−2.3		0.01		−
		(3.6)		(0.01)		(
Observations	131	123	124	117	131	
R^2	0.20	0.24	0.47	0.48	0.21	0

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