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ON THE LINK BETWEEN HUMAN CAPITAL AND FIRM PERFORMANCE

A Theoretical and Empirical Survey

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ON THE LINK BETWEEN HUMAN CAPITAL AND FIRM PERFORMANCE. A THEORETICAL AND EMPIRICAL SURVEY

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ABSTRACT

The present paper provides a review of the literature focusing the relationship between human capital and performance essentially at firm level. The exposition is approached in three different but interrelated perspectives: economic, technological and survival. The exercise of reviewing existing literature permitted to uncover four major neglected issues: 1) the analysis of human capital – skills relationship; 2) the determinants of demands for human capital and how those demands change; interrelated with the second, 3) the influence of social and institutional context on the accumulation of human capital; and 4) the link between human capital and firms capacity of survival at both theoretical and empirical grounds.

Keywords: *Human Capital, Skills, Economic Performance, Technological Performance, Survival*

RESUMO

O presente artigo fornece uma revisão da literatura que foca a relação entre capital humano e performance ao nível, essencialmente, da empresa. A exposição encontra-se organizada sob três perspectivas de performance diferentes mas interrelacionadas: económica, tecnológica e sobrevivência. O exercício de revisão da literatura revelou quatro grandes áreas até aqui relativamente negligenciadas: 1) a análise da relação capital humano - qualificações; 2) as determinantes da procura por capital humano e de que forma tal procura evolui; relacionada com a segunda 3) a influência dos contextos social e institucional sobre a acumulação de capital humano; e 4) a relação entre capital humano e capacidade de sobrevivência das empresas quer sob o ponto de vista teórico quer empírico.

Palavras chave: *Capital humano, Qualificações, Performance Económica, Performance tecnológica, Sobrevivência*

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INTRODUCTION

Human capital has long been acknowledged to be an important factor for the productivity of individuals (Schultz, 1961a, b; Becker, 1962) and more recently has been increasingly identified as a factor influencing the competitiveness of firms (Bartel, 1989; Senker and Brady, 1989; Howell and Wolff, 1991; Prais, 1995).

The development of modern ideas about human capital is largely due to the works of Theodore Schultz and Gary Becker 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. Other (previous) authors, as the next section documents, have written about capital and some of these recognised that the productive powers of individuals could be augmented by the accumulation of skills or capabilities (much like improving a physical capital good). These earlier contributions do not, however, offer the richness of analytical capabilities that the modern definition of 'human capital' offers.

Currently, human capital is a widely used concept with complex and varying definitions that are often left rather vague. In certain contexts it might include only schooling (i.e., acquired formal education), whereas in other circumstances it can encompass a wider set of investments that potentially influence the well-being and productivity of people, firms, and nations (Mincer, 1996). These might include investments in health and nutrition, as well as vocational training acquired outside the formal education system.

Moreover, given operationalisation difficulties, human capital and skills often appear in the literature as interchangeable concepts, which might, at best, be misleading. Skill tends to be a more all-embracing concept than human capital and, besides tangible investment in education and off-the-job training (i.e., human capital as commonly defined), includes intangible (tacit) knowledge acquired by people in the course of their activities.

The present paper organises the theoretical and empirical literature on the relation between human capital and firm performance within a conceptual framework where firm performance is examined at the economic, technological and survival elements.

[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.

In Section 1, attempts are made first to clarify the concept of human capital. In Section 2 an overview on the relationship between human capital and performance is presented. The review of the literature focusing essentially the relationship between human capital and performance at firm level is performed in the following section (Section 3). In order to make the exposition clear performance was approached in three different but interrelated perspectives: economic (Sub-section 3.2), technological (Sub-section 3.3) and survival (Sub-section 3.4) [In Appendix it is available summary-tables containing studies which focus those perspectives]. Finally, Section 4 concludes pointing some neglected issues and interesting areas for future research on the subject covered by the present paper.

1. DEFINING HUMAN CAPITAL

1.1. 'Humans' as Capital

Including human beings within the analytical framework of capital is by no means a new idea. Many past economists (and non-economists) have considered human beings and/or their skills as capital. Adam Smith, Say and List considered skills and acquired abilities of human beings as human capital, whereas von Thünen, Senior, Walras, Marshall and Fisher considered human beings as capital.[2]

Adam Smith (1723-1790) included in the category of fixed capital the skills and useful abilities of human beings. The skill of a man, he said, may be regarded as a machine that has a genuine cost and yields a profit.

> Fixed capital consists of the acquired and useful abilities of all the inhabitants or members of the society. The acquisition of such talents, by the maintenance of the acquirer during his education, study, or apprenticeship always costs a real expense, which is a capital fixed a realized as it were, in his person. […] The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labor, and which, though it costs a certain expense repays that expense with a profit. (Smith, [1776] 1937: 265-266)

In the same vein, J.-B. Say (1767-1832) asserted that since skills and abilities are acquired at a cost and tend to increase worker productivity they should be regarded as capital (Say, 1821: 92-94). Even Friedrich List (1789-1846),[3] despite his focus on the doctrine of nationality, placed great emphasis on intangible capital (accumulation of all

[2] Adam Smith (born 1723, published 1776), Say (born 1767, published 1821), List (born 1789, published 1928), von Thünen (born 1783, published 1875), Senior (born 1790, published 1939), Walras (born 1834, published 1954), Marshall (born 1842, published 1959) and Fisher (born 1867, published 1927). See Kiker (1966 and 1968) for a detailed overview of the main contributors to the notion of human capital.

[3] *The National System of Political Economy*, originally published in 1841.

discoveries, inventions, improvements, perfections and exertions of all the generations of the past).

In general, however, most of the well-known names in the history of economic thought have neither attempted an evaluation of human capital nor employed the concept for any specific purpose, despite recognising the importance of investment in human beings as a factor that increases their productivity. In fact, the concept of human capital was fairly prominent in economic thinking until Marshall discarded the notion as being "unrealistic" (Kiker, 1966). Marshall's influence helps to explain why the typical view of economists up to the 1960s was that the demand for education was a demand for a type of consumption good (Bowman, 1990).[4]

In the twentieth century, Walsh (1935) argued that the more advanced the education (that is, the more vocational the purpose) the more profitable it is, and hence the motive for undertaking it is economic gain. Thus, abilities acquired through professional education closely resemble conventional capital.[5]

The concept of human capital was fully developed in the 1960s with the emergence of human capital theory formalised by Schultz (1961a, b) and Becker (1962, 1964). The former analysed educational expenditure as a form of investment whereas the latter developed a theory of human capital formation and analysed the rate of return to investment in education and training.

In his seminal work, *Investment in Human Capital: a Theoretical Analysis*, Becker (1962) included in his concept of human capital activities such as formal education and off-the-job training (general human capital) and on-the-job training (specific human capital). For this author, as well as for the majority of researchers who adopted the human capital framework, education, skills and human capital are interchangeable concepts. In particular, in the vast majority of human capital studies, "… education is the most important component of human capital" (Schultz, 1993: 17). There are, however, an increasing number of authors who point to the fact that formal education is

[4] Shäffer (1961) in a critique of Schultz's human capital concept (see Schultz, 1961a), cites the impossibility of separating investment and consumption components of human capital. According to this author, there are other factors that explain why people invest in education beside the eventual economic return that it may bring. Although Schultz (1961b) recognised the importance of the cultural contribution made by education, he argued that its economic contribution is even greater.

[5] Although Walsh concluded that college training may be a form of capital formation, he admitted that it is affected by important factors not all identical with those that bear on other forms.

only one way to create skills.[6] Arrow (1962) and Young (1992), among others, have stressed the role of other forms of skill improvement, such as 'learning-by-doing' and on-the-job training.

Taking a microeconomic view, i.e., plants as the unit of reference, one could consider, along the lines of Lall and Wignaraja (1997), several ramifications of the human capital concept: firm stocks of skills (background and training of the entrepreneur or business leader, the production manager, and other technically qualified personnel); the structure of the labour force (by quality and education); the accumulation of human capital (increases in human capital stock by training investment); and losses in human capital (exit of employees to set up their own businesses or join other firms). More simply, and in accordance with this view, the human capital concept can be divided into two main components: skill development, referring mainly to industry-related education and training (both formal and informal); and technological capability formation, which accounts for the development of individual and institutional skills and knowledge derived from technological effort (Lall, 1998).

It is worth noting, however, that 'technological efforts' and 'education and training' are often commingled activities.[7] In this vein, although one may be able to 'count' inputs (*e.g.* hours 'off line' or costs) to education and training activities, the 'separateness' of these activities to the accumulation of knowledge is far from obvious.

These human capital ramifications highlight the intricate connection that exists between human capital and skills concepts. The point below discusses this issue.

1.2. Human capital and skills

Although skills and human capital are treated in countless studies as synonymous concepts (*e.g.*, Harris and Helfat, 1997), more accurately they are distinct though interrelated concepts.

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[6] Howell and Wolff (1991), for instance, question the adequacy of years of education as a measure of workplace skills. They argue that most jobs require a multitude of different skills for adequate task performance, ranging from physical abilities to cognitive skills and interpersonal skills. Moreover, they consider that in some occupations educational attainment may not be a direct measure of job-related skills *per se,* but a device used to screen for the ability to learn on the job (Thurow, 1975) and for desirable social and personal characteristics (Bowles and Gintis, 1976).

[7] In on-the-job and 'on line' problem-solving activities individuals consult with others, refer to texts, and seek out instruction or guidance. Similarly, in 'off line' education, individuals bring with them their practical experience, past and current, and this experience interacts with the abstractions or examples that are offered by the designer of the pedagogy. The individuals offering education or training may not only be recounting theory and abstraction, but also recounting experience and engaging in collective problem solving with the 'students'.

Skill is itself a rather ambiguous term (Green *et al*., 1996). It can mean the ability to perform given tasks or to master various techniques, or, more broadly, it can refer the range of behavioural attributes such as reliability, ability to work without supervision, and stability of employment. Thus, in a strict perspective, skills can be defined as the required competence or needs of employment (Wu, 1992),[8] whereas in a more comprehensive sense, skill may be identified as a complex "social relation" (Naville, 1956).[9]

Several sociologists and other professionals point to different typologies of skills in order to account for the multiple dimensions of the skill concept.[10] A simplified version, based on Cézard's (1979: 18) proposal, distinguishes: "job skills" – the qualities required by the particular occupation; "workers' skills" – workers' professional knowledge, derived from both formal education (internal or external to the school system) and learning on-the-job; and "conventional skills" – classification of workers in an occupational categories grid of a conventional form. These elements are often intermingled in actual 'grids' or matrices so that an individual is distinguished as a technician not only because of the content of his work but also because of the nature of his education and training. Other typologies, such as that of Ashton *et al.* (1997) identify three concepts of 'skills': the stock of human capital acquired (Becker, 1964; Stevens, 1994); the autonomy individuals enjoy at work (Braverman, 1974); and the tasks people perform within their jobs and how effectively they carry these out (Ash, 1988; Primoff and Fine, 1988).

Skills can be acquired through education and (formal) training but also (and mainly) through the course of people's activities at work (i.e., learning-by-doing). Rosen (1986) points to the fact that most specific job skills are learned from performing the work activities themselves. Formal schooling complements these investments, both by setting down a body of general knowledge and principles for students, as well as teaching them how to learn. He goes on to argue that there is no perfect substitute for apprenticeship and for work experience itself. Learning potential is viewed as a by-product of the work environment, tied to a specific work activity, but varying from activity to activity and from job to job. In this vein, skills include tangible investments such as investments in

[8] Colardyn and Durand-Drouhin (1995) also maintain that the notion of "competence" in the sense of a "capacity to accomplish concrete tasks" is now frequently associated with the idea of "skills".

[9] '*Qualification*' is the French equivalent used by Naville for 'skills'.

[10] See, for instance, the works of Naville (1956) and Rodrigues (1988).

education and formal training (in short, human capital) and intangible ones, i.e., knowledge and know-how.

'General knowledge' may be defined as the common scientific, technological, and cultural heritage potentially available to everyone (Aghion and Howitt, 1998). This suggests that know-how can be generated by learning-by-doing (working on the job) as well as by research. Skills, therefore, appear as a chain concept linking human capital, knowledge and technology – much "technology" being knowledge of certain sorts of skilled workers and differences in technology may in reality be differences in the availability of certain skills (Wood and von Tunzelmann, 1996).[11] The operationalisation of such interrelation, however, has struggled in the face of enormous difficulties. Notwithstanding, those same interrelationships can be useful to show that from the viewpoint of job performance there may be substitution relationship between experience and training or education, or complementarity.

In Lall *et al.* (1993) skills are explicitly related to technology. These authors focus on the concept of technological capabilities and stress that these capabilities are much more than a simple sum of the education and training of firm's employees. In fact, they stress that capabilities are a form of institutional knowledge that is made up of the *combined skills* of a firm's members accumulated over time.

In this context, investment in knowledge suggests a natural externality (Romer, 1986). For instance, the creation of new knowledge by one firm is assumed to have a positive external effect on the production possibilities of other firms because that knowledge cannot be perfectly appropriated.[12] In Lucas (1988) the specification externalities take the form of *public* learning, which increases the stock of human capital (Verspagen, 1993). In fact, Lucas includes in the "general skill level", along with an individual's human capital effects on his/her own productivity, an external effect translated into the aggregated human capital stock that contributes to the productivity of all production factors.

[11] Wood and von Tunzelmann (1996) also suggest that the higher wages of skilled workers (relative to unskilled workers) may derive from two sources, a return on investment in human capital, and a rental for scarce know-how.

[12] Externalities derived from the lack of appropriability of investments in skills or knowledge creation can lead to market failures. This may lead firms to underinvest in their own technological development (Lall *et al.*, 1993).

In general, however, human capital as commonly defined (formal education and training) conveys a view of human capital as being a *private* good, whereas knowledge, as referred to above, tends to some degree to be *public* and therefore non-appropriable.[13] Therefore, the equivalence between human capital and skills depends largely on the 'tangibleness' of the respective components.[14]

Note that, in a finite lifetime, although an individual's human capital cannot grow without bounds, skills acquired by the individual may be applied to an ever improving set of production technologies, in which case the value of human capital will continue to rise through time.

Regardless of the issue of tangibleness, it is undeniable that skills and human capital are interrelated. For instance, Howell and Wolff (1991) distinguish between direct measures of skills (cognitive, interactive, and motor skills), which appear to measure independent dimensions of job skills and indirect measures of skills (educational attainment and earning indicators), and conclude that educational attainment is highly correlated with cognitive and interactive skills. Additionally, Lynch (1994) point out that cross-functional competencies, "the requisite new skills", are not easy to acquire informally, requiring instead a strong base of analytical, quantitative, and verbal skills that formal higher education is more likely to convey.

Empirically, one can often find measures of education attainment that can be used as proxies of human capital and skills (*e.g.*, Bates, 1990; Barro and Lee, 1993, 1996; Teixeira, 1998, 1999a). Several authors also rely on earnings and wage indicators (Griliches, 1970; Suliman, 1971; Mincer, 1996; Majumdar, 1998) and occupational grids (Berman *et al*., 1993) to distinguish between skilled and unskilled workers. Romer (1989) and Grossman and Helpman (1994) see human capital as the accumulation of effort devoted to schooling and training.

The neglect of differences between human capital (in particular, education) and skills (and between the different concepts of skills), in spite of introducing some noise into the

[13] A public good (or service) is available to everyone in a particular catchment area, cannot be withheld from non-payers, and is 'non-rival'; that is, one person's consumption does not diminish that of others. Of course, there are means (especially legal means, for instance, patents) to make knowledge appropriable, in particular that derived from research, and therefore have the possibility of excluding non-payers.

[14] Note, for instance, that human capital models such as those presented by King and Rebelo (1987), Jones and Manuelli (1988), Rebelo (1990), and Becker, Murphy and Tamura (1990) treat all forms of intangible knowledge as being analogous to human capital skills that are rivalrous and excludable (Romer, 1990).

analysis, may be empirically justified.[15] Firstly, general education teaches two 'skills', which constitute much of the basis of the so-called 'social skills' (Soskice, 1994): it enables young people to develop a high degree of social communication skills, and teaches a high degree of self-discipline, self-organisation, and self-reliance.[16] Secondly, Howell and Wolff (1991) show that educational attainment is strongly correlated with both cognitive and interactive skills.

Next two sections the literature review is performed focusing the relationship between human capital and performance at firm level. Firstly, a retrospective overview of this relationship is presented (Section 2), then in Section 3 performance is approached in three different but interrelated perspectives: economic (Sub-section 3.2), technological (Sub-section 3.3) and survival (Sub-section 3.4).

2. RETROSPECTIVE OVERVIEW OF HUMAN CAPITAL AND PERFORMANCE

As noted in previous section, 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. Smith and his followers, however, accepted that popular education, though socially important, was largely unrelated to success in the workplace (Bowman, 1990).

Research in the late 1950s and early '60s, which constituted the foundations of the human capital theory (Schultz, 1961a, b; Becker, 1962), stimulated a new level of interest in the relationship between education and the economy.[17] 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.

After such a promising beginning, human capital theory has been seriously challenged since the 1970s by the appearance of alternative theories (reviewed in Teixeira, 1999b). In middle-income countries where there was arguably considerable difficulty in

[15] Note that the possibility of a mismatch between job qualification and education levels (workers' skills or human capital in a strict sense) creates scope for the existence of the "diploma disease" (Dore, 1980) or the "credentials inflation", and the associated employment effects reflected in phenomena such as "bumping" (Fields, 1972) and "job queues" (Thurow, 1975).

[16] These 'social skills' may be considered a part of Wolf and Silver (1995)'s "broad skills"; that is, higher order skills which people can conceptualise and discuss as applying to a whole variety of contexts.

[17] Human capital theory (which emerged in the 1960s) avoids the thorny questions raised by Mill and Marshall regarding maximising behaviour in the context of parent-child relationships by focusing on the demand of (young) adults for post-compulsory education. This phenomenon did not exist for Smith, Mill and Marshall, who assumed that any schooling received by the working classes was acquired during childhood, subject primarily to parental decision-making.

absorbing people into occupations who had spent substantial time in university the growth of unemployment promoted increasing scepticism about educational achievements and their economic benefits. In this context, university education was counter-productive to achieving some types of work discipline including authoritarian control of work content and the acquisition of manual skills (for which experience is a better teacher). In economies that had by the 1970s fully plunged into de-industrialisation, the value of university education in general literacy as well as developing advanced and convergent social skills for interaction in the workplace was much higher (Howell and Wolff, 1991). The industrial activities in these economies also often reflected a higher degree of abstract problem-solving and knowledge acquisition (learning to learn) for which university education (often regardless of subject) was of value. Specifically, economists in the US were concerned from the 1970s not only with issues such as de-skilling (Braverman, 1974; Kraft, 1977; Zimbalist, 1979)[18] but continued to follow the agenda outlined by Schultz and Becker for assessing the value of human capital, which led at the end of that decade and throughout the 1980s to efforts to explain the excess returns that appeared to accrue to individuals with higher education. The so-called filtering and screening/signalling theories (Arrow, 1973; Spence, 1973; Thurow, 1975) constituted an attempt to develop a theory to explain these wage differentials and to address the persistent problems of racial and gender wage differentials.[19]

The 1980s was characterised by a reversal in this critical attitude towards human capital theory. The screening hypothesis appeared less applicable than the human capital theory it sought to replace, and failed to produce an empirically confirmed alternative theory (Blaug, 1976).[20]

[18] Additional evidence of falling skill requirements came from staying on in higher education and concluded that Americans were 'over-educated' for the jobs that were available (Berg, 1970; Freeman, 1976; Rumberger, 1978).

[19] According to filtering theory (Arrow, 1973) employers prefer workers with high levels of education because the education system acts as a filter for individuals according to their innate productivity, thus education is a source of information not competencies. Screening (Thurow, 1975) or signalling (Spence, 1973) theories reject two basic assumptions of human capital theory: perfect competition and deficits of human capital (according to which human capital increases are always absorbed by demand). They recognise the possibility of human capital oversupply. In such conditions there is competition for jobs not for wages. Education is nothing more than a signal through which workers indicate to employers their capabilities to take on certain jobs (Spence, 1973).

[20] A detailed study of workers in Kenya and Tanzania (Knight and Sabot, 1990), using data on ability, schooling, skills and wages, shows that, by and large, the effect of schooling on wages is not a result of signalling, but rather because schooling raises skills and skills raise wages.

Therefore, since the late '80s, education (mainly at higher levels) became once again increasingly associated with economic performance issues. In particular, with the revival of research into economic growth and the emergence of the so-called 'endogenous growth theories', an important role – "the engine of growth" (Ehrlich, 1990: S4) – has been assigned to human capital. The development of both the Lucas (1988) approach (inspired by the work of Becker) and the Nelson-Phelps (1966) approach (which assumes complementarity between education and R&D activities) converge in a positive effect being attributed to educational attainment. This positive effect was visible in terms of the productivity of workers, with an important growth enhancing effect.

The shift towards human capital issues and performance was also a consequence of the growing concern that the education system should be more responsive to expectations from the economic system.[21]

At present, governments mainly treat education not as a consumer good but as a productive asset. Increasingly, all over the world it is taken for granted that educational achievement and economic success are closely linked (*The Economist*, 1997). In Boyer's (1984) words "[t]he failure adequately to educate … would be … a fatal undermining of the vital interest of the nation." The conventional wisdom, therefore, is that 'more' education and training is assumed to lead automatically to improved economic performance.

Moreover, there is a widely held belief that new ways of organising production are also putting a premium on education (Rodrigues and Lopes, 1997). It is argued that the capacity for a critical number of enterprises in a given country to create a more efficient, post-Taylorist work organisation is strongly influenced by education (OECD, 1992).

Kovács (1994) points out that, in a less industrialised country, namely Portugal, the shortage of skilled resources and the lack of capability from the education and training

[21] One of the first attempts to rationalise the link of causality between the economic (industry) and the education sectors was that of Field (1974), who studied education reform and manufacturing development in mid-nineteenth century Massachusetts. He argued that there was a link between the development in the two sectors, with the main lines of causality running from the change in the system of production to changes in the system of education. The shift of the labour force out of predominantly agricultural or mining into manufacturing pursuits created a set of social tensions both within and outside the workplace; given universal suffrage, these tensions in turn led to a perceived need on the part of manufacturers and professionals for a universal agency of socialisation which would ensure a self-disciplined, differential, orderly, punctual, and honest citizenry, and a labour force which would work well in manufacturing or bureaucratic units characterised by administrative hierarchies, while in non-working hours it would go about its business in an orderly fashion in an increasingly interdependent social order.

system to respond to firm shortages of skilled workers are the two main obstacles to the development of the so-called 'anthropocentric production systems'. Firms and other work organisations seem to be changing from chiefly production-centred economic units to being learning-centred economic units (Ferreira, 1994). As a result there is a growing shift in emphasis from a focus on physical and financial capital to a focus on the increasing importance of human capital and continuous learning for sustaining competitive advantage.

In an era of human capital what matters, it seems, is not organisational form (entrepreneurial or managerial) but organisational process (learning and transformation).

The perceived status of more schooling in conjunction with political pressures on the education system to expand in order to accommodate all aspirants have tended to expand the number of educated persons beyond the availability of appropriate jobs in the economic system.

This outcome may be influenced by the fact that, even though the earnings and employment opportunities for highly educated persons, such as university graduates, may decline over time, the earnings and employment opportunities for less educated persons may deteriorate even more (Levin, 1987).

Irrespective of the underlying causality, however, the production of numerous graduates and post-secondary trained individuals who are not able to obtain appropriate employment presents an immense problem for the formal education sector of many countries (Whiston *et al.*, 1980).[22]

[22] Two decades ago, Dore (1980) was already focusing on the problem of "educated unemployment" and the associated "diploma disease". According to this author the mismatch between job qualifications and education levels and the quality of schooling (schooling without education) constitute challenges to the argument that "the more education the better". The problem of a surplus of job seekers over jobs available was also tackled by Thurow (1975) who developed the concept of the 'labour queue'. According to this view, employers prefer to hire people with more education, at the prevailing wage rate, either because they are (or are believed to be) more productive or simply because employers prefer to associate with the better educated. Thus, those who have received remedial education, for example, are unlikely to get first preference In the job competition model marginal products, and hence earnings, are associated with jobs not individuals. Individuals are allocated to available jobs based on an array of personal characteristics, including education, that suggest to employers the cost of training them in the skills necessary to perform the tasks associated with their jobs. Thus, workers may possess more education and skills than their jobs require (i.e., employers may be unable or unwilling to fully utilize the education and skills of their workers). Rumberger (1987), found that, as Thurow's (1975) job competition model predicts, schooling is not rewarded similarly in all occupations. Moreover, additional schooling beyond that required for the job is not always rewarded. He concluded that additional schooling is not completely unproductive, but

In this context young people may demand education on the margin specifically in order to stand a better chance of being hired for low-level jobs. This reflects Fields' (1972) 'bumping' argument, which explains the rise in the private rate of return in the presence of an increasing supply of education. Preferential hiring, by education level, would lead to the general upgrading of hiring standards and of the labour force in general, so long as the education system produces more graduates than are needed to fill skilled positions and some of them are willing to seek employment at lower levels. The educated person moves to the front of the queue for unskilled jobs and is hired first at the unskilled wage rate, "bumping" a less educated person from a job. This lowers the probability of such an individual getting an unskilled job and also lowers the present value of expected lifetime income for the unskilled, whereas the expected lifetime income for a person in the skilled labour market is unchanged. This results in a greater demand for education and even more political pressure.

It is reasonable to expect that in recessions the first reaction of employers is to stop recruiting new entrants (Bosanquet, 1987). However, what is puzzling is the widening of educational wage differentials, which accompanies the increasing number of educated workers in the labour force. The current solutions offered to this puzzle are based on the argument of the existence of a corresponding (an even stronger) demand for educated labour derived from capital-skill complementarities (Griliches, 1969, 1970) and the technology-skill interaction (Katz and Murphy, 1992; Card and Limieux, 1996), which is based on the argument that education becomes more valuable in periods of rapid technological change (Nelson, 1964; Nelson and Phelps, 1966; Welch, 1970). However, empirical evidence corroborating these explanations is not convincing. An alternative explanation put forward in Teixeira (2002) argues that the risk of fission (the event that a given plant loses part or all its top educated and/or top skilled workers), which is likely to undermine an establishment's survival capacity, leads employers to pay increasing amounts to top educated or skilled workers (in spite of the increasing availability of these type of workers in the labour market) and justifies the relative inertia on the demand side for human capital. This argument takes the view that the

simply the jobs constrain the ability of workers to fully utilize the skills and capabilities they acquire in school.

composition of human capital accumulation is shaped by demand, which according to the author is more socially constructed than admitted in the economics literature.[23]

As next section documents, the majority of studies within human capital theory did not focused attention upon the determinants of demands for human skills and how those demands change.[24] Indeed, rate-of-return studies and more aggregative approaches assume that demands for the better educated will rise with an increase in their relative numbers in such a way as to maintain the same real incomes (Bowman, 1966). More accurately, one of the reasons that there is no specific focus on the 'demand' side in rate of returns studies is that it is already incorporated in recursively in the formulation of the incentives for accumulation given the existence of labour market equilibrium. If there were an insufficiency of demand for higher levels of human capital, the incentives for its accumulation would be lower and the supply would automatically adjust to the demand. By studying supply, therefore, one is studying demand as well.

In what follows, a set of both theoretical and empirical studies on the relation between human capital and (economic, technological and survival) performance are systematised. The focus of the present literature review is on those studies that have the firm, establishment or plants as unit of reference. More aggregated studies, namely those concerning human capital and economic growth, and micro studies respecting workers' earnings or productivity are only punctually referred to the extent that they are related with firm-based analysis.

[23] For example, earlier designs of industrial equipment presumed the addition of certain types of skill for its productive application while, as time goes by, the skills that are assumed change (*e.g.* in Braverman (1974) the operation of equipment is de-skilled while its 'set-up' becomes beyond the skill of the operator).

[24] The main concern in the studies about human capital was, and continues to be, to explain 'the residual' (see, for instance, the works of Solow, Lundberg, Griliches, Denison and Schultz) - Fabricant, Abramovitz, Kendrick and Solow found that most of the observed economic growth could not be explained by conventional labour and capital measures (see Griliches, 1996); Schultz (1960) was the first to connect human capital with the puzzle of the 'residual'; for a literature review on the topic of human capital and economic growth see, for instance, Teixeira (1996). At a more micro level, some authors (*e.g.*, Walsh, Friedman, Kuznets, and Becker) attempted to assess to what extent individuals behave in an economically rational optimising manner with respect to human capital investment and also to assess the impact of human capital on individual productivity, essentially based on Mincerian earning regressions; Mincer (1958) was a pioneer of the earnings regression approach, which relates individual human capital traits, such as education and training, with the corresponding productivity proxied by the respective wages or earnings.

3. HUMAN CAPITAL AND FIRM ECONOMIC, TECHNOLOGICAL AND SURVIVAL PERFORMANCE

3.1. Initial considerations

Many studies identify human capital as a pre-condition for and often a determinant of economic performance and international competitiveness (*e.g.*, Aldcroft, 1992).[25] In addition, some authors argue that the process of industrial deepening and upgrading requires higher levels of skill, know-how and organisation in almost every function.

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):[26] "… 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). The other benefit of basic education is, according to Hirshleifer (1966) and Judson (1998), as an indicator of the suitability for further education (education's 'option value'). In this sense, education, besides providing a direct improvement in productivity, also works as a source of information about the individual's ability to translate education into skills.[27]

At the level of firm or establishment, 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,[28] whereas, in terms of technological performance, the bulk of the recent (empirical) literature is

[25] Human capital, in particular education, is, according to some authors, the source of economic growth through its development impact in agriculture and industry (Schultz, 1961b) and as an engine for attracting other factors (Benhabib and Spiegel, 1994). In addition, Lazonick (1997) argues that "skill bases" form the foundation for people to engage in collective and cumulative (or organisational) learning, which in turn is central to the process of economic development. According to this author, the foundation of Japan's success in international competition was investments in broad and deep skill bases to generate organisational learning.

[26] A vast amount of studies on human capital within the human capital theory framework implicitly assume that individual productivity is reflected in earnings and thus earnings are often used as a proxy for productivity (see, for instance, works of Becker, 1964; Schultz, 1961b; and Mincer, 1996).

[27] Note that since human capital is a factor in producing additions to human capital (Ben-Porath, 1967; Becker, 1964), the disadvantages of an impoverished early human capital stock accumulate over a lifetime.

[28] Blaug (1968, 1972, 1987) and Psacharopoulos (1987) constitute reference bibliographies on human capital issues that provide an overview of the then existing literature.

focused on the assessment of the hypothesis that technological change is biased toward human capital, and thus generates demands for such human capital.[29]

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. An exception is Teixeira (2002) whose study's main argument (the fission risk hypothesis) relies on the concept of firms fitness, that is, firms survival capacity.

Given what was said above, next points present theoretical and empirical evidence on the relation, at firm level, between human capital and economic (Sub-section 3.2), technological (Sub-section 3.3) and survival (Sub-section 3.4) performance. They intend both to detail existing findings in the area and identify the main common pitfall whose overcoming it is argued here passes in large extent by a more profound analysis of human capital demand side.

3.2. Economic performance

Neoclassical principles are at the heart of human capital theory. The wage - the price of labour - constitutes the mechanism of adjustment between supply and demand. Optimising behaviours motivate economic agents: profit maximisation in the case of those who demand labour, and maximisation of utility/welfare in the case of those supplying it. The quantity of labour supplied is dictated by the rational (optimising) choice of workers between leisure and work. The quality of this labour is determined by past investment in human capital. The match between demand and supply occurs in a perfectly competitive market where, in particular, perfect information (about

[29] Katz and Murphy (1992) found that the majority of employment shifts in the industrial and occupational composition of employment toward relatively skill-intensive sectors reflect shifts in relative labour demand occurring within detailed sectors. These within-sector shifts are likely to reflect skill-biased technological changes (Davis and Haltiwanger, 1991; Krueger, 1991; Mincer, 1991, 1995; Berman *et al*., 1993; Machin *et al*., 1996). At the level of industry a greater incidence of training was found in industries whose productivity growth (as a proxy of technological change) was fastest (Lillard and Tan, 1986; Bartel and Sicherman, 1995). Bartel and Lichtenberg (1987) reported that relatively more educated workers were employed in those manufacturing industries where capital equipment was newer and R&D expenditures much more intensive. Similarly, a greater utilisation of educated workers and steeper wage profiles were observed in sectors with more rapid decade-long productivity growth (Gill, 1989). Mincer (1993) found that a more rapid pace of technological change in a sector generates a greater demand for education and training of the sectoral workforce as evidenced by: the greater share of educated workers and use of training, larger educational wage differentials within sectors with rapid productivity growth, larger mobility of educated, young workers, steeper wage profile in progressive sectors, and increase of separation rates in the short-term.

opportunities and wages) exists, and free mobility. From this a wage results based on the corresponding marginal productivity.

Human capital theory, improving upon the neoclassical background which framed it, admits labour heterogeneity when it considers the investment performed in human capital. This latter emerges as the explanatory factor for wage differentiation between workers endowed with distinct productivities. The competitive workings of the market ensure that for equal work there is a corresponding equal wage. The interest of employers in maximising their profit leads them to employ all labour units that, in marginal terms, lead to an output increase (evaluated in monetary terms) higher than the cost increase. That is, new employees will be hired up to the point where marginal productivity (decreasing) equals the wage (the only cost assumed to be supported by employers). From a marginal productivity schedule the labour demand by the firm in a competitive situation can be derived.

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.[30] This incentive is bounded only by the existence of (eventual) diminishing returns to human capital, as to any other factor of production.[31]

Of the studies surveyed in this section (concerning particularly the relation between human capital and economic performance at firm level), several emphasise 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

[30] In general, employers pay educated workers more than uneducated ones throughout their working life. Psacharopoulos and Layard (1979) argued that the reason why employers continue to prefer educated workers is that, not only does the possession of an educational qualification indicate that an individual has certain abilities, aptitudes and attitudes, but the educational process helps to shape and develop those attributes.

[31] In an extension of Becker's theory, Stevens (1993) demonstrated that firms have an incentive to invest in "transferable training" (training for skills that are useful for other firms, but for which there may not be a competitive labour market), and that an externality may exist. When the labour market for skills is imperfectly competitive, firms may be able to increase the future supply of labour through training. Note that several authors referred to the complementarity between the different components of human capital, namely education and training. In fact, formal education may prepare people to learn more quickly the specific production skills taught by older workers in on-the-job training (Foster, 1987; McMahon, 1987). Hence, people with more formal education also tend to receive more on-the-job training (Bartel and Sicherman, 1995; Kremer and Thompson, 1998). Ben-Porath's (1967) model asserts that more educated workers will train more, simply because human capital is an input in the production of new human capital.

may enhance a manager's ability to acquire and decode information about costs (Welch, 1970), and to achieve and operate the best factory organisation (Fleming, 1970). For Pack (1972) managerial skill is in fact the critical catalytic factor for productivity growth. More dramatically, Eltis (1996) argues that weaknesses in management (i.e., the industry's failure to recruit those who had achieved the greatest success at the university stage of their careers) explain the low profitability of UK manufacturing firms. Focusing on entrepreneurs instead of managers, Fluitman and Ondin (1991) found that, within a trade, those entrepreneurs who have attended school for longer are more likely to be successful.

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.

The clear direction of all the studies surveyed in this section (see Table 1 in appendix for a summary) 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.

It is important to note, however, that there still are enormous gaps in the knowledge concerning the magnitude of any links between skill formation 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 fact, much of the optimism about human capital's contribution to economic growth and development comes from microeconomic evidence, which associates labour income increases with the improvement of formal education (the easiest measurable human capital component) and training (Lynch, 1989). As

Rumberger (1987) reported, except in the case of agriculture, few empirical studies support the notion that education raises individual productivity. Contrasting with the positive view of human capital theorists, Berg (1970), based on US evidence, concluded that education generally does not raise the productivity of workers. An education emphasis by managers in recruitment is justified, according to this author, by the fact that years of schooling are a good indication of the ability to get along with others, and that more educated workers have greater potential to be promoted to more responsible jobs. Moreover, Medoff and Abraham (1980, 1981) found that experience (an important component of human capital) was associated with higher earnings but not with higher performance ratings in the two firms they studied. Also, Hotchkiss (1993) found that secondary vocational training in the US (1980) was not effective in raising the wage received. Some studies even challenge the notion that earnings are directly and positively related to productivity. For instance, Gottschalk (1978) found that wages are not proportional to productivity either among or within occupations.

Additionally, it remains to be clarified how some forms of skill formation have much more impact on the productivity of some workers depending on their situation within the firm.

> We seem ignorant in our understanding of the determinants of the derived demand for labor with differentiated amounts of schooling. (…) in general, employers offer higher pay to more highly educated workers, but our knowledge of what elements … of schooling make people more productive is scanty. (Hansen, 1963 in Blaug, 1972: 35)

Moreover, factors of production, in particular different types of workers, may not be so easily substituted for each other as human capital theory assumes. Lock-in effects on the production side, as well as the institutional context, may severely diminish the scope for substitution possibilities. These lock-in effects may occur on the demand side (*e.g.*, a requirement of a given quality level in products and associated minimisation of the possibility of human errors/sloppiness), which may limit the usefulness of wage cuts (van Zon and Muysken, 1996).

Within the human capital theory framework it cannot be easily conceived that, in large swathes of seemingly still successful industrial capitalism there are distinctly low limits on the demands placed on the education and training system by employers, unless one resorts to the belief that these employers must be ill-informed or irrational. In this context, the institutional context seems to be crucial in influencing the salience of the skill formation system. It is not conclusive, however, that more education and training

could remove the institutional barriers. There may still be a strong case, as far as business is concerned, for placing strict limits on the amount spent on raising the skill levels of workforces.

For instance, Finegold and Soskice (1988: 22) recognising the strategic complementarities between workers' human capital investment and firms' R&D investment, claimed that the resulting multiple equilibria provided the theoretical rationalisation for a 'low skills' equilibrium, i.e., a "self-reinforcing network of societal and state institutions", which interacts to stifle the demand for improvements in skill levels and is consistent with a rational, optimising behaviour. Similarly, Teixeira (2002) stresses the 'rationality' of a low skill route in the accumulation pattern of human capital at the level of the firm. Contrasting with Finegold and Soskice (1988), however, behaviour is not optimising but 'satisficing'. In concrete, following the evolutionary approach, it is assumed that firms cannot maximise over the set of all conceivable alternatives due to the complexity of problems involved; it is assumed explicitly that rational behaviour of the firm is 'bounded'.

3.3. Technological performance

The relevance of human capital to technological competence and development seems to be universally accepted in the literature, though empirically the evidence has produced mixed results.[33] According to Schultz (1961a), human capital investments, namely expenditure in formal education and training, explain the superiority in production of the technically advanced countries.[34] Formal education, largely through the provision of

[33] In specific sectors, such as Banking, some evidence suggests little or no relation between human capital and technological change. For instance, Groot and Grip (1991), based on a sample of 100 banks in the Netherlands (1980-1987), found that the educational structure of commercial employers, managers and boards seemed to be somewhat less influenced by technological developments. Similarly, Levy and Murnane (1996), concluded that computerisation had increased the bank's demand for college graduates but this increase had to do more with the increasing size of the financial industry than on changing skill requirements within the bank. At the level of industrial firms, Green e*t al.* (1996), found no relation between the introduction of technological change and establishments' human capital accumulation (in effect, their training intensity by occupation). Additionally, Penn *et al.* (1994), based on a 1985 UK survey, documented a tendency towards a modest increase in the skill and responsibility of the largest block of jobs; instead, they found that many newly created jobs called for few skills.

[34] In Benhabib and Spiegel's (1994) model it was assumed that the ability of a nation to adopt and implement new technology from abroad is a function of its domestic human capital stock; human capital levels directly affect aggregate factor productivity through two channels: one by determining the capacity of nations to innovate technologies suited to domestic production (*cf.* Romer, 1990), the other by influencing the speed of technological catch-up and diffusion (*cf.* Nelson and Phelps, 1966). This relation between human capital and technological change is also stressed by van Zon and Muysken (1996: 44), who argue that "qualities may be of overriding importance in the face of embodied technical change, where the use of new technologies may require workers to have a skill level which offers enough slack (learning) capacity in order to master the new production technologies forced upon us by increased

literacy, numeracy, and general education, is likely to generate a basic 'ability to learn' that is vital in the innovation process (Foster, 1987) and may provide vicarious experience of a broader world than the individual can personally encounter; thus, presenting to the mind alternatives of environment and of policy and suggesting opportunities for progress, but also hazards against which protection is required (Hirshleifer, 1966). Education constitutes, therefore a source of information (Gibbons and Johnston, 1974) which tends to be highly relevant to 'decode' new technical information (Lall *et al*., 1993), and to incorporate it into manufacturing process.[35]

The idea that the spread of new technology for modern economic growth depended on learning potentials and motivations that were linked to the development of formal schooling is also stressed by Easterlin (1981).

> … the more schooling of appropriate content that a nation's population had, the easier it was to master the new technological knowledge becoming available. Moreover, … substantial increases in formal schooling tend to be accompanied by significant improvement in the incentive structure. Hence, increased motivation often accompanied increased aptitudes for learning the new technology. (Easterlin, 1981: 6)

An important aspect that comes up from the studies surveyed (see Table 2 in appendix) is an increasing recognition that with new technology employers may need to retain the skills of at least *some* workers (Bosworth *et al.*, 1992). In an environment characterised by rapid technological change, several authors emphasise the role of top educated and top skilled workers, in particular managers. University education is, according to Gibbons and Johnston (1974) crucial for "problem solvers", as it imparts a more general capability to assess the adequacy of knowledge for the resolution of a problem and to initiate a search to obtain further relevant information ("knowledge of knowledge"). The more educated a manager is, the quicker he/she will be to introduce new techniques of production; additionally, he/she is likely to adopt productive innovation earlier because his/her ability to understand and evaluate the information on new products and processes is higher; moreover, he/she tends to be quicker to adopt profitable new processes and products because the expected payoff from innovations is likely to be greater and the risk smaller. In other words, such a manager is better able to

international competition." Using the stock of human capital (measured by a combination of literacy and years of schooling) as proxy of social capability in a sample of 80 countries (1960-1985), Hanson and Henrekson (1994) found a clear effect of human capital on the capability of assimilating technology from abroad. They concluded that a higher level of human capital facilitates productivity growth by technological diffusion from leaders to followers.

[35] Accordingly, the absorption of new technology still calls for skill and know-how development, though clearly at a different, if not lower, level from that required for innovation.

discriminate between promising and unpromising ideas and less likely to make mistakes (Nelson and Phelps, 1966).

In one of the first micro-studies which related human capital and technological issues, Layard *et al*. (1971) point out that, in industries where technical progress is rapid, firms lose their markets unless they innovate and therefore they demand qualified personnel.[36] The same argument is stressed by Whiston *et al.* (1980). According to these authors many highly trained and educated people may be needed to change the design of products, processes and organisations in an environment of rapid technological change. In this context, the argument goes, a shortage of skilled people (in particular, engineers and scientists) can result in a failure to develop, or delay in developing, the planned products and the production processes by which they are to be made (Senker and Brady, 1989). In the same line, other authors (Welch, 1970; Bartel and Lichtenberg, 1987; Gill, 1989; Booth and Snower, 1996) argue that in a dynamic context, educated persons can take more advantage of available technology and thus be more productive.[37] In fact, high levels of education may interact with technological progress on at least two levels (Rebelo, 1994): firstly, highly skilled individuals, who have undergone long periods of formal schooling, are responsible for the vast majority of innovations; secondly, the effective use of new technologies often requires high levels of human capital.[38]

Empirically, some authors (Bartel and Lichtenberg, 1987; Wozniak, 1987; Steedman and Wagner, 1989; Senker and Senker, 1994; Rios-Rull *et al.*, 1996) have proved that the incentives to invest in technology and particularly in research and development and human capital are interdependent. Using case study material Senker and Brady (1989) argued how important it is for firms to complement their processes of technological development with appropriate human resource development strategies[39]

[36] The type of product explains a good deal of the variation (23%) in the proportion of the labour force having technical qualifications. The method of manufacture explains 15% of the variation whereas the 'newness' of the product explains 32%.

[37] Earlier, Collins (1974) demonstrated that educational requirements are highest in organisations with a high rate of technological change.

[38] Pack (1974) points out that lower efficiency in less developed countries in a given industry would not necessarily imply technical inferiority of older equipment, rather such differential efficiency could result from organisational and motivational factors or human skill differentials that are unrelated to equipment characteristics.

[39] Similarly, for Aoki (1986, 1988, 1990) the prerequisites for the functioning of an integrated structure within the firm involve not only a technical dimension, but particularly qualifications and more precisely the learning and adaptative capabilities of human resources.

In a deeper analysis of the human capital-technology issue Lall and Wignaraja (1997) found that technologically competent firms are larger, pay better, represent much higher levels of education for the entrepreneur and production managers, and employ more technical personnel. According to these authors, firms have reached this large size because they are competent, i.e., they invested in technological capabilities development both earlier and to a greater extent, or more effectively, than other firms.[40]

Despite the relation between human capital and technological performance is not deterministic (Walton, 1985; Dertouzos *et al.*, 1989), one clear conclusion does emerge from the research on technological, namely in those studies that address the issue of top educated (*e.g.*, Nelson and Phelps, 1966; Gibbons and Johnston, 1974) and top skilled (*e.g.*, Layard *et al*., 1971; Senker and Brady, 1989) workforce: in situation characterised by technological and market stability the demand for high levels of human capital is not particularly strong.

3.4. Survival performance

As referred earlier on this paper most of the studies that concentrate on human capital related issues, 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 achieve significant growth (Mansfield, 1962; Mata and Portugal, 1994; Demess/Cisep, 1994; Baldwin, 1995).[41]

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[40] Notwithstanding this, in many of the technologies there were economies of specialisation and size that meant that only large firms could reach efficient levels of technological capabilities. Moreover, the existence of market segmentation meant that only firms above a certain size were able to gain access to the skills, information and credit needed to be competent (Stiglitz, 1989). The fact that competent firms pay better may indicate that they employ workers with higher skills levels, give more training, and then offer higher wages to retain workers.

[41] Referring entry instead of survival, Stinchcombe (1965) argues that literacy and schooling raise practically every variable that encourages the formation of organisations and increases the staying power of new organisations. Along the same lines Lall *et al*. (1993) argue that the fact that firms fail to grow and move into larger size groups may reflect lack of internal capabilities to compete and grow and/or lack of skills, information or 'vision' on the part of entrepreneurs that would allow them to seek the right inputs or adopt the right business strategy.

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.[42] Those that mention the human capital variable do so in a rather marginal way, and mostly in relation to the process of entry (see Table 3). For instance, in his study of the process of entry and location of US plants, Carlton (1983) concluded that having a pool of technical expertise in a region seems to matter only for the most technologically sophisticated industry (communication).[43] Also, relative to entry processes, Storey (1986), restricting his analysis to the county of Cleveland in England, found that individuals working in large firms are unlikely to have the breadth of knowledge of otherwise comparable individuals working in a small firm and that their opportunity cost (wage foregone) is likely to be higher too. Hamermesh (1988), from another perspective, found that additional years of schooling by workers, *ceteris paribus*, reduce the probability of plant closure, whereas tenure had only a small influence on that probability.[44]

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). The first study was based on a sample of 4,429 firm entrants (white males entering self-employment) between 1976 and 1982 in the US; the author found that the likelihood of business discontinuance fell sharply for the owner education groups having four years or five-plus years of college, and that college education improves access to debt capital; this offers an alternative explanation for the survival of small businesses: human capital inputs are in part the cause of financial capital inputs, and the latter variables may be true predictors of firm survival. The study of Teixeira (2002), relating plants performance with firms human capital accumulation patterns, focus essentially on the concept of firms fitness, that is, firms survival

[42] The main concerns of studies of the demography of firms are concerned with the relation between size and growth (Simon and Bonini, 1958; Hymer and Pashigian, 1962; Mansfield, 1962; Ghemawat and Nelebuff, 1990; Lieberman, 1990; Dunne and Hughes, 1994), the magnitude of job creation and destruction flows (Carneiro, 1995; Baldwin *et al*., 1998), or the relative importance of industry and macroeconomic factors on firms' survival performance (Mata, 1993, 1996a, 1996b; Mata and Portugal, 1994). Stiglitz (1989), however, points out that many firms fail to grow and get into larger size groups due to the segmentation in factor markets – small firms find it more costly than large firms to obtain the inputs, credit, skills or information they need.

[43] Carlton's (1983) study encompassed new entries in fabricated plastics, communication transmitting equipment and electronic industries in the US between 1967 and 1971.

[44] Plant closures in Hamermesh's (1988) study are not effective exits but are proxied by the number of 'displaced' workers. The sample encompasses 2,636 workers in the US in the period 1977-1981.

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.

4. CONCLUDING SUMMARY

The present paper organised the theoretical and empirical literature on the relation between human capital and firm performance within a conceptual framework where firm performance is examined at the economic, technological and survival elements.

The clear direction of all the studies respecting human capital and economic performance pointed to the 'rationality' conveyed by human capital theory, namely that of increasing the quantity of firm's human capital. In this context it cannot be conceived that, in large swathes of seemingly still successful industrial capitalism there are distinctly low limits on the demands placed on the education and training system by employers, unless one resorts to the belief that these employers must be ill-informed or irrational. This exercise of reviewing existing literature permitted thus to uncover the little attention given by the majority of studies within human capital theory upon the determinants of demands for human skills and how those demands change. Moreover, it put forward the need and interest in analysing how the composition of human capital accumulation can be shaped by demand, and the role of social and institutional context may influence it. Finally, respecting human capital and survival it was concluded that empirically, research on the link between human capital and survival is scarce. Most of the studies that concentrate on human capital related issues, namely those associated with human capital theory, ignore the issue of survival. In this vein, these relatively neglected issues would be interesting and challenging areas for future research.

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APPENDIX

Table 1: Human capital and firms *economic* performance

Authors	Relation HC and performance	HC component	Main idea/mechanism
Becker (1962)	+	Training	Firms invest in human capital in the expectation of higher future profits derived from higher productivity levels relative to the wage paid
Weisbroad (1962)	+		Positive externalities between workers within a firm
Booth and Snower (1996)	+		
Stevens (1993)	+	'Transferable' training	Positive externalities between firms
Benson and Lohnes (1959)		Skilled personnel	Differences in intensity of employment of skilled personnel appeared to be systematic and were related to the major process and market of plants
Welch (1970)	+	Managers' skills	Increased education enhance a manager's ability to acquire and decode information about costs
Fleming (1970)	+		Importance of the skill of management to achieve and operate the best factory organisation
Pack (1972)	+		Managerial skill is a critical catalytic factor for productivity growth
Fluitman and Ondin (1991)	+		Entrepreneurs who have attended school for longer tend to produce more and to be more productive; moreover, having enrolled in formal training impacts favourably on enterprise performance
Eltis (1996)	+		The failure to recruit those who had achieved the greatest success at the university stage of their careers explain the low profitability of UK manufacturing firms
Griliches and Regev (1995)	+	Labour quality index (occupational distribution)	The inclusion of a labour quality index contributes significantly to an explanation of inter-firm differences in productivity
Majumdar (1998)	+	Labour quality (average wage per employee)	Human capital quality significantly impacted on thecompanies' abilities to exploit increasing returns and enhance the scale of their operations
Lynch and Black (1995)	+	Average education level of firm	The average educational level of the establishment has a positive and significant effect in revenue productivity; moreover, the greater the proportion of time spent in formal off-the-job training, the higher the productivity
Lall *et al* (1993)	+		Prior investments in human capital have to be made in order to *'decode' new technical information*
Senker and Brady (1988)	+	Training	Firms should complement their processes of technological development with *appropriate* human resource development strategies
Green *et al*. (1996)	0		*No relation* was found between the introduction of technological change and establishments' human capital accumulation (i.e., their training intensity by occupation)

Table 2: Human capital and *technological* performance

Authors	Relation HC and performance	HC component	Main idea/mechanism
Hirshleifer (1966)	+	Education	Education can suggest opportunities for progress and provides *protection* against *hazards*
Welch (1970)	+		In a dynamic context, educated persons can take *more advantage* of available technology and thus be more productive
Gill (1989)	+		
Collins (1974)	+		Educational requirements are *highest* in organisations with a high rate of technological change
Easterlin (1981)	+		New technology for modern economic growth depended on *learning potentials* and motivations that are linked to the development of formal schooling
Foster (1987)	+		Formal education, largely through the provision of literacy, numeracy, and general education, is likely to generate *a basic 'ability to learn'* that is vital in the innovation process
Wozniak (1987)	+		Differences in education explain differences in the capacity to *overcome resistance* to early adoption of new technologies
Groot and Grip (1991)	0		In banking the educational structure of commercial employers, managers and boards seemed to be somewhat *less influenced* by technological developments
Nelson and Phelps (1966)	+	Top educated	The more educated a manager is, the *quicker* will be to introduce new techniques of production, is *likely to adopt* productive innovation earlier because his/her *ability to understand* and evaluate the information on new products and processes is higher, tends to be *quicker to adopt* profitable new processes and products because the expected payoff from innovations is likely to be greater and the risk smaller. Such a manager is *better able to discriminate* between promising and unpromising ideas and less likely to make mistakes
Gibbons and Johnston (1974)	+		Education is a *source of information* contributing to technological innovation. Emphasis on university education for "problem solvers", as this imparts a more general capability to assess the adequacy of knowledge for the resolution of a problem and to initiate a search to obtain further relevant information ("knowledge of knowledge")
Whiston *et al* (1980)	+	Top educated	Many highly trained and educated people may be needed *to change the design of products, processes and organisations* in an environment of rapid technological change
Bartel and Lichtenberg (1987)	+		Within firms, better educated workers tend to have a *comparative advantage* in implementing new technology. The employment of more well-schooled workers is negatively related to the age of installed equipment and industries with higher R&D expenditures tend to have a more educated workforce.
Levy and Murnane (1996)	0		Computerisation had increased the bank's demand for college graduates but this increase had to do more with the increasing size of the financial industry than on changing skill requirements within the bank

(…) continuation of **Table 2**

Authors	Relation HC and performance	HC component	Main idea/mechanism
Pack (1974)		Skills	Differential *efficiency* can result from *human skill differentials* that are unrelated to equipment characteristics
Steedman and Wagner (1989)	+		Workforce skills as one of the major explanations for the greater innovativeness of German firms
Bosworth *et al* (1992)			New technology employers may need to retain the skills of at least *some* workers
Senker and Senker (1994)	+		Firms using information technologies in the service sector have been demanding *higher skills* from their employees
Penn *et al* (1994)	0/-		Tendency towards a *modest increase* in the skill of the largest block of jobs; many newly created jobs called for *few skills*
Booth and Snower (1996)	+		People who acquire skills make capital investment more productive, make *more effective use* of machines, and enable managers to introduce *more sophisticated* and productive machinery
Rios-Rull *et al* (1996)	+		The development of better and cheaper capital equipment *benefits skilled workers* and drives down the real wages of unskilled workers
Lall and Wignaraja (1997)	+		Technological learning process is a result of *deliberate investment* in creating skills and information (i.e., in technological development)
Aoki (1986)	+		The prerequisites for the functioning of an *integrated structure* within the firm involve the *learning and adaptative capabilities* of human resources
Knight (1921)	+	Top skilled	A key role of management in the firm is to cope with *uncertainty* by exercising judgement and developing the capacity for judgement in others
Layard *et al* (1971)	+		In industries where technical progress is rapid, *firms lose their markets unless they innovate* and therefore they demand qualified personnel
Rebelo (1994)	+	Top skilled	Highly skilled individuals, who have undergone long periods of formal schooling, are *responsible* for the vast majority of *innovations*
Senker and Brady (1989)	+		A *shortage* of skilled people (in particular, engineers and scientists) can result in a *failure to develop*, or delay in developing, the planned products and the production processes by which they are to be made. Moreover, failure to provide adequate and relevant education and training may *destroy the opportunity for moving into new markets*, for enjoying new prospects and for benefiting from new technology

Table 3: Human capital and *survival* performance

Authors	Relation HC and performance	HC component	Performance	Main idea/mechanism
Stinchcombe (1965)	+	Literacy	Creation	Literacy and schooling raise practically every variable that encourages the formation of organisations and increases the staying power of new organisations.
Carlton (1983)	+	Technical expertise		In technologically advanced industries, firms' entry is enhanced by the existence of a pool of technical expertise.
Storey (1986)	+	Skills		Firms' entry is enhanced by the existence of a large proportion of small firms, whose employees constitute potential new employers given their wider skills, compared to their larger firms counterparts.
Lall *et al.* (1993)	+		Growth	Firms fail to grow due to lack of skills.
Hamermesh (1988)	+	Education	Survival	Additional years of schooling by workers, *ceteris paribus*, reduce the probability of plant closure.
Bates (1990)	+	Top education		The likelihood of business discontinuance falls sharply for the owner education groups having four years or five-plus years of college.
Teixeira (2002)	0	Top educated and top skilled	Survival	Inert behaviour in terms of human capital accumulation is likely to enhance plants survival probability.