Is Portuguese regional growth schumpeterian?
An empirical assessment of the relation between schooling, firm destruction and firm productivity

Aurora Castro Teixeira

CEMPRE, Faculdade de Economia,

Universidade do Porto

ateixeira@fep.up.pt

Pedro Cosme Costa Vieira

Faculdade de Economia,

Universidade do Porto

pcosme@fep.up.pt

Abstract

A study focusing Portuguese textile firms dynamics during the eighties and nineties (Teixeira, 2002; Teixeira and Vieira, 2004) demonstrated that plants which tended to hire workers with higher levels of human capital (education) were those that, on average, presented a lower probability of survival. Macro-level evidence on the relation between human capital, per capita income and productivity seems to be at odds with the micro evidence reported. Specifically, at the economy level the bulk of studies found a positive relation between human capital accumulation and productivity dynamics (Michie et al, 2002; Teixeira and Fortuna, 2003; Maudos et al, 2003) which, at first glance, seems hard to match with the micro-level evidence suggesting that the accumulation of human capital is associated with higher failure rates on firm's behalf.

The potential explanation for this may be related with the fact that firms can be positioned into one of the two possible states – low productivity and low risk or high productivity and high risk. In order for a low productivity-low risk firm to become high productivity-high risk firm it has to hire top educated workers. Successful high productivity-high risk firms, i.e, those that survive, are the 'engine of growth'. This may explain that regions, which have higher levels of human capital, be those that, in the medium term, have higher levels of per capita income and higher firm failure rates. This association of higher per capita income/productivity levels and higher firm destruction rates translates the schumpeterian issue of creative destruction (Schumpeter, 1942).

In the present paper we try to validate this theoretical explanation using empirical evidence at the regional level. Based on panel data relative to 27 Portuguese regions (NUTIII) over the period 1992-1999, we estimate an econometric model of the relation between human capital, firm productivity and firm failure rates. Estimation results suggest important policy implications, namely that policy measures involving schooling incentives, i.e., human capital supply side focused policies, should be replaced by more human capital demand side focused policies aiming to easy bankruptcy processes.

Keywords: Schooling, Productivity, Firm Survival, Regions

1. Introduction

It is unquestionable the theoretical argument that workers with higher schooling are more productive than their low-grade counterparts (Becker, 1962). Throughout workers' productive life there is a blending of simple operations, whose productivity is independent of schooling, with complex operations whose, learning curve increases with schooling. This speed of learning has a positive effect on the average productivity of workers (Prais, 1995).

But the schumpeterian question of creative destruction (Schumpeter, 1942) predicts that the dynamic process of productivity increase is associated with firms' failure. Taking into account this schumpeterian association, we intend to test empirically, firstly whether firms increase their risk when hire top educated workers and, secondly whether regions with higher failure risk have a higher level of product per capita.

The paper is structured as follows. In the following section some theoretical underpins of the relation between human capital, productivity and firm survival is highlighted. The empirics is presented in detail in section 3, which is divided into two distinct but interrelated analysis, one related with testing the link between top educated workers hiring and firms survival prospects (section 3.1.), and the other respecting the test of the link between productivity and firms failure risk at the regional level (section 3.2). Finally, section 4 concludes with the main outcomes of the research.

2. On the link between human capital, productivity and firm survival. Theoretical underpins

2.1. The concept of human capital

Classical economists drew attention to the importance of education as a form of national investment. For several classical authors (*e.g.*, Smith, Say and Senior), acquired skills and abilities were seen as increasing worker productivity. Research in the late 1950s and early '60s stimulated a new level of interest in the relationship between education and the economy. These approaches were typically driven by supply side economics, and by the neoclassical notion of equilibrium in which supply (of education) will create its own demand.

The development of modern ideas about human capital is largely due to the works of Theodore Schultz (1961a, b) and Gary Becker (1962) because of their separation (and Becker's wording) of the terms 'general' and 'specific' human capital.[1] This, for the first time, provided a comparative insight into the incentives for the accumulation of capabilities.

2.2. Human capital and productivity

According to several authors - most of them human capital theorists - human capital includes those activities (for instance, education, on-the-job training and off-the-job training) that are likely to increase the productivity of workers in complex ways (Woodhall, 1987): "… increased education may enhance a worker's ability to acquire and decode information about costs and productive characteristics of other inputs" (Welch, 1970: 42); education enhances a worker's "ability to deal with disequilibria" (Schultz, 1975); education enhances productivity because it is complementary to other inputs (such as capital) in the firm (Griliches, 1969), or because it enables workers to adapt to technological change (Nelson and Phelps, 1966).

At the level of firm, neither theoretical nor empirical studies are as numerous as more aggregated studies. In terms of economic performance most studies concentrate on the issues of economic growth or rate-of-return analysis, whereas, in terms of

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[1] Employers could not be expected to invest in an employee's general human capital because of an absence of appropriability. Its accumulation could be seen as the responsibility of the individual or the society as a whole. Specific human capital would serve to stabilise employment and provided its own incentive problems since employees would be reluctant to co-invest in its accumulation unless the employer was willing to compensate them.

technological performance, the bulk of the recent (empirical) literature is focused on the assessment of the hypothesis that technological change is biased toward human capital, and thus generates demands for such human capital.

According to human capital theory firms have an economic incentive to invest in human capital (Becker, 1962). In particular, firms invest in human capital in the expectation of higher future profits derived from higher productivity levels relative to the wage paid. This incentive is bounded only by the existence of (eventual) diminishing returns to human capital, as to any other factor of production.

Several studies emphasize the fact that education and skills may have particular effects at top levels of the firm. Firms hire new managers and invest in both market and production information. Increased education may enhance a manager's ability to acquire and decode information about costs (Welch, 1970), and to achieve and operate the best factory organization (Fleming, 1970). For Pack (1972) managerial skill is in fact the critical catalytic factor for productivity growth.

Putting all levels of skills together, one of the earliest empirical studies to relate human capital and firm performance, Benson and Lohnes (1959), concluded that differences in intensity of employment of skilled personnel appeared to be systematic and were related to the major process and market of plants. More recent research shows that labour quality contributes significantly to explaining inter-firm differences in productivity (Griliches and Regev, 1995) and significantly impact on the companies' abilities to exploit increasing returns and enhance the scale of their operations (Majumdar, 1998). Similarly, Lynch and Black (1995) demonstrate that human capital is an important determinant of establishment productivity.

It is important to note, however, that there still are enormous gaps in the knowledge concerning the magnitude of any links between human capital and economic performance (Ashton and Green, 1996). Direct evidence regarding the impact of education on productivity is not particularly abundant, although virtually all aggregate studies suggest that a positive relation exists (Fallon, 1987). According to Maglen (1990), most of the key links between education and productivity have been assumed rather than tested.

In the present paper we test the relation between human capital and productivity at regional level, aiming at assess whether highly endowed human capital regions are

those where productivity levels are higher. More importantly, this relation is appraised jointly with the schumpeterian question of creative destruction, according to which in more productive regions firm failure rates would be higher.

2.3. Human capital and firm survival

The clear direction of all the studies surveyed in the previous section point to the 'rationality' conveyed by human capital theory, namely that of increasing the quality of the firm's labour force, in other words, the quantity of firm's human capital. Education and training are seen to improve performance in an unproblematic manner by making people more productive workers.

Survival performance is a rather neglected perspective in what concerns performance and human capital related subjects. Most of these studies, namely those associated with human capital theory, implicitly assume that survival is not problematic. In fact, most of the existing empirical studies, both those that use database analysis (e.g., Bartel and Lichtenberg, 1987; Bartel, 1989, 1991; Michie and Sheehan, 1998) or case studies (e.g., Blanchflower and Burgess, 1996; Mason and Wagner, 1998) neglect the issue of survival, focusing their analysis on firms that are in business at the time of survey or study.

Firms, however fail at rates that are too high to support the contention that survival is easy. A large proportion of firms do not survive as identifiable units beyond their first few years, and only a small proportion achieves significant growth (Mansfield, 1962; Mata and Portugal, 1994; Demess/Cisep, 1994; Baldwin, 1995).

The matter of survival has been given less attention in the literature on education and skills than it plays in industrial dynamics. These studies nevertheless refer only in passing (or give only scant attention) to human capital as a relevant variable for firm or establishment survival. Those that mention the human capital variable do so in a rather marginal way, and mostly in relation to the process of entry (Carlton, 1983; Storey, 1986).

Empirically, research on the link between human capital and survival is scarce. Those few studies, which focused explicitly on this link, were that of Bates (1990) and, more recently, that of Teixeira (2002). This later study, relating plants performance with its human capital accumulation patterns, focus essentially on the concept of firms fitness, that is, firms survival capacity; the estimated logistic model provides statistical

evidence that it is more profitable for a textile establishment, in terms of fitness or survival capacity, to maintain inertia (characterised by employment of no top educated or top skilled workers) than to hire an individual with high levels of human capital.

In the present paper we test, at regional level, the relation between human capital endowments and productivity, connecting it with regions' average firm failure rates. The purpose is to assess whether the relation between human capital and productivity results from the straightforward traditional explanation conveyed by human capital theory or, complementarily, this link is intermediated by a less clear-cut connection of human capital and firm survival capacity embedded in the schumpeterian notion of creative destruction. According to the traditional human capital explanation, highly human capital endowed population turns workers more productive and therefore leads to more productive firms and regions. In the second perspective, high levels of human capital requires more intense industrial restructuring, which is achieved through high levels of firm failures. In this process, less capable firms disappear and more able firms enter increasing regions average productivity levels.

3. On the link between human capital, productivity and firm survival. The empirics

3.1. Testing the link between human capital and firms failure risk

Studies focusing the dynamics of the whole population of Portuguese textile firms with at least one wage earner during the eighties and nineties (Teixeira, 2002; Teixeira and Vieira, 2004) demonstrated that small firms increase their risk by hiring workers with high levels of human capital (i.e., schooling).

Similarly to the above-mentioned studies, we test empirically the determinants firms surviving using a hazard function. During a certain period of time (1984-1992), firms survive ($Y = 1$) or not ($Y = 0$). The survival capacity of firms is subjected to a set of exogenous variables, Xex, and to the entrepreneur decisions, a set of endogenous variables Xen. Being β the model parameters, it results:

$$P(Y = 1) = F(Xen, Xex, \beta) + \varepsilon \tag{1}$$

Assuming several control variables (dummy variables for firm size groups and firm

activity sub-sector - further details in Teixeira, 2002), we separate firms into five human capital accumulating patterns from 1984 up to 1988 (using four dummy variables): firms that lost their entire top educated workers (*RF*, Radical Fission dummy); firms that lost some of their top educated workers (*PF*, Partial Fission dummy); firms that maintained all top educated workers (*INP*, Inert Positive dummy); firms that did not have top educated workers (*IN0*, Inert Zero dummy); and firms that increased the number in top educated workers (default category).

$$P(Y=1) = \frac{1}{1+e^{-Z}}$$
$$\Rightarrow \quad Ln\left(\frac{P(Y=1)}{P(Y=0)}\right) = \beta_0 + \beta_1 RF + \beta_2 PF + \beta_3 IN0 + \beta_3 INP + ... + \varepsilon \quad (2)$$

Using data for 1395 observations from textile firms taken from "Quadros de Pessoal" unpublished database embracing the periods 1984-1992, we estimated the following model (Table 1).

Table 1 – Estimation of firms odds of survival, 1988 and 1992 (Portugal)

Variable	Definition	exp(β) estimate and (significance)
RF	Firms that lost their entire top educated workers	0.534 (0.047)
PF	Firms that lost some of their top educated workers	1.390 (0.444)
INP	Firms that maintained all top educated workers	1.030 (0.917)
IN0	Firms that did not have top educated workers	0.695 (0.067)
	Firms that increase top educated workers	1
	Control variables not presented	

Note: The complete estimated model can be seen in Teixeira (2002)

From the estimation, we cannot exclude the hypothesis that the surviving probability of firms that increased the number top educated workers (the default group) is equal to the surviving probability of firms that maintained all (*INP* group) or that lost some (*PF* group) of their top educated workers.

On the opposite, we can accept the hypothesis that the surviving probability of firms that lost their entire top educated workers (*RF*) is smaller than every other group of firms.

The estimation does not guarantees that, on average, firms increase the failure risk by increasing the number of top educated workers. Nonetheless, it corroborates the hypothesis that the surviving probability of firms with no top educated workers (*IN0*) is higher than the surviving probability of firms that lost all their top educated workers (*RF*). In fact, in a dynamic perspective, although the hiring of top educated workers increase firm short-term survival probability, in the medium-long run they may be exposed to a high failure risk when that top educated worker exits. In this way, in the long run, at least for small firms, it seems optimal not to hire top educated workers (*cf.* Teixeira, 2002).

This micro-level evidence seems at first glance to be at odds with the macro-level evidence on the relation between human capital, surveyed in the previous section. Specifically, at the economy level the bulk of studies found a positive relation between human capital accumulation and productivity dynamics (Michie et al, 2002; Teixeira and Fortuna, 2003; Maudos et al, 2003) which, seems hard to match with the micro-level evidence suggesting that the accumulation of human capital is associated with higher failure rates on firm's behalf.

The potential explanation for this may be related with the fact that firms can be positioned into one of the two possible states – low productivity and low risk or high productivity and high risk. In order for a low productivity-low risk firm to become high productivity-high risk firm it has to hire top educated workers. Successful high productivity-high risk firms, i.e, those that survive, are the 'engine of growth'. This may explain that regions, which have higher levels of human capital, be those that, in the medium term, have higher levels of per capita income and higher firm failure rates. This association of higher per capita income/productivity levels and higher firm destruction rates translates the schumpeterian issue of creative destruction (Schumpeter, 1942). The next sub-section tests this hypothesis.

3.2. Testing the link between "productivity" and "firms failure risk"

As we exposed in section 2, a considerable number of studies at macro-level support a positive relation between human capital accumulation and productivity dynamics (Michie et al., 2002; Teixeira and Fortuna, 2003; Maudos et al., 2003). The regional dimension of this relation is, however, seldom tackled.

In this section we test the relation between human capital and productivity at regional level, aiming at assess whether highly endowed human capital regions are those where productivity levels are higher. Furthermore, the reasonability of such relation is evaluated jointly with the schumpeterian question of creative destruction, according to which in more productive regions firm failure rates would be higher.

Thus, in a reduced form model used to explain productivity, we consider schooling as an explanatory variable, using the variable GDP per capita as a proxy to productivity, S as the average years of schooling and R the firms failure risk. The following model is estimated to scrutinize the relation between failure risk and productivity at regional level.

$$GDPpc = \beta_0 + \beta_1 S + \beta_2 R + \varepsilon \tag{3}$$

Data for GDPpc and Schooling is available for all Portuguese "counties" or municipalities (305 observations). However, data on firm failure risk is only available at NUT III regional level, encompassing 27 observations.[2] A pragmatic solution was to aggregate county data at NUT III level.

Econometric outcomes evidence positive estimates for parameters associated with schooling and firm failure risk, being the first parameter statistically not significant and the second one significant at 5% (significance in brackets):

$$\hat{GDP}pc = -1097,631 + 76,725\,S + 185,886\,R$$

$$(0,215) \quad (0,489) \quad (0,027) \tag{4}$$

An alternative procedure was also undertaken which managed to improve estimation outcomes. In concrete, we use all data disaggregated at county level, assuming for each county the average failure risk corresponding to its NUT III region. Re-estimating the model, parameters estimates remained positive for both schooling and risk of failure. However, statistical significance inverts, the first parameter becomes significant at 1% whereas the second one becomes not significant (significance in brackets):

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[2] Each NUTIII region involves several counties.

$$G\hat{D}Ppc = -1001,704 + 346,394\,S + 18,510\,R$$

$$(0,002) \qquad (0,000) \qquad (0,539)$$

(5)

This result enforces the hypothesis that both variables are relevant and that their effect positive but due to data-related shortcomings we cannot simultaneously and fully corroborate our hypothesis – more productive regions are those with higher levels of human capital and with higher firm failure rates.

The following equation shows that regions with higher levels of human capital, evidence, on average, higher firm failure rates, although results are not statically significant.

$$\hat{R} = 7,239 + 0,1386S + 0,000967GDPpc$$
$$(0,000) \quad (0,584) \qquad (0,027)$$

(6)

Considering the overall estimation results, we may envisage an indirect link between schooling and productivity. Specifically, we may argue that the uncovered positive relation between these variables is related with the fact that firms can be positioned into one of the two possible states – low productivity and low risk or high productivity and high risk. In order for a low productivity-low risk firm to become high productivity-high risk firm it has to hire top educated workers. Successful high productivity-high risk firms, i.e, those that survive, are the 'engine of growth'. This explains that regions, which have higher levels of human capital, are those that, in the medium term, have higher levels of per capita income and higher firm failure rates. This association of higher per capita income/productivity levels and higher firm destruction rates translates the schumpeterian issue of creative destruction.

4. Conclusion

The theoretical argument that workers with higher schooling are more productive than their low-grade counterparts seems to be widely accepted. Furthermore, at the macro-economic level the bulk of studies found a positive relation between human capital accumulation and productivity dynamics. However, micro-level evidence suggests that the accumulation of human capital is associated with higher failure rates on firm's behalf.

In the present paper we present and test a potential explanation, which permits to match the seemingly above opposite facts.

Based on panel data relative to 27 Portuguese regions (NUTIII) over the period 1992-1999, we estimate an econometric model of the relation between human capital, firm productivity and firm failure rates. Results point that regions, which have higher levels of human capital, are those that, on average, have higher levels of per capita income and higher firm failure rates. Such association of higher per capita income/productivity levels and higher firm destruction rates is likely to translate the schumpeterian issue of creative destruction.

This may suggest also important policy implications, namely that policy measures involving schooling incentives, i.e., human capital supply side focused policies, should be replaced by more human capital demand side focused policies aiming to easy bankruptcy processes.

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