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ABSTRACT

Entrepreneurship, Institutions and Skills in Low-Income Countries[1]

This paper develops a model of costly firm creation in an economy with weak institutions, costly business environment as well as skill gaps where one of the equilibrium outcomes is a low-productivity trap. The paper tests the implications of the model using a cross-sectional dataset including about 100 countries. Both theoretical and empirical results suggest that to move the economy into a productive equilibrium, complementarity matters: reforms to improve the business environment tend to be more effective in creating productive firms when accompanied by narrowing skill gaps. Similarly, more conducive business regulations amplify the positive impact on firm creation of better education and reduced skill mismatches. To escape a low-productivity trap, policymakers should thus create a pro-business framework and a well-functioning education system.

JEL Classification: L26, J24, J48, O17

Keywords: model of start-ups and strategic complements, institutions, education, low-income countries, threshold regression

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1. Introduction

For a number of years, policymakers in low income countries have included productive entrepreneurship as a key part of their strategies for inclusive growth. In contrast to necessity (or subsistence) entrepreneurship aiming at survival, opportunity entrepreneurship can help people escape poverty and contribute to development (Bruton et al., 2013).[2] In many LICs, however, opportunity entrepreneurship and its contribution to growth and job creation have been limited. One of the reasons is the overall weak business environment and large skill gaps, especially when compared to more advanced economies.

The attention on entrepreneurship as a driver of growth and productivity has heightened with the low global growth and the slow-down in world trade. To guide efforts aimed at stimulating entrepreneurship, the Global Entrepreneurship Monitor (GEM) group has developed the 'Entrepreneurship Enabling Conditions' framework, which clusters factors conducive to entrepreneurship into: i) basic requirements (e.g. institutions, infrastructure, macroeconomic stability and human capital); ii) efficiency enhancers (e.g. better education, goods and labor market efficiency, financial sector development, technological readiness and market size) and iii) innovation and entrepreneurship policies (Herrington and Kelley; 2013).

Relatedly, this paper examines the role of institutions, the business environment and skills for firm creation and performance in low income countries.[3] It presents a model of start-ups in an economy with a rigid business environment, skill gaps, and matching frictions. The model builds on Brixiová (2013) and Brixiová and Égert (2012). Similarly to Bah and Fang (2015) it emphasizes the business environment. The paper is related to the literature on education and entrepreneurship, recently applied to Malawi by Kolstad and Wiig (2015). It builds on Redding (1996) and Snower (1996) who model strategic complements in production and related externalities. It shows how an economy can end up in a low-productivity equilibrium, where the overall less productive informal sector provides most of employment. The results of the model are tested on aggregate data for entrepreneurship, governance, business environment and education for a large set of countries. Both theoretical and empirical results show that to move the economy into a productive equilibrium, complementarities matters: reforms to the business environment are more effective in creating productive firms when accompanied by narrowing skill gaps and vice versa.

The rest of the paper is organized as follows. Section 2 gives a literature overview and establishes the paper's contribution relative the literature. Section 3 presents stylized facts on entrepreneurship, institutions, business regulations and education. Section 4 presents the model, the results and model sensitivity analysis.. Section 5 tests the model on a large set of cross country covering developing, emerging and advances economies. Section 6 finally provides some concluding remarks.

[2] Papers that view entrepreneurship as part of the solution to poverty include Anderson et al. (2010), Brixiová and Asaminew (2010), McKague and Oliver (2012), Bandiera et al. (2013), Bruton et al. (2013) and Tobbias et al. (2013).
[3] Focus is on productive entrepreneurship, as its shortage constrains LICs' income catch up with advanced economies. The concept of the business environment utilized in this paper includes both basic institutions and infrastructure as well as greater product and labor market flexibility and access to finance.

2. A Brief Review of Literature

This paper develops a model of entrepreneurial start-ups in an economy with frictions in the labor and product markets and with a sizeable informal sector, as is the case of many low-income countries. The model builds on several strands of the literature. First, it extends the framework of Brixiová and Égert (2012) for transition economies and Brixiová (2013) for developing countries to the case of low income countries by modeling: i) imperfect competition (and information) in the labor market for skilled workers, and ii) frictions in product markets. The model focuses on the creation of new firms as driver of job creation, productivity increase and growth.

Second, in line with Redding (1996) and Snower (1996), we model entrepreneurs' search for business opportunities and workers' training as strategic complements with both exhibiting economic externalities as incentives for undertaking them interdependently. The model shows that in low-income countries where institutions are weak and exchanges in the labor market for skilled workers are sparse, labor and product market failures lead to suboptimal outcomes. The large informal sector and the lack of institutions blur entrepreneurs' information about available workers and discourage them from creating firms. In turn, insufficient firm creation discourages workers from acquiring skills. Together with the rigid business climate, these frictions impede highly-productive private firms to employ skilled labor. In the absence of government coordinating policies, the economy may be 'trapped' in a low-skill and low firm creation equilibrium.

The paper also draws on two strands of literature on endogenous growth theory: i) on human capital accumulation as in Lucas (1988) and Stokey (1991), and ii) on innovation and productivity improvements driven by new firm entrants, as in Acemoglu and Cao (2015) and Bena et al. (2015)[4]. Similarly, Hausmann and Rodrik (2003) show that because of high social value to discovering costs of new activities, policymakers should encourage investment in productive entrepreneurship. Against this background, we study how, in low-income countries, weak institutions and education systems can impede both the creation of highly productive firms and accumulation of human capital. Lastly, our paper is related to the literature on firm entry barriers and firm size distribution pioneered by Jovanovich (1982), Evans and Jovanovich (1989) and Hopenhayn (1992). (Our contributions to this strand lies in shedding light on factors contributing to firm size distribution in low-income countries, with the bulk of firms being small and operating in the informal sector.

The model reflects several stylized facts of the urban labor markets in low income countries, such as the existence of a dual economy where a small modern industrialized sector coexists with a large informal sector with little capital and low marginal productivity of labor. It examines which policies help develop the highly productive formal SME sector. In sum, the model in this paper focuses on start-ups of highly productive private firms in the formal sector, as their absence is an important constraint to productivity and job growth in a number of low income countries (see, for example, Auriol, 2013 and Klapper et al., 2006).

The empirical contribution of the paper is to shed light on the fact that weak institutions and skill/education shortages are complementary with regard to the creation of new businesses. A

[4] Acemoglu and Cao (2015) develop a framework for the analysis of growth driven by both entry of new firms and productivity improvements by existing firms, where entry of new firms leads to more radical innovations. .

string of papers has studied the relationship between institutions and regulations on the one hand and firm entry on the other hand (Desai et al., 2003; Troilo, 2011; Estrin et al., 2013 and Bripi, 2016). Other papers looked at how education influences entrepreneurship and firm growth (Elert, 2012; Lee 2014).Still, to the best of our knowledge, the empirical literature raising the issue of complementarity between education and institutions and regulation is non-existent. In this paper, we try to fill this gap with an empirical analysis for a large panel of countries including developing, emerging and advanced economies.

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3. Stylized Facts

This section presents several stylized facts on the quality of the business environment, education and new firm creation.[5] The business environment can be captured by several indicators. A measure that captures framework stability is the quality of regulations. Panel A of Figure 1 below suggests that higher regulatory quality is associated with higher new firm density, which proxies new firm creation. More generally, higher cost of starting a business and weak property rights can be particularly damaging to entrepreneurship: they hinder entrepreneurship either at the very start by barring entry or by raising the risk of losses directly through expropriation and indirectly due to increased uncertainty. A broad measure of uncertainty is political instability. There is indeed a strong connection between higher political instability and less firm creation and thus reduced entrepreneurships (panel B of Figure 1 below).

Other measures of framework uncertainty include the degree of corruption and the strength of the rule of law. Admittedly, these factors increase uncertainty about future outlook. Greater corruption means higher transaction costs (through bribes and other forms of payments). It also means that laws and rules are applied with discretion and that they can be discriminative and that there is no play level field for businesses. It may also imply that laws are not enforced or are interpreted on a case-by-case basis. This is captured by the rule of law indicator. Panel B of Figure 1 indicates that increased uncertainty stemming from higher political uncertainty, more corruption and weaker rule of law are associated with a lower new business density. Panel C also shows that these effects do not change if splitting the sample into pre- and post-crisis periods.

The data plotted below indicate that more low-income countries operate in a low-quality institution environment. . Defining low-income countries as countries having per capita income below 5000 USD (constant PPP) at any point in time[6], it appears that all these countries are in the bottom half of the distribution regarding regulatory quality. These countries also score badly in terms of political instability, the extent of corruption and the strength of the rule of law. Most of them are clustered below zero and only a few countries in few instances exhibit a little more stability (panel D in Figure 1). These observations suggest that policy interventions aimed at improving the framework conditions could substantially encourage firm creation and entrepreneurship. Firm entry is one of the main drivers of productivity growth. New firms increase competition, which promote a more efficiently allocation of resources across and within firms. Productivity growth is admittedly the single most important driver of long-term economic growth (see e.g. OECD, 2015).

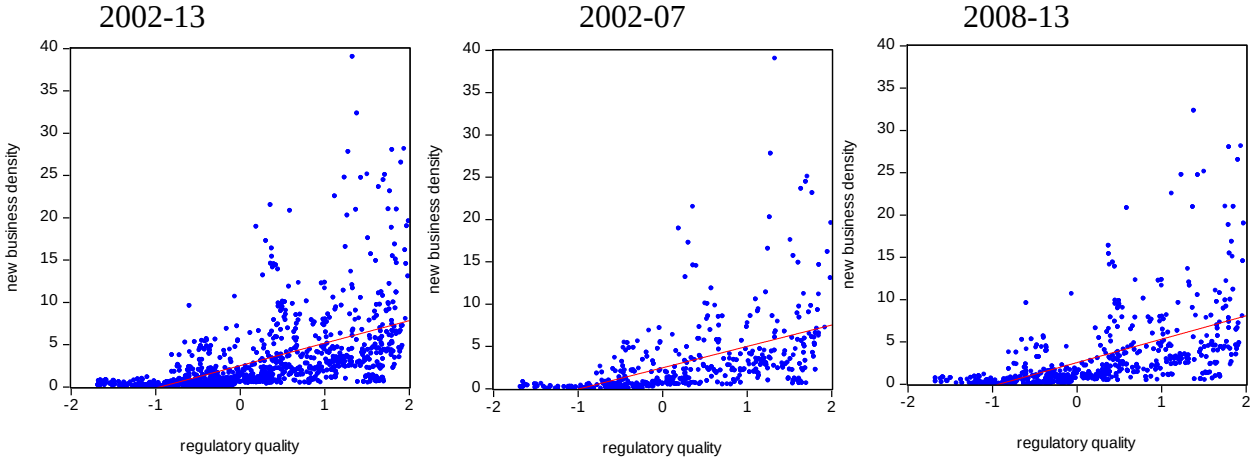
[5] The data presented hereafter cover developing, emerging and advanced economies. We also present data for developing countries separately.

[6] Alternative definitions of developing countries in terms of per capita income (3000 and 7000 USD, respectively) yield very similar results.

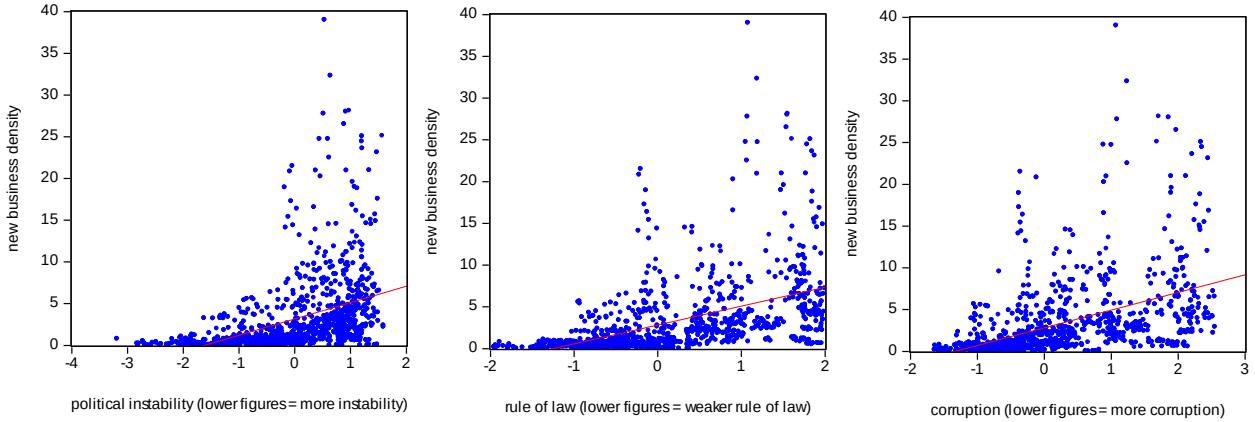
Hence, developing countries could benefit enormously from enhancing framework conditions more conducive to firm creation.

Figure 1. Institutions, regulations and new firm creation

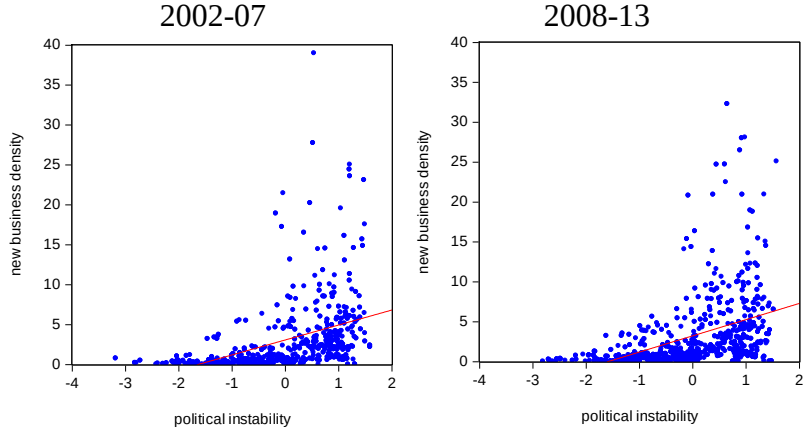
Panel A. The quality of regulations and new firm creation



Panel B. Political instability, the rule of law, corruption and new firm creation

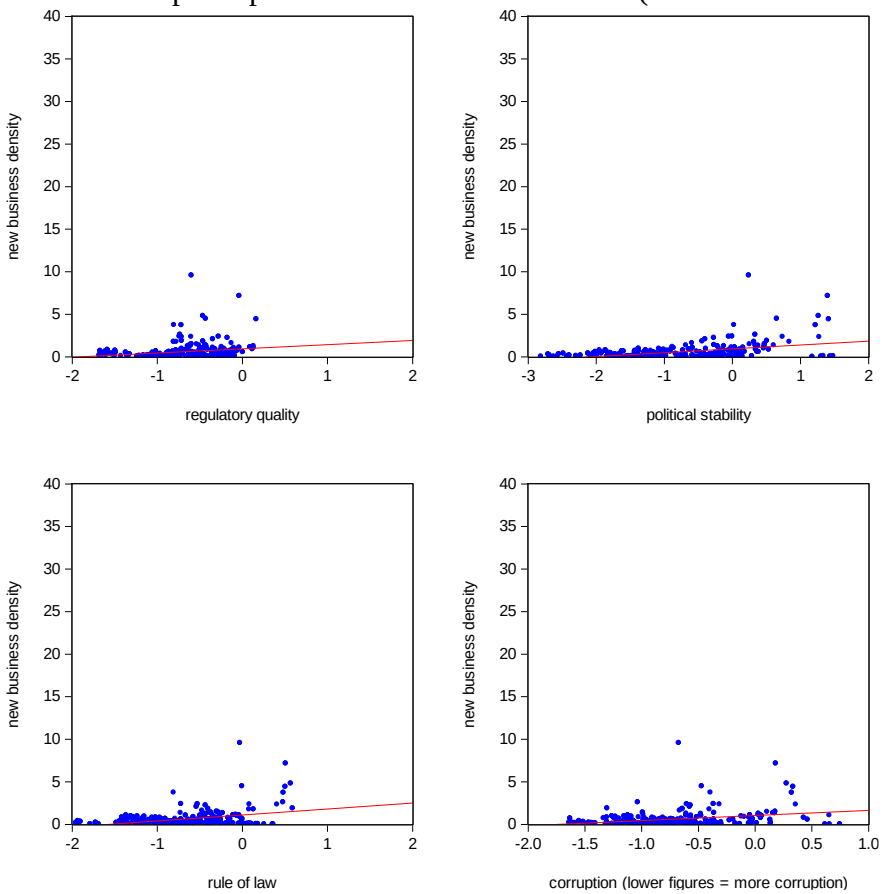


Panel C. Political instability and business creation, sub-samples



Panel D. Regulatory quality, political instability, corruption and the rule of low in low-income countries, 2002-13

Countries with per capita income below 5000 USD (2005 constant PPP).



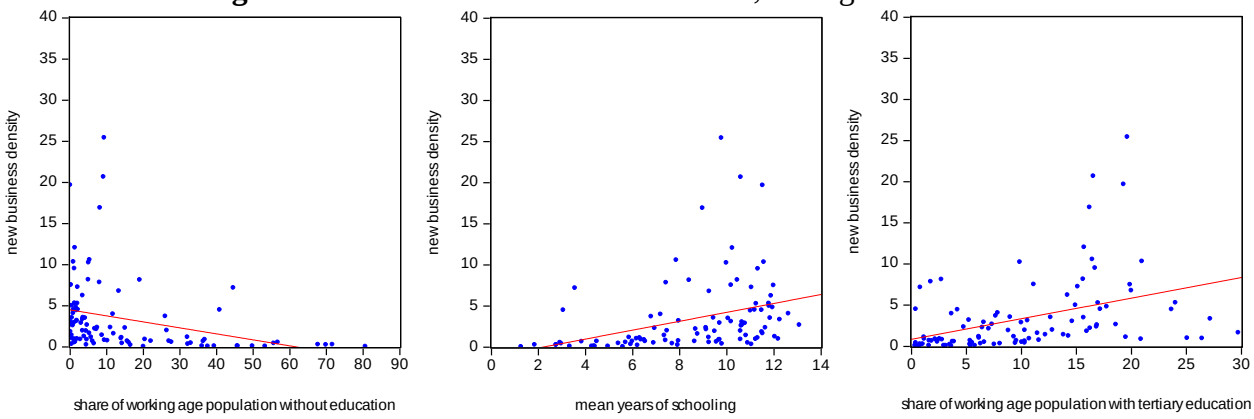
Source: Authors' calculations based on the World Bank Entrepreneurship and World Governance databases.
Note: The sample consists of around 100 developing, emerging and advanced economies. New Business Entry Density is the number of newly registered companies per 1,000 working-age people.

Above and beyond a general framework helping the entry, thriving and exit of businesses including regulation and macroeconomic and political stability, an educational system that would instill entrepreneurial attitudes early on is of primary importance.[7] Education and training for both entrepreneurs and workers, accompanied by job or entrepreneurial search assistance, is an important driver of entrepreneurial start-ups. Eyeball econometrics provides a strong case for this: a population's overall educational achievement seems to be connected with the intensity of firm creation. Figure 2 plots three measures of educational outcomes against new firm density. A higher share of people without education goes hand in hand with reduced firm creation. Measures reflecting the amount of education received over one's lifetime correlate positively with the number of new start-ups: higher mean years of schooling and a greater share of the working age

[7] While the definition of a 'good' education system from the point of view of entrepreneurship varies across countries, in the context of our model it refers to it as a system that would reduce prevalent skill gaps and help match students' skills and competencies with demands of the labor market, including entrepreneurial skills.

population with tertiary education is reflected in more new businesses.[8] Again, this indicates that efforts to improve the quantity of education could probably result in more firm creation and hence better economic outcomes.

Figure 2. Education and new firm creation, average over 2002-13



Source: Authors' calculations based on the World Bank Entrepreneurship and World Development Indicators databases.
Note: The sample consists of around 100 developing, emerging and advanced economies. New Business Entry Density is the number of newly registered companies per 1,000 working-age people

4. The Model and Policy Analysis

This section develops a model illustrating the role of an enabling business environment and skills for stimulating productive entrepreneurship and reflecting the role of skill shortages.

4.1 The Environment

The population is normalized to one. There are two types of agents, entrepreneurs and workers, with population shares μ and $1-\mu$, respectively. They live for one period, are endowed with one unit of time and $\overline{w}$ amount of consumption good, and have preferences, $E(c)$, where c denotes consumption good and E the expectations agents form at the beginning of the period.

Entrepreneurs

At the beginning of the period, entrepreneurs search for opportunities to open productive firms in the private sector. This search costs them $\gamma_1 x + \gamma_2 x^2/2, \gamma_1, \gamma_2 > 0$ units of the consumption good. We thus assume that on the margin, a fixed fraction γ_1 of the consumption good is needed to start searching for opportunities in the formal entrepreneurial sector, after which costs of additional effort rise at a rate $\gamma_2 > 0$. This costly search results in the probability x of finding a business

[8] Data depicted in Figure 2 reflect averages over 2002-13. The scatterplots based on averages from 2002 to 2007 and from 2008 to 2013 are very similar and hence not shown here.

opportunity with productivity per worker z_s. They can turn a business opportunity into a highly-productive firm by hiring $\bar{n}_s$ skilled workers.

The entrepreneurs who found business opportunities in the formal sector and unemployed skilled workers engage in a time-consuming process of search and matching. Similarly to Fonseca et al. (2005), the process is governed by an aggregate matching function.[9] Denoting m_p as number of entrepreneurs who found business opportunity can hire skilled workers, the technology *h* that matches the aggregate skilled vacancies, $V_s = m_p \bar{n}_s$, with skilled workers searching for employment, N_s, is as follows:

$$h = A\min[N_s; V_s] = A\min[N_s; m_p \bar{n}_s] \quad (1)$$

where *h* is the total number of matches and *A* denotes matching efficiency. $A < 1$ since skilled workers have imperfect information about available vacancies and entrepreneurs with skilled vacancies are also not fully aware of available skilled workers. Policy measures that raise the efficiency of the matching process thus include information dissemination and, more generally, job search support, establishment of a national job databases, and quality of labor market placement offices. Transport infrastructure and housing supply are also important, as they allow linking suitable jobs and workers in different locations, overcoming regional mismatches.

Entrepreneurs with a high-productivity business opportunity find skilled workers with probability $\rho = A\min[\frac{N_s}{V_s}, 1]$.[10]

After finding a highly-productive business opportunity and skilled workers, entrepreneurs pay start-up cost c^F (e.g. licensing fee, land and building lese, etc.) and produce output according to (2). The output depends on the productivity level, $z_s > 0$, and the quality of the business environment in the formal sector, β^F, $0 \le \beta^F \le 1$.[11] Firms in the formal sector pay profit tax τ and earn after-tax profit:

$$\pi_s = (1-\tau)(\beta^F z_s \bar{n}_s - w_s \bar{n}_s - c^F) \quad (2)$$

Where w_s is the wage of skilled workers (in the formal sector), determined through bargaining.

Entrepreneurs who do not find highly-productive opportunities or skilled workers open low-productivity firms in the informal sector, with productivity per worker of z_u. The entrepreneurs'

[9] In their dynamic search model, the matching function takes Cobb-Douglas form described.

[10] As Snower (1996) points out, when firms are imperfectly informed about the availability of skilled workers, even skills that are useful to all firms are not general since not all firms have access to these workers. In (1) $A < 1$ to reflect imperfections in the matching process.

[11] More generally, β^F reflects quality of formal institutions. Amoros (2009) shows empirically that differences in institutional quality help explain differences in entrepreneurship across countries.

productivity is further lowered by the business climate factor in the informal sector β^I where $0 < \beta^I < \beta^F < 1$.[12] The entrepreneurs employ unskilled workers, $\bar{n}_u$, where $0 < \bar{n}_u < \bar{n}_s$, that is firms in the informal sector are smaller. Entrepreneurs in the informal sector do not pay taxes, but are subjected to tax monitoring and full confiscation for tax evasion. Their profit amounts to:

$$\pi_u = (1-\phi)(\beta^I z_u n_u - w_u n_u - c^I) \quad (3)$$

where w_u is the wage of an unskilled worker in a low-productivity, informal firm, which equals the income, *b*, of the self-employed in the informal sector, and ϕ is the probability that the firm's tax evasion is detected by the tax authority. In sum, $z_s > z_u > b > 0$ are productivity levels in high-productivity firms (in the formal sector), low-productivity firms (in the informal sector), and self-employed, respectively.

Workers

When acquiring skills demanded in the highly productive private firms, workers incur cost, $k(q) = \theta q^2 / 2$ where $\theta > 0$ is the cost parameter. Their effort results in probability *q* of obtaining skills[13] and probability $\xi = A\min[\frac{V_s}{N_s}, 1]$ of finding a job in a highly productive firm. Workers who do not obtain skilled jobs work in the informal sector, either as self-employed or in a low-productive firm. In both cases they earn income $b < w_s$.

While the market for unskilled workers is perfectly competitive, wages for the skilled workers are set through decentralized bargaining between the skilled workers and the productive private firms. If bargaining does not lead to an agreement, the workers would receive income from self-employment in the informal sector, b. The outcome of decentralized bargaining depends on the relative strength of the skilled worker and the firm, α:

$$w_s = \alpha(\beta^F z_s - \pi_u) + (1-\alpha)b \quad (4)$$

The wage gap between skilled and unskilled jobs amounts to $\alpha(\beta^F z_s - \pi_u - b)$.

Labor Market Clearing Conditions

The characterization of the environment is completed by the labor market equilibrium conditions. Denoting m_u as the share of entrepreneurs running low-productivity firms and employ the unskilled workers, the market clearing condition for the entrepreneurs is:

[12] Dethier at al. (2011) observe that not only can better business environments cause firms to be more efficient, but that also that inherently more efficient firms choose better business environments.

[13] *x* (and *q*) are between 0 and 1. Despite their efforts, workers (entrepreneurs) occasionally fail to acquire skills (find business opportunities).

$$\mu = m_u + m_p \quad (5)$$

Denoting n_s to be the total number of skilled labor employed in the formal private sector, $n_u = m_u \bar{n}_u$ the total unskilled labor in the informal sector, and n_i as the total number of self-employed in the informal sector, the labor market equilibrium condition for workers is:

$$1 - \mu = n_s + n_u + n_i \quad (6)$$

4.2. Multiple Equilibria

An equilibrium in this economy is defined as an allocation of entrepreneurs and workers and wage rate such that: (i) each entrepreneur chooses the effort *x* put into search for business opportunities; (ii) each workers chooses effort *q* put into acquiring skills; (iii) wage rate is set through Nash bargaining as in (4); and (iv) labor market clearance conditions are met.[14]

In equilibrium, the marginal cost of entrepreneur's search for a business opportunity equals the net profit as in Equation (7). Similarly, the worker's marginal cost of acquiring skills equals the expected difference between a skilled wage and alternative income, given by (8): [15]

$$\gamma_1 + \gamma_2 x = \rho(\pi_s - \pi_u) = A \min\left[\frac{(1-\mu)q}{\mu x \bar{n}_s}; 1\right](\pi_s - \pi_u) \quad (7)$$

$$\theta q = \xi(w_s - b) = A \min\left[\frac{\mu x \bar{n}_s}{(1-\mu)q}; 1\right](w_s - w_u) \quad (8)$$

and w_s specified in Equation (4). Equations (7) and (8) can be obtained by solving entrepreneur´s and worker´s problems, together with the labor market clearing conditions (5) and (6). In (7), $\gamma_1 + \gamma_2 x \geq 0$ denotes the marginal cost of entrepreneurial search.

The equilibria form at the intersections of the entrepreneurs' 'search curve' as in (7) and workers' 'training curve' given by (8) and (4). The system described by (4), (7) and (8) can lead to two equilibria: (i) a low-productivity equilibrium, where entrepreneurs exhort limited effort to start firms and (ii) a high-productivity equilibrium with higher effort by entrepreneurs. There are also nonlinearities in the relationship between firm start-ups, institutions and skills. Specifically, at low skill levels and with underdeveloped institutions these two factors can act as substitutes, while at higher levels they become complements.

[14] It is straightforward to show that depending on the parameters, the model either has (i) a unique 'low-productivity' equilibrium where workers and entrepreneurs exert zero effort or (ii) one 'low productivity' and one 'high productivity' equilibrium with positive efforts by workers and entrepreneurs.

[15] In (7) and (8), the number of skilled vacancies is $V_s = \mu x \bar{n}_s$, where $m_p = \mu x$ is the number of entrepreneurs who found a highly productive business opportunity. Similarly, the number of skilled workers searching is $N_s = (1-\mu)q$.

Low Productivity Equilibrium

The first equilibrium is the low productivity trap, where – under a shortage of private firm, i.e. $\mu x\bar{n}_s < (1-\mu)q$ – the business environment (i.e. tax rates, start – up cost, search cost) is such that $\pi_s - \pi_u \leq \gamma_1 / A$. Equation (7) shows that in such environment where difference in profit between running high and low productivity (informal sector) firm is small, entrepreneurs will not search for highly productive business opportunities, i.e. *x = 0*. Equation (8) in turn shows that workers will not acquire skills i.e. *q = 0*. The economy will thus consist only of low-productive firms and unskilled workers, both operating in the informal sector.[16] As Snower (1996) emphasized for the case of developed countries, when the economy is in a low-productivity equilibrium (or 'low-skill, bad-job trap'), the need for public stimulus rises markedly relative to other equilibrium cases.

Profit tax rate is a key policy instrument impacting the equilibrium outcome, as it helps determine the difference in profitability between running a high-productivity (formal sector) and low-productivity (informal sector) firm. Running a private firm in the formal sector needs to be sufficiently profitable to enable entrepreneurs to cover cost of searching for business opportunities.

High Productivity Equilibrium

The second, high productivity equilibrium comprises both positive entrepreneurial search and workers' learning efforts (*x, q>0*). A pre-condition is a business environment conducive enough so that profits in the highly productive private firms employing skilled workers sufficiently higher than those in productive firms with unskilled workers, i.e. $\pi_s \geq \pi_u > 0$. In this equilibrium, the economy consists of both high productivity private firms in the formal sector, low productivity firms in the informal sector as well as self-employed workers in the informal sector.

4.3. Policy Analysis

In this section, we relate the key parameters of our model to evidence on institutions in low income countries. During a start-up phase, each entrepreneur searches for a business opportunity. After a suitable opportunity is identified, the entrepreneurs need to turn it into productive firms. At this stage, they can be hampered by cumbersome registering and licensing procedures, stringent hiring regulations, and the lack of skilled workers, among other factors. The ability of the legal framework to protect property rights is equally important, as it influences the expected profit and hence effort that entrepreneurs put into search. The entrepreneurs also consider the state of the financial infrastructure such as development of capital markets, control of corruption, and effectiveness of the government during their start-up phase.

[16] The second case is when the share of skilled workers is below that or same as the share of skilled vacancies, i.e. $(1-\mu)q \leq \mu x\bar{n}$. When $w^s \leq w^u = b$, that is $\beta^F \leq \frac{\pi^u + b}{z_s}$, unskilled workers will not have incentives to obtain training. The absence of the skilled workers will remove incentives for entrepreneurs to search for business opportunities requiring skilled workers.

Strengthening Institutions

This section underscores the impact of improved institutions on (i) entrepreneurs' search for highly-productive business opportunities; and (ii) workers' effort to acquire skills. It follows from (4), (7) and (8) that in the case of shortage of skilled vacancies, $(1-\mu)q < \mu x\bar{n}_s$, a better business environment (e.g. higher β^F and lower γ) will encourage entrepreneurs to intensify their search effort *(x)* for productive business opportunities. This in turn, will incentivize unskilled workers to acquire skills.[17] A more intense search by entrepreneurs due to improved institutions/business environment and the subsequent additional learning efforts by workers will result in a higher number of productive firms, increased output, and additional productive employment.

Reforming Property Rights

Unclear property rights, which imply a possibility of expropriation (where $\beta^F = 0$), are an important component of the business climate in many low income countries. Denoting probability of expropriation as ψ, the efficiency coefficient in the production function changes to $\bar{\beta}^F = (1-\psi)\beta^F + \psi 0.$ Entrepreneurs are more likely end up running low productivity firms in the informal sector, as the expected profit in the formal sector is reduced by the possibility of expropriation. The reverse also holds – if improvements to property rights are sufficiently large, entrepreneurs who will increase their search effort and more likely end up in the formal sector.

Given two negative externalities (searching and learning) that characterize the low-productivity trap, sizeable interventions both on the side of business environment (generating labor demand) and training (improving quality of labor supply) are needed. The non-linearity in the searching and learning are key for prioritizing interventions. Specifically, policies should first target the most significant constraint to the creation of productive firms. In sectors or communities with shortages of productive firms, policies should focus on better business environment to encourage entrepreneurial search. In (some high-tech) sectors characterized by skill shortages, interventions encouraging training should be prioritized. Since the binding constraint may be changing over time, complementary, and well-sequenced, policies would be most effective.

4.4 An Illustrative Numerical Solution

This section illustrates the impact of policies including an improved functioning of the labor market and business environment as well as lower cost of search for business and reduced profit

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[17] More formally, from (2) $\frac{\partial \pi_s^F}{\partial \beta^F} > 0$ and $\frac{\partial \pi_s^F}{\partial \tau}$, $\frac{\partial \pi_s^F}{\partial \gamma} < 0$. From (7) the entrepreneurial search effort *x* becomes $x = A(\pi_s^F - \pi_u)/\gamma$ if skilled jobs are scarce. Hence $\frac{\partial x}{\partial \beta^F} > 0$ and $\frac{\partial x}{\partial \gamma}, \frac{\partial x}{\partial \tau} < 0$. From (8) then $\frac{\partial q}{\partial x} > 0$.

tax, with a numerical example. Table 1 reports the baseline parameters, chosen to match the available information on labor markets in low income countries or convey reasonable values.[18]

Table 1. Parameters for the illustrative numerical solution

Parameter	β^F	β^I	z_s	z_u	n_s	n_u	γ_1	γ_2	ϕ	A	b	τ	α	θ	μ
Value	0.55	0.35	1.95	1	4	2	0	1	0.1	0.5	0.2	0.35	0.5	0.1	0.3

Applying the parameters from Table 1 to the model generate a a share of the informal sector in total employment of 50 percent and that of informal sector firms in total firms of 71 percent. The indicative elasticity of informal sector employment to changes in each of the policy variables may be calculated by changing the value of these variables by 20 percent and computing the new informal employment rate.

The results reported in Table 2 are consistent with those in the earlier sections: improvements in the business climate would increase the number of highly-productive firms and would boost high-skilled employment. In this example, the 20 percent improvement would lower low skilled/low-wage employment in the informal sector by 27 percent, with a corresponding increase in employment in the formal sector. Another effective way of raising productive, formal sector employment is to improve the functioning of the labor market, including through provision of information and reducing costs of job search. Table 2 also shows that reduced costs of entrepreneurial search (search subsidy) would increase the number of highly productive firms and skilled employment (in both the formal or informal sectors). For firms in the formal sector, wage subsidies or income tax cuts would have a similar effect. Yet they would not impact informal sector firms unless the cuts/subsidies were sufficiently large to induce these firms to formalize.

The results show that government interventions can improve upon the laissez-faire outcome as the economy is characterized by suboptimal level of little investment in education and skill acquisition as well as limited incentives for entrepreneurship in their absence. Optimal policy counteracts these market failures and pro-actively encourages both firm creation and skill acquisition.

Table 2. Elasticities

Variable (1)	New value (2)	New share of informal firms (3)	New share of informal employment (4)	Elasticity of informal employment to 20 % change in variables in column (1) (5)
A	0.60	65	40	-20
τ	0.29	69	47	-6
γ_2	1.20	68	45	-10
β^F	0.65	63	37	-27

[18] For example, the productivity parameters are chosen so that shares of the formal and informal employment are 50 percent each. The gap between the wages of unskilled workers in the informal sector amounts to 1/3 of the wage of the skilled workers, and the wage gap between skilled workers in the formal and informal sector is 40 percent.

Source: Authors' calculations. 1/ Original shares in the formal sector were 30% or firms and 50% for employment.

5. Empirical Analysis

This section sets out to study empirically the issues raised in the stylized facts and then described and analyzed more formally in our model. The econometric estimations reported hereafter are based on a large sample covering as many countries as possible, including developing, emerging and advanced economies. Threshold regressions are used to investigate whether the business environment and education are complementary for firm creation. This section first describes the data used. It then presents the estimation approach. It finally reports the estimation results and provides some policy implications and conclusions.

5.1. Data Issues

The relationship between entrepreneurship on the one hand and institutions, the business environment and education on the other are tested on a cross country dataset, including around 100 developing, emerging and advanced economies. Entrepreneurship is measured by the number of new businesses, normalized by population (new business density). For institutions, we make use of the World Bank's World Governance Indicators. This database contains six variables, which are very strongly correlated with each other. Therefore, we pick the variable capturing political stability. For the business environment, the World Bank's Doing business indicators are employed. This database includes variables measuring the costs of starting a business. More specifically, the indicator measuring the number of procedures necessary to start a business will be used in the empirical analysis. Finally, education is measured by three variables: 1.) people with tertiary education as a share in the population of 25 years of age or more; 2.) the mean years of schooling, and 3.) the share of population without education as a share of the population 25+ years. These series are drawn from the Barro-Lee database on education and the World Bank's World Development Indicators database. These three indicators on education are a measure of the quantity of education and do not necessarily reflect quality aspects. Yet the amount of education most likely captures fairly well the quantity and the quality of education in our sample covering a large number of countries. Differences in quantity are large enough across countries so that quantity also reflects quality (or quality does not matter much).[19]

Data are obtained for the period from 2004 to 2012. The average values for 2004-2012 are used in the regression analysis, mainly in an attempt to filter out short-term noise and to concentrate on long-term outcomes.[20] Table 3 provides an overview of the data used for the estimations. Panel A gives some descriptive statistics. Panel B reports the correlation between the variables. The correlation between the various explanatory variables appears moderate. An exception is the correlation between the alternative measures of education. These variables will therefore be used individually, and not jointly, in the regressions in order to avoid the problem of multi-collinearity.

[19] For a more homogenous group of countries in terms of education attainment (like the OECD countries), measuring the quality of the education would be more important. That could be done using the OECD's PISA or PIAAC measures (PISA is a measure of quality of education at the age 15 years. PIAAC reflects adults' skills.
[20] For instance, one branch of the growth literature uses a similar argument in favour of multi-year averages rather than annual observations (see e.g. Levine and Renelt, 1992; Sala-i-Martin, 1997; Sala-i-Martin et al. 2004; and Crespo-Cuaresma and Doppelhofer, 2007).

Table 3. Data overview

Panel A. Descriptive statistics

	Mean	Median	Maximum	Minimum	Std. Dev.
new business density	3.40	1.93	25.42	0.00	4.35
political stability	0.10	0.19	1.47	-2.47	0.90
starting a business (no. of procedures)	8.12	7.89	17.56	1.56	3.14
share without education	14.12	5.41	80.68	0.12	18.55
share with tertiary education	10.08	9.47	29.74	0.34	7.22
mean years of schooling	8.59	9.27	13.09	1.27	2.91

Panel B. Correlations

	business density	pol. stability	starting business	no education	tertiary education	mean years of school
business density	1					
pol. Stability	0.44	1				
starting business	-0.40	-0.47	1			
no education	-0.32	-0.47	0.20	1		
tertiary education	0.39	0.35	-0.38	-0.58	1	
mean years of school	0.35	0.54	-0.36	-0.89	0.72	1

5.2. Modelling Issues

In the baseline model, the number of new firms per capita is regressed on our measure of institutions / business environment and the education variable. Institutions and business environment are not included at the same time as these variables are highly correlated with each other.

$$NewFirmDensity = c + \alpha_1 Bu\sin essEnvironment + \alpha_2 .Education + \varepsilon \qquad (9)$$

Equation (9) is estimated using OLS. Statistical significance is obtained on the basis of heteroscedasticity robust standard errors. All equations reported below are based on a sample excluding outliers of the dependent variable.

In order to explore complementarities between different policies, we use threshold regressions. They help tell us if the impact of the business environment on business density is different depending on the level of education or the other way around. The threshold value is determined endogenously through a grid search: a grid search with steps of 1% of the distribution is carried out to find the value of the threshold variable that minimises the sum of squared residuals of the estimated two-regime model. The grid search starts at 30% of the distribution and stops at 70% to ensure that a sufficient number of observations fall into each regime. There is evidence for non-linearity if the null hypothesis of $\beta_1 = \beta_2$ can be rejected against the alternative hypothesis of $\beta_1 \neq \beta_2$.

$$NewFirmDensity = \begin{cases} c_1 + \alpha_1 Education + \beta_1 Bu\sin essEnvironment + \varepsilon & if \quad Education < T \\ c_1 + \alpha_1 Education + \beta_2 Bu\sin essEnvironment + \varepsilon & if \quad Education \geq T \end{cases} \qquad (10)$$

and

$$NewFirmDensity = \begin{cases} c_1 + \alpha_1 Bu\sin essEnvironment + \beta_1 Education + \varepsilon & if \quad Bu\sin essEnvironment < T \\ c_1 + \alpha_1 Bu\sin essEnvironment + \beta_2 Education + \varepsilon & if \quad Bu\sin essEnvironment \geq T \end{cases} \tag{11}$$

5.3. Estimation Results

The estimations results of the linear specification (equation 9) lend support to the hypothesis that institutions, regulations and educational outcomes all matter to a large degree for firm creation. We find that better institutions, measured by the political stability, encourage entrepreneurship and business dynamics (columns 1 to 3 in Table 4). Also, a more business friendly regulatory environment, captured by the (lower) number of procedures needed to start a business, appear to boost the number of new firms (columns 4 to 6 in Table 4). Finally, we find that better educational outcomes are associated with a higher number of newly created firms (columns 1 to 6 in Table 4). More specifically, the coefficients on share of people with tertiary education and the mean years of schooling are precisely estimated and have the expected positive sign. Also, and in line with expectations, the share of people without education (people without primary education) is negatively correlated with new firm creation.

These results are reasonably robust to whether the pre-2007 or post-crisis period is considered. Panels B and C of Table 4 report estimations results which are based on period averages for 2004-07 and 2008-12, respectively. The results do not move an inch for the pre-crisis period. Results are also robust for the post-crisis period. The only exceptions are the means year of schooling and the share of population without education (columns 2 and 3), which are not precisely estimated in the equations including political stability. Nevertheless, all three education variables are very robust in the regressions including the cost of starting business variables (columns 4 to 12). More generally, our findings hold for semi-log specifications when the variables on business environment and education are taken in logs (columns 7 to 9) and for log-log specifications (columns 10 to 12) for the entire sample but also for the two subsamples..[21]

[21] Further robustness checks include the use of a variable measuring access to finance, namely the private credit to GDP ratio. This variable is not overly robust but leaves the variables included in the baseline specifications largely unchanged.

Table 4. Business density, institutions, business environment and education

dependent variable	new business per capita									log (new business per capita)		
Panel A: cross-country averages over 2004-12												
	(1)	(2)	(3)	(4)	(5)	(6_)	(7)	(8)	(9)	(10)	(11)	(12)
c	1.849**	0.862	2.994**	3.869**	1.777	5.727**	5.534**	2.076	6.998**	1.265	-1.817	2.766**
political stability	1.384**	1.22**	1.301**									
starting a business (no. procedures)				-0.255**	-0.227**	-0.278**						
share with tertiary education	0.075*			0.097**								
mean years of schooling		0.204**			0.329**							
share without education			-0.027**			-0.05**						
log (starting a business)							-1.916**	-1.747**	-1.708*	-0.987**	-0.855**	-0.882**
log(share with tertiary education)							0.574**			0.559**		
log(mean years of schooling)								2.035**			1.874**	
log(share without education)									-0.478**			-0.394**
adj R-squared	0.319	0.318	0.311	0.175	0.23	0.232	0.154	0.220	0.172	0.309	0.493	0.307
obs / no. of countries	95	95	95	87	87	87	87	87	87	87	87	87
Panel B: pre-crisis period - cross-country averages over 2004-07												
c	1.569**	0.927	2.842**	3.819**	2.643**	5.725**	5.686**	3.556*	7.444**	1.149	-1.32	3.136**
political stability	1.245**	1.166**	1.204**									
starting a business (no. procedures)				-0.267**	-0.266**	-0.292**						
share with tertiary education	0.09**			0.11**								
mean years of schooling		0.18**			0.263**							
share without education			-0.026**			-0.042**						
log (starting a business)							-2.091**	-2.078**	-1.997**	-1.099**	-1.071**	-1.058**
log(share with tertiary education)							0.641**			0.707**		
log(mean years of schooling)								1.618**			1.83**	
log(share without education)									-0.442**			-0.439**
adj R-squared	0.325	0.31	0.311	0.246	0.26	0.278	0.225	0.251	0.222	0.406	0.509	0.355
obs / no. of countries	95	95	95	87	87	87	87	87	87	87	87	87
Panel C: post-crisis period - cross-country averages over 2008-12												
c	1.956**	1.352	2.905**	3.641**	1.908	5.465**	4.889**	2.155	6.559**	1.05	-1.648	2.519**
political stability	1.395**	1.306**	1.391**									
starting a business (no. procedures)				-0.234**	-0.217**	-0.268**						
share with tertiary education	0.067*			0.091**								
mean years of schooling		0.151			0.294**							
share without education			-0.018			-0.045**						
log (starting a business)							-1.657*	-1.605*	-1.629*	-0.866**	-0.79**	-0.848**
log(share with tertiary education)							0.591**			0.519**		
log(mean years of schooling)								1.813**			1.707**	
log(share without education)									-0.378**			-0.327**
adj R-squared	0.295	0.283	0.276	0.146	0.18	0.177	0.133	0.169	0.13	0.277	0.426	0.264
obs / no. of countries	95	95	95	87	87	87	87	87	87	87	87	87

Note: * and ** indicate statistical significance at the 10% and 5% levels, based on robust standard errors.

Our theoretical model posits that the effect of skills (proxied by education) on entrepreneurship (new firm density) varies with the quality of the business environment achieved. In fact, the positive effects of education on entrepreneurship are larger in a pro-business environment than in a business-unfriendly regulatory environment. To test the hypothesis of complementarity between education and the quality of the business environment, we estimate threshold regressions in accordance with equations (10) and (11).[22]

Our estimation results support the view that better educational outcomes lead to more firm creation if it is easier to start a new business. This result indeed suggests that more educated people would create their firms and that they would hire more high-skill workers if the transaction costs are low. But this result also suggests that the effectiveness of educational improvements on entrepreneurship is limited when the costs of business creation are high. Looking at the detailed estimation outputs reported in Table 5, it appears that the coefficient estimates on the mean years of schooling and tertiary education are higher as the administrative burdens to start a business decreases.

[22] We also experimented by the inclusion of interaction terms between education and the business environment / quality of institutions but the estimation results did not show any significant interactions between these variables.

Our results also indicate to some extent that the complementarity between education and better framework conditions works the other way around. That is, the more pro-business regulatory environment will be associated with more firm creation, conditional on higher education outcomes. The specific estimation results reported in column 4 of Table 5 show that the higher the share of uneducated people is, the lower the positive impact on new firm creation of increased political stability is.

Table 5. Complementarities between education and institutions/business environment
Dependent variable: new firms / capita

	(1)	(2)	(3)	(4)
	2.671*	1.377	8.649**	3.687**
political stability				
starting a business (no. procedures)	-0.12	-0.128	-0.549**	
share with tertiary education LOW REGIME	0.279**			
share with tertiary education HIGH REGIME	0.062			
mean years of schooling LOW REGIME		0.537**		
mean years of schooling HIGH REGIME		0.237**		
share without education LOW REGIME			-0.071**	
share without education HIGH REGIME			-0.034**	
share without education				-0.04**
political stability LOW REGIME				2.388**
political stability HIGH REGIME				1.106**
starting a business (no. procedures) LOW REGIME				
starting a business (no. procedures) HIGH REGIME				
Threshold variable	**starting a business**			**no education**
Test of non-linearity (Wald test) p-value	**0.025**	**0.014**	**0.071**	**0.069**
threshold percentile	0.300	0.300	0.660	0.620
threshold value	7.00	7.00	9.93	11.41
adj R-squared	0.257	0.234	0.200	0.204
obs / no. of countries	91	91	91	100

Note: * and ** indicate statistical significance at the 10% and 5% levels, based on robust standard errors. Bold figures indicate that the null hypothesis of no non-linearity can be rejected at the 10% level. Results for alternative educational measured as threshold variables are not reported here because the null of no non-linearity cannot be rejected at the 10% level.

The last question we would like to answer in this paper is whether the effect of education and institutions on new business density depends on the level of economic development, measured by per capita income (USD, constant PPP). is used as the threshold variable.

The estimation results suggest that for countries with per capita income levels roughly below USD 10.000, primary education matters most whereas tertiary education and the mean years of schooling have a positive effect above this threshold. More specifically, the coefficient estimate on the share of people without primary education is strongly negative blow the threshold and not significant above it (columns 1 to 5 in Table 6). Conversely, the other two education variables become statistically significant above that threshold

These findings suggest that basic skills matters most in developing countries. But as countries develop and once there is a broad base for basic skills, secondary and tertiary education matters mostly once there is a broad base for basic skill.

Table 6. Non-linearity depending on the level of development (measured by per capita income) Dependent variable: new firms / capita

	(1)	(2)	(3)	(4)	(5)	(6_)
c	1.87**	1.741**	3.529**	4.459**	4.056**	7.517**
political stability	1.395**	1.167**	1.809**			
starting a business (no. procedures)				-0.304**	-0.319**	-0.454**
share with tertiary education LOW REGIME	0.001			-0.039		
share with tertiary education HIGH REGIME	0.183**			0.191**		
mean years of schooling LOW REGIME		-0.010			0.007	
mean years of schooling HIGH REGIME		0.285**			0.328**	
share without education LOW REGIME			-0.034**			-0.058**
share without education HIGH REGIME			0.058			0.092
Threshold variable	**per capita income**					
Test of non-linearity (Wald test) p-value	**0.001**	**0.000**	**0.089**	**0.000**	**0.000**	0.110
threshold percentile	0.500	0.540	0.540	0.540	0.540	0.580
threshold value	9942	11564	11564	11564	11564	12893
adj R-squared	0.260	0.240	0.207	0.244	0.246	0.219
obs / no. of countries	98	98	98	89	89	89

Note: * and ** indicate statistical significance at the 10% and 5% levels, based on robust standard errors. Bold figures indicate that the null hypothesis of no non-linearity can be rejected at the 10% level.

6. Conclusions

This paper investigated the relationship between the intensity of entrepreneurship on the one hand and institutions, the regulatory environment and skill mismatches on the other hand. 'We developed a model of entrepreneurial start-ups where an equilibrium outcome could be a low-skill, low-productivity trap. We showed that strengthened institutions and education would foster creation of high-productivity private firms, output and employment. The model suggests that reforms to improve the regulatory environment and educational outcomes are complementary. Our empirical estimation results, carried out on large cross-section of countries, confirm the model results and show that more business friendly regulations amplify the positive impact of better education and reduced skill mismatches on firm start-ups.

The first policy implication is that policymakers should strive to improve institutions, the business environment and the education system to spur productive entrepreneurship and thus to achieve better economic outcomes. While this is a hardly surprising conclusion, a more interesting policy implication is that in areas of strategic complements, policy reforms should not be carried out sequentially. That is rather than reforming one area at a time, and once completed, reforming another area, policymakers should move on key aspects of reforms simultaneously to maximize their impact. As the empirical evidence in our paper showed, they should seek to improve institutions, the regulatory framework and the education system in parallel, as reform in one area will positively reinforce the impact of a reform in another area.

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