Financing Constraints and Firm Investment in Human Capital: Evidence from Emerging Markets*

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Abstract

Using a unique survey database of 9,655 firms from 27 emerging markets, I investigate whether various financing constraints affect investment in on-the-job training. I find that general lack of access to finance, the inavailability of bank credit, and strict collateral requirements reduce corporate investment in human capital. These effects are stronger for small firms and for firms which rely on external finance for technological reasons. Importantly, the results are not driven by less efficient firms reporting higher constraints, and they are robust to accounting for labor market frictions.

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1 Introduction

Evidence abounds that investment in the human capital of its employees is essential for enhancing the firm's productivity. For example, Bartel (1994) finds that firms which implemented new training programs experience productivity gains of up to 20%, 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. At the same time, the cost of such investment appears to be quite substantial. Total annual spending on on-the-job training in the U.S. economy routinely amounts to 2% of GDP, about one third of total expenses on formal education (for early evidence, see Mincer, 1962, 1974), and the per-employee cost of training programs in the industrial world is over $20,000.[1] The opportunity cost of training is also large: for example, the mean length of a training program for an adult worker is around 1300 hours (or the equivalent of 8 weeks of full employment) in the OECD countries, with a high of 2627 hours in New Zealand.[2] Given that the additional knowledge and skills generated through training are lost to the firm once the worker switches jobs, empirical research has focused heavily on properties of the labor markets in explaining variations in firm-level investment in human capital (see Becker, 1964; Acemoglu and Pischke, 1998, 1999a,b; Arulampalam et al., 2004).

Corporate finance theory provides another possible explanation for why firms would choose not to offer training, which goes beyond mere competitive labor markets. In particular, credit market imperfections, such as those caused by underdeveloped financial systems, may constrain firms' ability to fund investment projects (Greenwood and Jovanovic, 1990). Consequently, financial development promotes growth by alleviating credit constraints, by allocating investment to the highest-return projects, and by allowing firms to exploiting growth opportunities. There is also abundant evidence that financial development has a strong, positive, and causal effect on aggregate growth.[3] Clearly, one channel through which such investment-driven growth will be realized

[1] For example, Von Bardelelben et al. (1995) put the gross annual costs of training in a German apprenticeship program at around $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.

[2] See OECD Employment Outlook report..

[3] The idea to link finance and growth in a causal way traces back to Schumpeter (1912) and later Goldsmith (1969) and McKinnon (1973). The modern impetus to studying the nexus is usually attributed to King and Levine (1993a,b), and includes influential studies by Demirguc-Kunt and Maximovic (1998), Rajan and Zingales (1998), Beck et al. (2000), and Fisman and Love (2007), among others. For recent surveys, see Beck, Demirguc-Kunt, Levine, and

(given the large costs associated with this process) is the channel of on-the-job training. Unfortunately, there is no empirical research documenting whether financial development results in a wider provision of training.

In this paper, I investigate empirically whether financing constraints affect negatively the firm's ability to invest in its employees' human capital. I employ a simple investment model to show that financial development should raise investment in firm-sponsored human capital by lowering the cost of credit to constrained firms, accounting for the properties of the labor market. Next, I use data from the 2005 Business Environment and Enterprise Performance Survey (BEEPS) on $9,655$ firms from 27 emerging markets to analyze the impact of various financing constraints on corporate investment in human capital. The survey contains detailed firm-level information on on-the-job training practices by firms, as well as firm balance sheets and ownership information. It also contains data on the specificity of the firm's technology, on the firm's degree of monopsony power, and on labor market rigidities faced by the firm, all of which allow me to account for standard predictions from human capital theory.

A priori, it is unclear whether it is small or large firms that should benefit more from such development. On the one hand, large firms are able to internalize most of the capital allocation functions carried out by financial intermediaries, so by that rationale, it is small firms that should benefit disproportionately from financial development (Aghion and Bolton, 1997; Beck et al., 2008). On the other hand, large firms depend to a larger extent on long-term investments and on larger loans, so in that sense, it is them who should be disproportionately affected by such improvements (King and Levine, 1993; Petersen and Rajan, 1995). The detailed firm-level data allows me to test explicitly these theories.

The empirical results suggest that financial constraints do affect the provision of firm-level training. In addition to general access to financing being problematic, an actual or an expected loan rejection, lack of access to equity capital, and strict collateral requirements are also associated with less training. Small firms are affected more by all types of constraints, and so are firms in industries more dependent on external finance. Institutional development seems to alleviate such constraints: I find that training is higher in countries with better developed credit markets, in

Maksimovic (2001) and Levine (2005).

countries with better information sharing, and in countries with better investor protection. Finally, I find that through the channel of less training, financing constraints reduce the firm's efficiency as firms which offer formal training grow faster and introduce more often new product lines and new technologies.

The empirical tests are designed as to control for a number of alternative explanations. In particular, markets characterized by credit constraints may also have underdeveloped legal systems, high degree of corruption, and underregulated labor markets. Consequently, firms may be training less because the lack of contract enforcement decreases the rate of return on investment, because corruption imposes a hidden tax, diverting resources away from investment, or because high employee turnover reduces the firm's incentives to train. The BEEPS contains information on legal, corruption, and labor obstacles, thus allowing me to control for all these alternative stories explicitly. While legal efficiency and labor regulations turn out to have an independent effect on corporate training decisions, the effect of financial constraints remains intact.

The paper builds on earlier studies on the real effects of financial constraints (e.g., Fazzari et al, 1988). La Porta et al. (1998) argue that differences in financial systems can explain much of the variation across countries in firms' financial policies and performance. Demirguc-Kunt and Maksimovic (1998) show that firms in countries with developed financial institutions obtain more external financing than firms in countries with less developed institutions. Cooley and Quadrini (2001) and Clementi and Hopenhayn (2006) develop theoretical models of borrowing/lending relationships to support the conjecture that borrowing constraints have important implications for firm growth and survival.

The paper also provides important evidence related to reforming financial systems in emerging economies, with a particular focus on its effect of human capital accumulation. While previous studies have pointed to the large negative effects of financing constraints on firm growth (Beck et al, 2005), the exact mechanisms for this effect are not fully understood. In particular, the literature has mostly focused on the effect of financing constraints and financial development on physical capital accumulation (Love, 2003). At the same time, financial development has been linked in a causal way to an increase in economic efficiency and productivity (Wurgler, 2000; Beck et al., 2000). The empirical link tested in this paper is one of the potential channels through which

financial development may lead to higher firm-level, as well as aggregate, productivity.

Finally, this paper provides the first direct test of how financing constraints affect training. Becker (1964) emphasized very early on the importance of credit constraints in the provision of human capital. He argued that if employees are constrained in their ability to fund their training, firms may step in and pay for the training provided that they can offer higher wages during the training period. However, for this to be the case, the firms themselves should not be constrained. While the literature has provided indirect tests of this argument based on the difference between wages and marginal productivity during the training period (e.g., Booth and Bryan, 2005), my paper is the first to offer a direct estimate of the magnitude of the effect of financing constraints on training, based on the observed severity of actual financing constraints.

The paper proceeds as follows. Section 2 presents a stylized theoretical model of credit constraints and corporate investment in human capital. Section 3 describes the data. Section 4 lays out the empirical methodology and presents the results from the empirical analysis. Section 5 concludes.

2 A 2-Period Model

Here I describe a simple model of corporate investment in human capital in the presence of credit constraints. A risk-neutral entrepreneur faces a deterministic maximization problem, has an initial asset level $a_0 = 0$ and lives for two periods. Her problem is to maximize

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

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

In period 0 the entrepreneur hires n new workers (I assume the number of workers is not a choice variable) and trains them at a level $\alpha \in R_+$. In period 0 the workers produce nothing. Investment in human capital is the sole engine of productivity growth, thus in the second period the entrepreneur generates revenues $y_1 = A \cdot n \cdot f(\alpha)$, where A is the technology available and $f(\alpha)$ is, for now, a general function of α. There is a specific set of skills necessary to work on the

project, which the newly employed workers do not possess.[4] 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 utility

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

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 $l_t \in \left\{0, \overline{L}\right\}$. We 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.

External funds are provided by investors who are risk neutral and discount the future at the interest rate r. As in Michelachi and Quadrini (2005), We assume that $\beta \leq \frac{1}{1+r}$ so that internal financing doesn't dominate external financing.

2.1 The investment problem: financial constraints

In this section we show how a different degree of legal and credit constraints can affect generate variation in the volume of training. 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 retiring or switching jobs. There is also an outside option, $\overline{w}(\alpha)$, which increases with the level of training.

[4] One can think of those as not being provided by the educational system.

As noted before, investment in human capital α is mapped into production y using a function $g(\alpha)$, where $g'(\cdot) \geq 0$ and $g''(\cdot) \leq 0$. Also, there is a cost of training $c(\alpha)$ such that $c'(\alpha) \geq 0$ and $c''(\alpha) \geq 0$. This ensures that the first-best training level is given by the equation $(1-\eta)\beta A g'(\alpha^*) = c'(\alpha^*)$, and that $\alpha^* > 0$.

Finally, firms and agents 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.

The per-worker maximization problem of the firm can be written as:

$$\max_{\{\alpha, W\}} \quad (1-\eta)\beta A g(\alpha) - c(\alpha) - W - (1-\eta)\beta w(\alpha) \tag{1}$$

s.t.

$$W + (1-\eta)\beta w(\alpha) \geq \overline{w}(\alpha) \tag{2}$$

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 firm after the first period.

2.2 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 $\{-c(\alpha^*), Ag(\alpha^*)\}$, 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 $\{-c(\alpha^{**}), Ag(\alpha^{**})\}$, where $\alpha^{**} < \alpha^{*}$. It is interesting to note that in this setup, we will observe the same training and wage schedule in all firms regardless of firm size.

2.3 Specific training in competitive labor markets

If training is specific to the firm, then the marginal product of workers in a different firm during the second period is zero. Hence, firms are not concerned that their investment will be lost, so they bear the full cost of training, and workers bear none of the cost of an investment which will have no effect on their productivity outside the firm in which they acquired it. Firms then maximize (1) subject to (2). Let λ be the Lagrange multiplier of (2). If the firms are unconstrained, the two FOCs with respect to α and W are:

$$(1-\eta)\beta Ag'(\alpha) - c'(\alpha) + (\lambda - 1)\beta(1-\eta)w'(\alpha) = 0 \tag{3}$$

$$\lambda - 1 = 0 \tag{4}$$

We can rewrite (3) using (4) as

$$(1-\eta)\beta Ag'(\alpha*) = c'(\alpha*) \tag{5}$$

Hence, firms invest in the optimal amount of training α^{*} as defined by (5), and pay a wage schedule $\{W^{*}, w(\alpha^{*})\}$ subject to the zero-profit condition.

Now, let the firms be constrained in the amount they can borrow. Assume that firms can borrow from credit institutions at a rate R and face a cost of intermediation services φ. Given that firms have a per-worker profit equal to 0 in period 0, but have to finance a per-worker wage and investment related cost equal to $W + c(\alpha)$, then one can rewrite the firm's problem as:

$$\max_{\{\alpha, W\}} \quad (1-\eta)\beta Ag(\alpha) - (1-\eta)\beta w(\alpha) - [W + c(\alpha)](1+\varphi)R \tag{6}$$

s.t.

$$W + (1-\eta)\beta w(\alpha) \geq \overline{w} \tag{7}$$

The FOCs for the problem with respect to α and W are:

$$(1-\eta)\beta A g'(\alpha) - (1-\eta)\beta w'(\alpha) - (1+\varphi)Rc'(\alpha) + \lambda(1-\eta)\beta w'(\alpha) = 0 \tag{8}$$

$$\lambda = (1+\varphi)R \tag{9}$$

Hence, we can use (9) to rewrite (8) as

$$(1-\eta)\beta A g'(\alpha) - (1-\eta)\beta w'(\alpha) - (1+\varphi)R\left[c'(\alpha) - (1-\eta)\beta w'(\alpha)\right] = 0 \tag{10}$$

Assume from now on for simplicity that $w(\alpha)$ is linear, thus $w'(\alpha) = k$. Differentiating with respect to α, where α is an implicit function of φ, evaluating at the optimum and rearranging, we obtain:

$$\left[(1-\eta)\beta A g''(\alpha^*) - (1+\varphi)Rc''(\alpha^*)\right]\frac{d\alpha^*}{dR} = (1+\varphi)R\left[c'(\alpha^*) - (1-\eta)\beta k\right] \tag{11}$$

Hence, as long as $c'(\alpha^*) \geq (1-\eta)\beta w'(\alpha^*)$, investment in human capital decreases with the cost of financial intermediation, and firms which face prohibitively costly financial services will choose not to run a training program at all.

2.4 General training in monopsony

This situation is very similar to the previous one. 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. Monopsony would be the case of a factory being the sole employer in a small town, where the cost of reallocating the workers face is sufficiently big. 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. The worker then has no incentive to invest in her training, and thus the firm bears the full cost and invests optimally so that $(1-\eta)\beta Ag'(\alpha^*) = c'(\alpha^*)$. The only difference is that now the firm receives all the returns to training, and workers are pushed down to their reservation utility, so that they are offered a level of training α^* and a wage structure $\{W^*, w(\alpha^*)\}$ such that $W^* + (1-\eta)\beta w(\alpha^*) = \overline{w}$, where $\overline{w}$ is independent of α as there are no alternative employers. Apart from that technicality, the analysis in the previous sub-section applies again.

3 Data and Summary Statistics

The firm-level data come from the 2005 version of the World Business Environment Survey which covers 54 countries throughout the world. I focus on the sub-section of the survey which was administered in the countries from the former Soviet Bloc, as this is the only part of the survey which contains questions on corporate investment in human capital. This sub-survey is known as the Business Environment and Enterprise Performance Survey (BEEPS) and it includes information on $9,655$ firms from 27 countries in Central and Eastern Europe. Apart from screening the firms' experience in dealing with financial, legal, and government institutions, BEEPS also includes questions about firm size, firm ownership structure, sector of operation, industry structure, export activities, subsidies received from central and local governments, etc. The firms were interviewed over a 1.5-year period, between the end of 2004 and the middle of 2005. The survey response rate was 36.9%. Surveyees who refused to participate or were unavailable for interviews accounted for 38.3% of the original target group. Firms that were ineligible due to the necessity to fulfill industry quotas accounted for the remainder. Respondent firms come from 8 different sectors: Mining and quarrying; Construction; Manufacturing; Transportation, storage and communication; Wholesale, retail, and repairs; Real estate, renting and business services; Hotels and restaurants; and Others. The number of firms covered is roughly proportional to the number of firms in the country, ranging from 200 in Georgia to 975 in Poland. The survey also tried to achieve representativeness in terms of the size of firms it surveyed: between two thirds and three quarters of the firms surveyed are "small" (less than 50 workers) and around 10% of the firms surveyed are "large" (more than 250

workers).[5] Table 1 provides the summary statistics on the number of firms and their distribution across industries, by country.

The main advantage of the dataset is that all information is firm-level, thus it enables me to control for a variety of otherwise unobserved characteristics. For example, in Kumar et al. (1999) the effect of financial development on investment is estimated using the industry as a unit of observation. Contrary to this approach, I am able to look at human capital investment decisions at the firm level. In addition, theory suggests that workers' human capital can be complementary with employees' education, as well as with the firm's physical capital base (Griliches [1969]), and that its optimal level can depend on the type of industry. BEEPS enables me to control for firm-level factors which in themselves have an effect on optimal training: firm size, skilled/unskilled labor ratio, educational level of the workforce, competition, whether the firm is an exporter, etc.

Table 2 gives summary statistics for the firm-level, country-level, and industry-level variables used in the empirical part of the paper. All country-level variables are averages for the period 2002-2004, and apart from GDP per capita include various indices for financial development. The industry-level benchmark for external financial dependence is calculated for US publicly listed firms using COMPUSTAT-North America. As noted by Rajan and Zingales (1998) and Beck et al. (2008), the US represents a market which is closest to one operating in the benchmark unconstrained regime, with respect to financial and legal development. Therefore, reliance on external credit by publicly listed (hence, non-constrained) large companies should capture well the industry's demand for (technological reliance on) external finance.

At the firm level, firms were asked qualitative and quantitative questions about how problematic were certain financial, legal, and labor constraints, as well as corruption issues. The relevant questions on financing constraints used in this paper: (a) How problematic is access to financing for the operation and growth of your business (from (1) "No obstacle", to (4) "Major obstacle"); (b) Access to equity capital (0 if no part of the firm's investment is financed with equity, 1 if at least part is); (c) Access to domestic credit (0 if no part of the firm's investment is financed with loans from domestic private banks, 1 if at least part is); (d) Access to foreign credit (0 if no part of the firm's investment is financed with loans from foreign private banks, 1 if at least part is); (e)

[5] See http://www.ebrd.com/country/sector/econo/surveys/beeps.htm for further detailed reports on the representativeness of the survey.

Last application rejected (1 if the firm's last loan application was rejected, 0 otherwise); (f) Loan application burdensome (1 if the firm did not apply for a loan because the loan application process is burdensome, 0 otherwise); (g) Strict collateral requirements (1 if the firm did not apply for a loan because its bank's collateral requirements are too strict, 0 otherwise); (h) High interest rates (1 if the firm did not apply for a loan because interest rates are too high, 0 otherwise); Loan would have been denied (1 if the firm did not apply for a loan because it thought the application would have been rejected, 0 otherwise).

The questionnaire also includes a variety of questions on issues of legal, labor, and corruption nature which allow us to control for a variety of alternative stories that could be affecting corporate investment in human capital. In particular, the firm was asked (a) How problematic is the functioning of the judiciary for the operation and growth of your business (from (1) "No obstacle", to (4) "Major obstacle"); (b) How problematic is corruption for the operation and growth of your business (from (1) "No obstacle", to (4) "Major obstacle"); and (c) How problematic are labor regulations for the operation and growth of your business (from (1) "No obstacle", to (4) "Major obstacle").

Finally, I make use of a set of firm-level controls, which theory has singled as major determinants of investment in human capital. In the first place, the firm's technology may exhibit a capital-skill complementarity[6], and thus size of the firm and the share of skilled labor and of employees with higher education should be included as controls. Ownership is also important in the sense that, for example, government ownership may be associated with soft budget constraints, and hence the detrimental effect of financial and legal constraints may be smaller. To that end, I use dummies that identify the firm as individually-owned, government-owned or foreign-owned. The negative effect of credit constraints will be less severe if firms have access to government subsidies, and so a dummy identifying whether the firm receives subsidies from state or local governments is included. Finally, the line of business and the industry structure may play a role in training decisions by determining the technology used, as well as the demand for quality (assuming that investment in skills and knowledge translates in product quality), and so dummies for industry and whether the firm is an exporter are included, as well as the number of competitors.

[6] See, for example, Griliches (1969) for an empirical methodology.

From the table, it is immediately clear that the distribution of firms in the data is heavily skewed, with 70.5% small firms and19.8% medium firms. The median firm in the dataset is owned by an individual or a family, has a male manager, is originally private, does not export in foreign markets, and receives no subsidies from central or local governments. It is also clear that financing obstacles are more severe than other types of obstacles, like legal obstacles, corruption, or labor regulations. Finally, access to equity as well as to credit, both foreign and domestic, is rather problematic, and only 26% of the firms finance their investment with any type of bank loans.

A number of country-level proxies for financial development are used in robustness exercises to address the potential criticism that firm-level financing obstacles may be heavily biased by firm pessimism. These are described in Table 3. Clearly, there are large variations across the countries in the sample both in terms of economic and financial development, and in terms of investment in human capital. GDP per capita varies from a low of USD 1,367 in Uzbekistan to a high of 17,609 USD in Slovenia. Only about 40% of the firms in the sample offer formal training, with a low of 14% in Uzbekistan and a high of 81% in Slovakia. Access to finance is on average perceived as a "Minor obstacle", but it is almost twice as much of an obstacle in Yugoslavia as it is in Estonia. Private credit to GDP is considerably lower than in developed countries, as high as 0.44 in Croatia and as low as 0.04 in Kyrgyzstan. The quality of credit information sharing ranges from a low of 0 in Albania, Croatia, Georgia, Kazakhstan, Moldova, Russia, and Uzbekistan, to a high of 6 in Lithuania. Finally, investor protection is highest in Kyrgyzstan and lowest in Belarus and Uzbekistan.

Table 4 presents a correlation matrix for the main variables used in the paper. Large firms, foreign-owned firms, and exporters offer the highest training, while individually-owned and small firms offer the lowest training. Financing obstacles are highest for small firms and lowest for foreign-owned firms., and they are lower in richer countries.

4 Results

4.1 Empirical methodology

The empirical focus of this paper is on the effect of financial constraints on the probability of running a formal training program. The basic model used is of the form:

$$Y_{ijk} = \alpha + \beta_1 Fin\ obstacle_{ijk} + \beta_2 X_{ijk} + \beta_3 Q_{ijk} + \beta_4 D_j + \beta_5 D_k + \varepsilon_{ijk} \tag{12}$$

where Y_{ijk} is a dummy equal to 1 if firm i in country j in industry k is running a formal on-the-job training program. X_{ijk} is a matrix of firm-level covariates: size (small/medium/large), ownership (individual/government/foreign), manager male/female, privatized/originally private, exporter, subsidized, and share skilled/educated labor. Q_{ijk} is a matrix of labor, legal, and corruption obstacles. D_j is a matrix of country dummies, and D_k is a matrix of industry dummies. The model is estimated using a probit regression.

Next, I test the theory that the effect of financial constraints on firm investment in human capital should vary by firm size. To that end, I estimate the equation

$$Y_{ijk} = \alpha + \beta_1^l Fin\ obstacle_{ijk} \cdot \mathrm{Si}\,ze_{ijk}^l + \beta_2 Fin\ obstacle_{ijk} + \beta_3 X_{ijk} + \beta_4 Q_{ijk} + \beta_5 D_j + \beta_6 D_k + \varepsilon_{ijk} \tag{13}$$

where $\mathrm{Si}\,ze_{ijk}^l$ is a dummy variable equal to 1 if firm i in country j in industry k has less than 50 employees ($l = 1$), a dummy variable equal to 1 if firm i in country j in industry k has between 50 and 250 employees ($l = 2$), or a dummy variable equal to 1 if firm i in country j in industry k has more than 250 employees ($l = 3$). The coefficients β_1^l, $l \in \{1, 2, 3\}$, should give us an idea if the same financial constraints affects more small firms, as theory predicts, or if its effect does not vary by firm size.

Finally, test the hypothesis that the same financing constraint is more severe for firms which rely more on external finance for technological reasons (Rajan and Zingales, 1998). In particular, I estimate the equation

$$Y_{ijk} = \alpha + \beta_1 Fin\ obstacle_{ijk} \cdot Ext\ dep_k + \beta_2 Fin\ obstacle_{ijk} + \beta_3 X_{ijk} + \beta_4 Q_{ijk} + \beta_5 D_j + \beta_6 D_k + \varepsilon_{ijk} \tag{14}$$

where $Ext\ dep_k$ is a benchmark measure the proportion of capital expenditures financed with external funds for mature Compustat firms over the 1990-2000 period. Consistent with the predictions of theory, we expect the coefficient of β_1 to be negative (financing constraints more severe for externally dependent firms in terms of investment).

In robustness tests, I replace the firm-level constraints with proxies for financial development. Our results will be biased if firms which are not growing because of internal problems systematically shift blame to financial institutions and report high obstacles. In this sense, country-level measures of financial development could provide a less biased view of financial constraints. We use proxies for financial development based on the ratio of private credit to GDP in the economy, on the quality of sharing of information about borrowers, and on the strength of protection of creditors.

4.2 Empirical evidence

4.2.1 Financing constraint and corporate investment in human capital: Main result

Table 5 provides the first basic test of whether the coefficient β_1 in (12) is statistically different from zero. The coefficients are from a probit regression, and we also estimate the economic impact of the obstacle by evaluating its effect at the sample mean. In column (1), the "access to finance" obstacle is the only explanatory variable. The sign on its coefficient is negative and significant at the 1% level, and the magnitude implies that relative to a firm for which access to finance is "no obstacle", an identical firm for which access to finance is a "major obstacle" has a 8.8% lower probability of running a formal training program.

In column (2), I include the rest of the firm-level covariates which theory predicts to have an effect on investment in human capital (see, for example, Barron et al., 1987; Frazis et al., 2000). We find broad support for the classic human capital theory. In particular, the probability of training increases with the size of the employment and the share of the particular group of workers (consistent with the capital-skill hypothesis and the Internal Labor Markets literature), with whether the

company is foreign owned (consistent with the managerial talent-workers skills hypothesis), and with the firm being an exporter (consistent, for instance, with human capital being an investment in product quality). In addition, receiving subsidies from a federal or local government increases the probability of running a training program, as it relaxes the firm's budget constraint. Importantly, the effect of financing constraints does not go away, although the magnitude of its effect is halved.

In column (3), I include country and industry fixed effects. These are important as they net out the effect on all types of market and sector unobservable. For example, markets with tighter credit constraints may be characterized by a higher firm propensity to hoard cash at the expense of investment. Alternatively, firms that face tighter credit constraints may be disproportionately represented in industries where the available technology makes the return to human capital investment lower. I find that such market and sector unobservables do not diminish the impact of financing constraints on the provision of training.

Finally, in column (4) I include the three other types of constraints: legal obstacles, corruption obstacles, and labor regulations. Legal (judiciary) obstacles turn out to have a positive effect on training. Albeit counterintuitive at first sight, this fact may be understood in the sense of the judiciary being too slow to uphold workers' rights in court. In this sense, an inefficient judiciary may be a substitute for strong unions, and unionization is associated with higher investment in training (Dustmann and Schonberg, 2009). Corruption has a negative effect on training (as it diverts resources which could otherwise have been invested productively), but the effect is not statistically significant. Finally, stricter labor regulation is predictably associated with higher training: it may constrain the firm in terms of its efficient hiring and firing, but by binding the firm and the worker, it increases incentives to train (Acemoglu and Pischke, 1999). Importantly, the effect of financing constraints survives.

4.2.2 Financing constraint and corporate investment in human capital: Types of constraints and firm size effects

In Table 6, I look at how specific financing obstacles affect corporate investment in human capital. I enter each of eight different obstacles, described in Section 3, in turn into equation (12), either individually (Panel A) or interacted with dummies for firms size (Panel B). The regressions include

all firm-level covariates from Table 5, but for brevity I do not report those.

Panel A reports that in addition to firms which perceive access to finance as a general problem (column (1)), firms which had their last loan application rejected (column (5)), firms which do not apply for bank credit because collateral requirements are too strict (column (7)), and firms which do not apply for credit because they believe the loan application would be rejected (column (9)), tend to offer less training. Other potential constraints, like access to domestic or foreign banks and high interest rates, are not significantly correlated with the probability of running a formal on-the-job training program. However, access to bank credit is measured as share of investment financed from bank loans. Clearly, this share would be zero if the firm has neither applied for a loan or it has been rejected, so the two sets of constraints should be highly correlated. Nevertheless, many firms that do not employ bank credit to finance investment may have done so because their (unobservable) technology is more suited to financing investment with retained earnings; such firms' demand for bank credit would be zero. Therefore, it is logical that bank constraints bind more for firms that actually desire bank credit but cannot obtain it.

Panel B shows that different types of constraints affect firms differently, based on their size. The types of constraints that have so far been associated with a lower probability of corporate investment in human capital seem to matter mostly for small firms. This is the case for firms which rate access to finance as problematic (column (1)), firms which had their last loan application rejected (column (5)), and firms which do not apply for credit because they believe the loan application would be rejected (column (9)). In addition, lack of access to equity seems to be a problem for small firms when it comes to financing training (column (2)). Medium and large firms seem to be largely unburdoned by financing constraints. In particular, they seem to not be affected by general lack of access to finance, by high bank rejection rates, by strict collateral requirements, and by high interest rates. Nevertheless, medium firms tend to invest less in training if they have been shut out of credit markets (column (9)), and big firms tend to invest less if they do not apply for credit due to burdensome procedures (column (6)). Still, the combined evidence suggests that financing obstacles have a much greater impact on the operation of small firms than on that of medium and large firms.

4.2.3 Institutional proxies for financial development

Next, I address the issue of whether the effect of firm-level obstacles is not overestimated due to unobservable firm pessimism. In particular, it is possible that firms which are not growing due to unobservable internal problems may systematically blame the financial system for it, and so over-report financing obstacles. If this is the case, the estimated effect of financing obstacles may overrepresent the true one. To that end, In Table 7, we perform a robustness check by replacing the self-reported firm-level obstacles with country proxies for financial development. In particular, I employ the logarithm of GDP per capita, the ratio of private credit to GDP, an index of credit information sharing, and an index of investor protection. These measures should measure actual ease of access to finance for all firms in the economy. Finally, I interact them with dummies for firm size (as in equation (13)) in order to be able to gauge the differential effect of constraints while being able to eliminate the effect of country-level unobservables common to all firms.

The institutional constraints tell a slightly different story than the firm-level constraints in the sense that whenever they matter, it is not small firms that they matter most for. For example, firms tend to offer more training in countries with higher degree of economic development, proxied by log GDP per capita, and the magnitude of effect actually increases in firm size. It is quantitatively about 50% higher for large firms than for small firms (column (1)). The quality and scope of credit information sharing is associated with more training by medium firms only (column (3)). Finally, how strictly investors are protected matters for firms of all sizes, but relatively more so for medium firms (column (4)). While the ratio of private credit to GDP, which captures various credit market developments, doesn't seem to matter on its own, it does for small firms in the horse race, alongside economic development and investor protection (column (5)). In all, these results confirm that financial constraints - and by extension, financial development - matter for corporate investment in human capital, but they also suggest that small firms may be overestimating the degree to which they are constrained.

4.2.4 Financing constraint, external dependence, and corporate investment in human capital

While most of the firms in the sample are SMEs and so one wouldn't expect them to be able to affect their country's financial development, endogeneity concerns still linger. I the sub-previous section I addressed the concern that the perception of financing constraints and investment in human capital are jointly determined by production inefficiencies. In this sub-section, I address the concern that the distribution of firm sizes is not identical across countries, and countries with a higher number of large firms may able to lobby the financial sector for better financial services, ultimately benefiting everyone. To address this issue, I now investigate whether the effect of financial constraints is higher for industries that are for technological reasons more dependent on external finance. The test described by equation (14) is based on interacting financing constraints and proxies for financial development with an industry benchmark for external dependence based on the demand for funds of large firms in a financial developed market (the U.S.). The idea, borrowed from Rajan and Zingales (1998) is based on the fact that the firm's technology is fixed, so it cannot "jump" industry classes in response to financing constraints, and that in addition financial constraints should be more detrimental for firms which for technological reasons finance a large portion of their investment with borrowed funds. While addressing the issue of reversed causality directly, this test would be weaker if firms that are capable of lobbying for better access to finance also tend to be dependent on external finance and more represented in more financially developed countries, but Table 1 suggests that the distribution of firms across industries is similar for all countries in the sample.

The results reported in Table 8 suggest that indeed financing constraints tend to have a more detrimental effect on investment in industries more dependent on external finance. In particular, column (1) suggests that the self-reported financing constraint decreases the probability of running a formal on-the-job training program for firms in such industries. Lending strength to this result, column (3) suggests that firms in industries more dependent on external finance tend to offer more formal training in countries with better developed credit markets. These two results survive a horse race which controls for economic development, credit information, and investor protection (column (5)), but these seem to not matter on their own. In all, these results suggest that the contamination of the effect of constraints on training by reversed causality is rather limited.

4.2.5 Financing constraint and corporate investment in human capital: Consequences for firm innovation and growth

One natural question to ask given the evidence so far is, what are the consequences of financing constraints through the channel of lower accumulation of firm-level productive knowledge. Less training would not be as detrimental if lack of training did not damage the firm's ability to innovate and grow. On the other hand, while the ability of financial markets to promote innovation is well understood, the channels through which this is realized are less so. In general, the evidence suggests that innovative growth is due to more productive use of capital. In particular, Beck et al. (2000) and Bonfiglioli (2008) show that financial sector development and financial integration help economic growth mostly through more efficient resource allocation rather than through increases in the scale of physical investment or savings mobilization. This suggests that one of the channels of this effect could be the accumulation of industrial human capital.

In Table 9, I set to investigate this question directly. As proxies for firm innovation, I pick questions on product line development and updating. In particular, the survey questions ask whether the firm "developed successfully a major new product line" in the past three years, whether the firm "upgraded an existing product line" in the past three years, whether the firm "introduced a new technology" in the past three years, and it asks for an estimate of average annual firm growth over the past three years. I employ these questions as proxies for firm innovation and dynamism. The estimates imply that firms which invest in their employees' human capital more frequently introduce new product lines (column (1)), update their existing product lines (column (2)), and introduce new technologies (column (3)). In addition, such firms tend to grow faster by 4.6% annually (column (4)). The evidence is thus suggestive of the fact that by reducing training, financing constraints are detrimental to both disruptive and gradual innovation, and so it points to one possible explanation of the negative effect of financing constraints on firm growth in Beck et al. (2005).

5 Conclusion

In this paper I investigate whether the financing obstacles firms report affect their propensity to invest in their employees' human capital, as well as the consequences of potential underinvestment. By making use of a unique survey database of $9,655$ firms from 27 emerging markets, I investigate a rich set of obstacles reported by firms, and I directly test whether any of these obstacles are significantly correlated with the availability of on-the-job training. The database also allows me to focus on differences in firm size, since it has a good coverage of small, medium, and large firms for each country. It also allows me to investigate the effect of technological dependence on external finance, as the firms in the database come from a variety of industries. I also check whether the effect of financing constraints is not overestimated by firms' excessive pessimism. Finally, I study the real implications of underinvestment in training in terms of firm innovation and growth.

The results indicate that general lack of access to finance, high bank rejection rates, and strict collateral requirements reduce corporate investment in human capital. Being "unconstrained" relative to being "constrained" is associated with about 10% higher probability of running a formal on-the-job training program. However, these results vary by firm size. For example, all of the above mentioned constraints are associated with less training for small firms, while only bank rejections seem to matter for medium firms, and only the the burdensome credit application process seems to matter for large firms. There is also some evidence that small firms may be overestimating the severity of financing constraints: when I employ country-level proxies for financial development, like general economic development and investor protection, I find that they matter equally, in terms of investment in human capital, for firms of all sizes. However, financial development measured by credit to the private sector indeed matters only for small firms, suggesting that credit market frictions are especially severe for those. Finally, concerns about reversed causality (more efficient firms lobbying for lower constraints) seem to be unfounded as the evidence suggests that the effect varies by industries as well as by firm size, and that firms in industries more sensitive to external financing indeed experience the largest reduction in human capital investment if they are constrained. These findings are robust to controlling for a variety of firm-level characteristics which should alleviate concerns that financing constraints are stronger for firms with less developed

technologies and firms facing more competitive labor markets.

I also find that underinvestment in human capital has implications for firm-level innovation and growth. In particular, firms that offer less training tend to have less advanced technologies, introduce new products less often, and grow more slowly. While this finding should be interpreted more in the sense of correlation than in the sense of causality, it is indicative of the detrimental effects of underinvestment in human capital.

These results have several important policy implication. For example, I show one particular channel through which financial constraints may be holding back economic growth in emerging markets with underdeveloped financial services. Many international institutions have been advertising different subsidy programs in order to stimulate SMEs and overcome credit constraints. By controlling directly for whether the firm receives subsidies from the local or federal government, I show that while subsidies may be important, larger gains may be achieved simply through competitive credit market reforms. Consistent with the evidence in the last part of the empirical section, these gains will be even bigger in the future, as the economies in these countries evolve from ones based on agriculture and manufacturing to ones based on knowledge, implying higher return to investment in both general and specific human capital. My paper also shows that small firms stand to benefit most from this process, and so the conclusions are especially important for emerging markets in which SMEs constitute the backbone of economic activity.

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Table 1. Industry distribution, by country

This table reports the total number of firms per country (Column 1), and the distribution of firms by industry per country. Industry 1 is Mining and quarrying; Industry 2 is Construction; Industry 3 is Manufacturing; Industry 4 is Transport, storage, and communication; Industry 5 is Wholesale, retail, and repairs; Industry 6 is Real estate, renting, and business services; Industry 7 is Hotels and restaurants; Industry 8 is Others. In some cases, the shares do not add up to 1 due to rounding. See Appendix for all variables definitions and sources.

Country	# firms	Industry 1	Industry 2	Industry 3	Industry 4	Industry 5	Industry 6	Industry 7	Industry 8
Albania	204	0.015	0.108	0.373	0.098	0.235	0.054	0.074	0.044
Armenia	351	0.011	0.037	0.647	0.031	0.142	0.046	0.051	0.034
Azerbaijan	350	0.014	0.091	0.600	0.043	0.171	0.023	0.029	0.029
Belarus	325	0.000	0.252	0.169	0.098	0.317	0.080	0.028	0.055
Bosnia and Herzegovina	200	0.015	0.075	0.365	0.070	0.310	0.035	0.080	0.050
Bulgaria	300	0.020	0.077	0.193	0.100	0.367	0.087	0.083	0.073
Croatia	236	0.042	0.119	0.301	0.076	0.254	0.127	0.051	0.030
Czech Republic	343	0.009	0.137	0.239	0.099	0.239	0.125	0.076	0.076
Estonia	219	0.023	0.119	0.183	0.082	0.251	0.183	0.119	0.041
Georgia	200	0.010	0.050	0.245	0.090	0.325	0.115	0.075	0.090
Hungary	610	0.011	0.072	0.585	0.036	0.161	0.061	0.039	0.034
Kazakhstan	585	0.021	0.097	0.593	0.031	0.142	0.074	0.022	0.021
Kyrgystan	202	0.045	0.119	0.277	0.074	0.297	0.079	0.045	0.064
Latvia	205	0.005	0.063	0.166	0.088	0.434	0.161	0.049	0.034
Lithuania	205	0.020	0.127	0.215	0.137	0.239	0.112	0.127	0.024
Macedonia	200	0.015	0.070	0.280	0.070	0.370	0.060	0.075	0.060
Moldova	350	0.014	0.017	0.586	0.040	0.240	0.009	0.023	0.071
Poland	975	0.000	0.090	0.541	0.066	0.197	0.056	0.017	0.033
Romania	600	0.000	0.048	0.643	0.043	0.140	0.053	0.035	0.037
Russia	601	0.020	0.145	0.246	0.062	0.290	0.092	0.038	0.108
Slovakia	220	0.009	0.095	0.164	0.077	0.245	0.268	0.077	0.064
Slovenia	223	0.027	0.117	0.251	0.076	0.188	0.175	0.067	0.099
Tajikistan	200	0.035	0.115	0.295	0.075	0.255	0.095	0.055	0.075
Ukraine	594	0.007	0.120	0.303	0.059	0.256	0.131	0.067	0.057
Uzbekistan	300	0.020	0.123	0.233	0.077	0.353	0.100	0.067	0.027
Turkey	557	0.016	0.068	0.287	0.054	0.364	0.056	0.117	0.038
Yugoslavia	300	0.017	0.077	0.280	0.083	0.297	0.110	0.080	0.057
Total	9,655	0.014	0.097	0.394	0.066	0.239	0.088	0.051	0.051

Table 2. Summary statistics

This table gives summary statistics of the firm-level (Panel A), country-level (Panel B), and industry-level (Panel C) variables used. 'On-the-job training' is a dummy=1 if the firm is running a formal on-the-job training program. 'Small firm' is dummy=1 if the firm has less than 50 employees. 'Medium firm' is dummy=1 if the firm has between 50 and 250 employees. 'Large firm' is a dummy=1 if the firm has more than 250 employees. 'Individual owner' is a dummy=1 if the firm is owned by an individual or a family. 'Government owner' is a dummy=1 if the firm is owned by a government agency. 'Foreign onwer' is a dummy=1 if the firm is owned by a foreign company. 'Privatized' is a dummy=1 if the firm was formerly state-owned. 'Exporter' is a dummy=1 1 if the firm has access to foreign product markets. 'Subsidized' is a dummy=1 if the firm receives subsidies from state or local governments. 'Share skilled workers' is the ratio of employees with at least some university education to the firm's total employment 'Share university education' is the ratio of employees with at least some university education to the firm's total employment. 'New product line' is a dummy=1 if the firm has introduced a new product line in the past 3 years. 'Product line upgrade' is a dummy=1 if the firm has upgraded an old product line in the past 3 years. 'New technology' is a dummy=1 if the firm has introduced a new technology between 2002 and 2005. 'Sales growth' denotes the firm's growth in total sales between 2002 and 2005. The different financial, legal, corruption, and labor obstacles are survey responses as specificed in the firm questionnaire. Higher numbers indicate greater obstacle. 'Log GDP per capita' is the natural logarithm of real per capita GDP, in U.S. dollars. 'Private credit to GDP' is the ratio of credit outstanding to the private sector divided by GDP. 'Credit information index' is a measure of the quality of credit information in the country. 'Investor protection' is an average index of disclosure, director liability, and shareholders rights. All country-level variables are averaged over 2002-2005. 'External financial dependence' is the median industry ratio of capital investment minus cash flows divided by total assets for mature Compustat firms, averaged for 1990-2000. 'Credit dependence' is the median industry share of capital investment financed with bank credit for large German firms, as reported in the 2004 BEEPS. See Appendix for all variables definitions and sources.

Panel A. Firm variables summary statistics

Variable	mean	median	st. dev.	min.	max.
On-the-job training	0.402	0	0.490	0	1
Small firm	0.705	1	0.456	0	1
Medium firm	0.198	0	0.399	0	1
Large firm	0.096	0	0.295	0	1
Individual owner	0.717	1	0.451	0	1
Government owner	0.087	0	0.283	0	1
Foreign owner	0.057	0	0.232	0	1
Female manager	0.205	0	0.404	0	1
Privatized	0.144	0	0.351	0	1
Exporter	0.246	0	0.431	0	1
Subsidized	0.069	0	0.253	0	1
Share skilled workers	49.510	50	31.153	0	1
Share university education	28.215	20	29.350	0	1
New product line	0.352	0	0.478	0	1

Product line upgrade	0.510	1	0.500	0	1
New technology	0.322	0	0.467	0	1
Sales growth (in 100%)	23.920	15	33.724	0	4
Financing obstacle	2.260	2	1.136	1	4
Legal obstacle	2.046	2	2.102	1	4
Corruption obstacle	2.151	2	1.137	1	4
Labor obstacle	1.867	2	0.980	1	4
Access to equity	0.087	0	0.282	0	1
Access to domestic banks	0.208	0	0.406	0	1
Access to foreign banks	0.052	0	0.223	0	1
Last loan application rejected	0.037	0	0.188	0	1
Loan application burdensome	0.034	0	0.181	0	1
Strict collateral requirements	0.024	0	0.219	0	1
High interest rates	0.051	0	0.220	0	1
Loan would have been denied	0.012	0	0.108	0	1

Panel B. Country variables summary statistics

Variable	mean	median	st. dev.	min.	max.
Log GDP per capita	8.746	8.886	0.584	7.216	9.77
Private credit to GDP	0.234	0.230	0.142	0.040	0.55
Credit information index	2.522	3.000	1.860	0	6
Creditors rights	6.673	7	2.237	2	10

Panel C. US Compustat industry summary statistics

Variable	mean	Median	st. dev	Min.	Max.
External financial dependence	0.221	0.288	0.205	-0.005	0.574

Table 3. Economic indicators and firm characteristics

This table summarizes some of the main variables of interest by country. 'Log GDP per capita' is the natural logarithm of real per capita GDP, in U.S. dollars. 'On-the-job training' is a dummy=1 if the firm is running a formal on-the-job training program. 'Financing obstacle' is an index of how problematic access to financing is for the operation and growth of the firm, from 1 (no obstacle) to 4 (major obstacle). 'Private credit to GDP' is the ratio of credit outstanding to the private sector divided by GDP. 'Credit information index' is a measure of the quality of credit information in the country. 'Investor protection' is an average index of disclosure, director liability, and shareholders rights. Firm variables are averaged over all firms in the country. See Appendix for all variables definitions and sources.

	Log GDP per capita	On-the-job training	Financing obstacle	Private credit to GDP	Credit info index	Creditors rights
Albania	7.992	0.418	2.179	0.060	0	9
Armenia	8.370	0.296	2.504	0.080	3	6
Azerbaijan	8.174	0.168	2.166	0.050	3	8
Belarus	9.310	0.479	2.460	0.125	5	2
Bosnia and Herzegovina	8.306	0.451	2.406	0.390	5	5
Bulgaria	8.703	0.351	2.054	0.160	3	8
Croatia	9.100	0.565	1.986	0.440	0	6
Czech Republic	9.585	0.621	2.463	0.270	3	6
Estonia	9.222	0.651	1.655	0.240	5	6
Georgia	8.320	0.293	2.286	0.080	0	6
Hungary	9.409	0.391	2.435	0.340	5	7
Kazakhstan	8.886	0.271	1.972	0.080	0	5
Kyrgyzstan	8.072	0.481	2.070	0.040	2	10
Latvia	8.966	0.506	1.642	0.230	3	9
Lithuania	8.974	0.457	1.644	0.140	6	5
Macedonia	8.664	0.399	2.448	0.190	3	7
Moldova	7.762	0.326	2.429	0.150	0	8
Poland	9.194	0.473	2.750	0.280	4	9
Romania	8.639	0.284	2.415	0.250	4	8
Russia	8.938	0.334	2.030	0.160	0	3
Slovakia	9.300	0.806	1.673	0.430	2	9
Slovenia	9.770	0.674	1.936	0.230	3	6
Tajikistan	7.488	0.277	1.880	0.065	2	3
Ukraine	8.560	0.424	2.311	0.230	2	9
Uzbekistan	7.216	0.136	1.960	0.087	0	2
Yugoslavia	8.452	0.442	2.805	0.260	1	8
Total	8.746	0.402	2.260	0.206	2.522	6.673

Table 4. Variables correlations

	On-the-job training	Small firm	Medium firm	Large firm	Individual owner	Government owner	Foreign onwer	Female manager	Privatized	Exporter	Subsidized	Share skilled workers	Share university education	Financing obstacle	Log GDP per capita	Private credit to GDP	Credit infomration index	Creditors rights
On-the-job training	1.00																	
Small firm	-0.22	1.00																
Medium firm	0.14	-0.76	1.00															
Large firm	0.15	-0.50	-0.18	1.00														
Individual owner	-0.14	0.35	-0.17	-0.30	1.00													
Government owner	0.06	-0.25	0.10	0.25	-0.48	1.00												
Foreign owner	0.13	-0.17	0.08	0.16	-0.37	-0.07	1.00											
Female manager	-0.08	0.19	-0.12	-0.12	0.31	-0.15	-0.12	1.00										
Privatized	0.05	-0.26	0.15	0.20	-0.11	-0.11	0.06	-0.06	1.00									
Exporter	0.17	-0.30	0.17	0.23	-0.14	0.03	0.17	-0.09	0.14	1.00								
Subsidized	0.13	-0.17	0.11	0.11	-0.15	0.20	0.01	-0.05	0.03	0.12	1.00							
Share skilled workers	-0.03	0.07	-0.05	-0.04	0.12	-0.08	-0.05	0.08	-0.04	-0.03	-0.03	1.00						
Share university education	0.06	0.01	-0.01	0.00	-0.09	0.06	0.06	-0.03	-0.04	0.04	0.00	-0.32	1.00					
Financing obstacle	-0.06	0.09	-0.05	-0.08	0.08	-0.02	-0.09	0.03	-0.04	-0.02	0.02	0.05	-0.07	1.00				
Log GDP per capita	0.15	0.04	-0.03	-0.01	0.02	-0.03	0.02	0.08	-0.09	0.06	0.16	0.14	-0.20	-0.01	1.00			
Private credit to GDP	0.08	-0.02	0.02	0.00	-0.02	-0.02	0.00	0.03	-0.08	0.08	0.11	0.19	-0.22	0.07	0.37	1.00		
Credit information index	0.04	0.04	-0.01	-0.04	0.03	-0.04	0.04	0.04	-0.08	0.08	0.12	0.13	-0.18	0.08	0.38	0.47	1.00	
Creditors rights	0.07	0.02	0.01	-0.02	0.01	-0.03	0.01	0.04	-0.04	0.05	0.07	0.05	-0.03	0.10	0.09	0.34	0.21	1.00

Table 5. Firm investment in human capital: The role of financing obstacles

This table reports coefficients from fixed effects probit regressions where the dependent variable is an indicator which equals 1 if the firm is running a formal on-the-job training program. Standard errors adjusted for heteroskedasticity within countries and industries appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix for all variable definitions and sources.

	(1)	(2)	(3)	(4)
Financing obstacle	-0.024	-0.012	-0.011	-0.021
	(0.005)***	(0.005)***	(0.005)**	(0.006)***
Small firm		-0.159	-0.172	-0.167
		(0.015)***	(0.015)***	(0.016)***
Large firm		0.055	0.057	0.060
		(0.022)***	(0.022)***	(0.022)***
Individual owner		-0.035	-0.034	-0.040
		(0.017)**	(0.017)**	(0.018)**
Government owner		-0.034	-0.044	-0.053
		(0.025)	(0.025)*	(0.026)**
Foreign owner		0.097	0.104	0.106
		(0.028)***	(0.028)***	(0.028)***
Female manager		-0.025	-0.031	-0.030
		(0.014)*	(0.015)**	(0.016)*
Privatized		-0.031	-0.002	-0.005
		(0.016)*	(0.016)	(0.017)
Exporter		0.110	0.076	0.063
		(0.014)***	(0.014)***	(0.015)***
Subsidized		0.152	0.087	0.086
		(0.023)***	(0.023)***	(0.024)***
Share skilled workers		0.033	-0.017	-0.024
		(0.024)	(0.023)	(0.024)
Share university education		0.130	0.184	0.182
		(0.026)***	(0.026)***	(0.028)***
Legal obstacle				0.030
				(0.007)***
Corruption obstacle				-0.003
				(0.007)
Labor obstacle				0.016
				(0.007)**
Country dummies	No	No	Yes	Yes
Industry dummies	No	No	Yes	Yes
Observations	7,165	7,048	7,048	6,374
Pseudo R-squared	0.01	0.08	0.16	0.16

Table 6. Firm investment in human capital: The role of financing obstacles and of firm size

This table reports coefficients from fixed effects probit regressions where the dependent variable is an indicator which equals 1 if the firm is running a formal on-the-job training program. In Panel A all financial obstacles are entered one at a time. In Panel B all financial obstacles are entered one at a time and interacted with the dummies for firm size. All regressions include the rest of the covariates from Table 5. Standard errors adjusted for heteroskedasticity within countries and industries appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix for all variable definitions and sources.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Financing obstacle	Access to equity	Access to domestic banks	Access to foreign banks	Last loan application rejected	Loan application burdensome	Strict collateral requirements	High interest rates	Loan would have been denied
					Panel A. Level constraints				
Financing obstacle	-0.011	-0.021	0.014	0.018	-0.052	-0.012	-0.057	0.004	-0.149
	(0.005)**	(0.021)	(0.014)	(0.025)	(0.032)*	(0.037)	(0.035)*	(0.029)	(0.048)***
Country dummies					Yes				
Industry dummies					Yes				
Observations	7,048	7,376	7,376	7,376	5,209	5,209	5,209	5,209	5,209
Pseudo R-squared	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15
					Panel B. Constraints interacted firm firm size				
Small firm	-0.017	-0.060	-0.008	-0.016	-0.054	0.001	-0.030	-0.016	-0.184
	(0.007)**	(0.031)**	(0.019)	(0.040)	(0.028)*	(0.040)	(0.047)	(0.033)	(0.052)***
Medium firm	0.004	0.019	-0.018	0.094	0.009	-0.085	-0.125	0.028	-0.262
	(0.013)	(0.052)	(0.031)	(0.054)*	(0.089)	(0.114)	(0.089)	(0.095)	(0.121)**
Large firm	-0.008	0.063	0.012	-0.001	-0.104	-0.365	-0.211	0.226	-0.194
	(0.017)	(0.063)	(0.041)	(0.064)	(0.177)	(0.199)*	(0.170)	(0.133)*	(0.206)
Country dummies					Yes				
Industry dummies					Yes				
Observations	7,048	7,376	7,376	7,376	5,209	5,209	5,209	5,209	5,209
Pseudo R-squared	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15

Table 7. Firm investment in human capital: The role of institutional financing obstacles

This table reports coefficients from fixed effects probit regressions where the dependent variable is an indicator which equals 1 if the firm is running a formal on-the-job training program. All regressions include the rest of the covariates from Table 5. Standard errors adjusted for heteroskedasticity within countries and industries appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix for all variable definitions and sources.

	(1)	(2)	(3)	(4)	(5)
Small firm × Log GDP per capita	0.105				0.158
	(0.029)***				(0.032)***
Medium firm × Log GDP per capita	0.145				0.187
	(0.033)***				(0.036)***
Large firm × Log GDP per capita	0.158				0.203
	(0.037)***				(0.042)***
Small firm × Private credit to GDP		-0.035			0.160
		(0.093)			(0.093)*
Medium firm × Private credit to GDP		0.006			0.003
		(0.150)			(0.145)
Large firm × Private credit to GDP		-0.006			0.012
		(0.150)			(0.177)
Small firm × Credit info index			-0.005		-0.018
			(0.009)		(0.012)
Medium firm × Credit info index			0.013		-0.002
			(0.007)*		(0.113)
Large firm × Credit info index			0.013		-0.004
			(0.012)		(0.015)
Small firm × Investor protection				0.038	0.019
				(0.006)***	(0.008)**
Medium firm × Investor protection				0.050	0.031
				(0.008)***	(0.009)***
Large firm × Investor protection				0.044	0.025
				(0.009)***	(0.011)**
			Yes		
			Yes		
Observations	7,376	7,376	7,376	7,376	7,376
Pseudo R-squared	0.16	0.16	0.16	0.16	0.16

Table 8. Firm investment in human capital: Financing obstacles and external dependence

This table reports coefficients from fixed effects probit regressions where the dependent variable is an indicator which equals 1 if the firm is running a formal on-the-job training program. All regressions include the rest of the covariates from Table 5. Standard errors adjusted for heteroskedasticity within countries and industries appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix for all variable definitions and sources.

	(1)	(2)	(3)	(4)	(5)	(6)
Financing obstacle × External dependence	-0.039					-0.043
	(0.023)*					(0.028)*
Log GDP per capita × External dependence		0.025				0.027
		(0.045)				(0.066)
Private credit to GDP × External dependence			0.314			0.479
			(0.177)*			(0.290)*
Credit info index × External dependence				-0.010		-0.011
				(0.015)		(0.021)
Investor protection × External dependence					0.003	-0.002
					(0.014)	(0.016)
Country dummies			Yes			
Industry dummies			Yes			
Observations	7,047	7,376	7,376	7,376	7,376	7,376
R-squared	0.16	0.16	0.16	0.16	0.16	0.16

Table 9. Firm investment in human capital and financing obstacles: Implications for firm performance

This table reports coefficients from fixed effects probit regressions (columns (1)-(3)) and from an OLS regression (column (4)) where the dependent variable is a dummy=1 if the firm has introduced a new product line in the past three years (column (1)), a dummy=1 if the firm has upgraded an existing product line in the past three years (column (2)), a dummy=1 if the firm has introduced new technology in the past three years (column (3)), and the difference in log sales between the current year and three years ago (column (4)). All regressions include the rest of the covariates from Table 5. Standard errors adjusted for heteroskedasticity within countries and industries appear below each coefficient in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix for all variable definitions and sources.

	(1)	(2)	(3)	(4)
	New product line	Product line update	New technology	Sales growth
Firm offers training	0.378	0.411	0.365	0.046
	(0.034)***	(0.034)***	(0.035)***	(0.009)***
Country dummies		Yes		
Industry dummies		Yes		
Observations	7,376	7,376	7,376	7,119
R-squared	0.09	0.11	0.10	0.08

Appendix. Variables definitions and sources

Variable Name	Definition	Source
	Firm characteristics	
On-the-job training	Dummy=1 if the firm is running a formal on-the-job training program, =0 otherwise	BEEPS 2005
Small firm	Dummy=1 if firm has fewer than 50 employees, =0 otherwise	BEEPS 2005
Medium firm	Dummy=1 if firm has between 50 and 250 employees, =0 otherwise	BEEPS 2005
Large firm	Dummy=1 if firm has more than 250 employees, =0 otherwise	BEEPS 2005
Individual owner	Dummy=1 if the firm is owned by an individual or a family, =0 otherwise	BEEPS 2005
Government owner	Dummy=1 if the firm is owned by a government agency, =0 otherwise	BEEPS 2005
Foreign owner	Dummy=1 if the firm is owned by a foreign company or individual, =0 otherwise	BEEPS 2005
Female manager	Dummy=1 if the general manager of the firm is female, =0 otherwise	BEEPS 2005
Privatized	Dummy=1 if the firm was formerly state-owned, =0 otherwise	BEEPS 2005
Exporter	Dummy=1 if the firm has export sales, =0 otherwise	BEEPS 2005
Subsidized	Dummy=1 if the firm received subsidized from the government in the past 3 years, =0 otherwise	BEEPS 2005
Share skilled workers	Ratio of employees qwith at least some university education to the firm's total employment	BEEPS 2005
Share university education	Ratio of employees with at least some university education to the firm's total employment	BEEPS 2005
New product line	Dummy=1 if the firm has introduced a new product line between 2002 and 2005	BEEPS 2005
Product line upgrade	Dummy=1 if the firm has upgraded and old product line between 2002 and 2005	BEEPS 2005
New technology	Dummy=1 if the firm has introduced a new technology between 2002 and 2005	BEEPS 2005
Sales growth	Variable denoting the firm's growth in total sales between 2002 and 2005	BEEPS 2005
Financing obstacle	How problematic is access to financing for the operation and growth of the firm, from 1 (no obstacle) to 4 (major obstacle)	BEEPS 2005
Legal obstacle	How problematic is the functioning of the judiciary for the operation and growth of the firm, from 1 (no obstacle) to 4 (major obstacle)	BEEPS 2005
Corruption obstacle	How problematic is corruption for the operation and growth of the firm, from 1 (no obstacle) to 4 (major obstacle)	BEEPS 2005
Labor obstacle	How problematic are labor regulations for the operation and growth of the firm, from 1 (no obstacle) to 4 (major obstacle)	BEEPS 2005
Access to equity	Dummy=1 if firm has part of operating expenses financed with equity, =0 otherwise	BEEPS 2005
Access to domestic banks	Dummy=1 if firm has part of operating expenses financed with borrowing from domestic banks, =0 otherwise	BEEPS 2005

Access to foreign banks	Dummy=1 if firm has part of operating expenses financed with borrowing from foreign banks, =0 otherwise	BEEPS 2005
Last loan application rejected	Dummy=1 if firm's last loan application was rejected, =0 otherwise	BEEPS 2005
Loan application burdensome	Dummy=1 if the firm perceives the loan application process as burdensome, =0 otherwise	BEEPS 2005
Strict collateral requirements	Dummy=1 if the firm perceives bank collateral requirements as too strict, =0 otherwise	BEEPS 2005
High interest rates	Dummy=1 if the firm perceives interest rates on loans as too high, =0 otherwise	BEEPS 2005
Loan would have been denied	Dummy=1 if the firm did not apply for a loan because it thought the application would have been rejected, =0 otherwise	BEEPS 2005
	Country characteristics	
Log GDP per capita	Logarithm of GDP per capita in 2005	Penn Tables
Private credit to GDP	Ratio of private credit to non-financial corporations to GDP, averaged over 2001-2004	IFS
Credit information index	Measure of rules affecting the scope, access, and quality of credit information	DBD
Creditors rights	Index of the extent to which collateral and bankruptcy laws facilitate lending	DBD
	Industry characteristics	
External financial dependence	Median SIC 1-digit industry ratio (capital investment minus cash flows)/total sales, for firms older than 10 years	Compustat

Sources: Business Environment and Enterprise Performance Survey (BEEPS), 2005; Penn Tables; IMF International Financial Statistics (IFS), 2004; Doing Business Database (DBD), 2006; Compustat – North America, 1990-2000.