HUMAN CAPITAL DIMENSIONS – EDUCATION AND HEALTH – AND ECONOMIC GROWTH

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ABSTRACT

The main scope of this paper is to analyse the role of human capital and its dimensions – education and health - as an essential factor of labour productivity and, consequently, of economic growth. Using a panel data model exclusively for developed countries for the 1980–2005 period and fixed effects methods, we conclude that the inclusion of health variables adds explanation power to the growth model. This empirical evidence corroborates the idea that health improvements have significant benefits on economic growth and therefore it should be considered as an important component of human capital along with education. Investing in individuals' education and health is important not only for an increasing wellbeing but also for a sustainable economic growth.

Key-words: Economic growth; health; education.

Topic area: Economic Growth.

1. INTRODUCTION

Gross domestic product (GDP) per capita is traditionally used as an indicator of the standards of living of a nation's population. Hence, a primary goal for governments and economic policy makers should be to raise the level of national output, assuring higher standards of wellbeing. Having this in mind, economists have tried from long time to explain what the main sources of economic growth are as well as to find the more suitable approaches to describe the growth process. While for the former it is largely accepted the role of capital investment and human capital as the main driving forces of economic growth, in what concerns the question of how to model and describe the economic growth process, there isn't a straight answer (López-Casasnovas *et al*., 2005).

In the last decades the human capital concept, traditionally associated to education, has been developed to include also health factors. In fact, health plays a relevant role in explaining the

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worker's productivity and, at the national level, the economy's performance. Therefore, it was necessary to adapt the theory of economic growth in a way to capture the effects of health factors as determinants of economic growth and convergence.

Assuming a broader notion of human capital that encompasses health along with education implies, however, additional difficulties namely with what concerns the empirical analysis. These difficulties are related with restrictions on the availability of adequate data, which limits international comparisons, but also with the multiple and complex pathways through which health can affect growth and that are directly associated with the reverse causality effects between health, education and growth.

In this paper our aim is to show how health capital has been integrated in the theory of economic growth and to present empirical evidence of its impact on developed countries' economic performance. With this purpose in the next section we explain the role of human capital as a production factor. Section 2.1 explains the main mechanisms through which health affects economic growth. In section 3 we describe the one of the most used methodologies in the economic growth theory that attempt to extend human capital to include health as an input factor, explaining in section 3.1. Sections 4 and 5 present our findings and discussion, respectively, and section 6 presents some conclusions and implications.

2. THEORY: HEALTH AS A FACTOR OF PRODUCTION

Health as a component of human capital has generated a great interest in the literature both from the theoretical point of view and empirical perspective[2]. If traditionally human capital is associated to the worker's education/skills, more recently it has assumed a broader notion to include health factors. The idea that human capital accumulation could be improved by investing in the population's health was already advanced in the sixties by Schultz (1961) and Mushkin (1962) and gained definitively relevance after Grossman's (1972) pioneer work. Indeed, Grossman (1972) was the first to consider explicitly this issue, relating a higher preference for health (as a consumption good) to more educated individuals. According to the same author, health can be also seen as a capital good, since the production of health determines how much time is spent in labour. Healthier individuals are less likely to be absent at work due to illness and so they are more productive. In this context, health status is an important part of human capital, directly linked with education, and it can be defined as an individual's health stock[3]. Like physical capital, health capital depreciates over time but individuals can invest to improve their health status.

At a macroeconomic level, the idea that human capital incorporates not only education but also health status of the population is more recent. Some pioneer studies that relate health

[2] For a review of the literature, see for instance Becker (2007).

[3] WHO Constitution of 1948 defines health as "a state of complete physical, social and mental wellbeing, and not merely the absence of disease or infirmity". However, in a context of health promotion, the WHO has assumed a more objective notion of health, being considered as "a resource which permits people to lead an individually, socially and economically productive life". In this perspective, health must be seen as "a positive concept emphasizing social and personal resources as well as physical capabilities" (WHO, 1998).

conditions with per capita income are due to Preston (1975), who showed a positive link between national income levels and life expectancy, and reports of the World Bank (World Bank, 1993). Initially the focus was on the role of health to less developed countries (LDC) as a mean to escape from the poverty trap[4]. Since then, there was an increasing interest in the economic growth literature, mainly to analyze differences between rich and poor countries' performances. Several studies showed that initial health conditions are the most robust predictors of subsequent growth, having a higher explanatory power than the initial level of education (Barro, 1996; Knowles and Owen, 1997).

To a lesser extent, in the last years the analysis has also been extended exclusively to rich countries. In fact, in what concerns the most developed countries (OECD countries for simplicity) health is also a central issue both at academic and political debates because of two main trends that affect especially this group of countries. One is the ageing of the population (explained by higher life expectancy and lower fertility rates) and the other is the higher prevalence of chronic diseases (major cause of mortality and morbidity in the OECD countries (WHO, 2008)). Higher average ages of the working population in countries with longer life expectancies may have negative consequences on resistance to change or innovation capacity, which is the driving force of economic growth according to new growth theories. On the other hand, the increasing incidence of chronic diseases, that affect not only the elderly but also individuals still at working age, causes incapacity and absenteeism and, consequently, lower productivity that affects negatively economic growth. Lastly, it is also important to note the severe challenge that ageing population represents to the social security systems and the pressure it causes on public finances.

2.1 Channels through which health affects economic growth

Improvements in the health status of the population have a positive impact on economic performance through different mechanisms widely discussed in the literature. Following Howitt (2005), we can identify five main channels:

(i) Productive efficiency

Health, like education, is a conditioning factor of an individual's productivity and efficiency. There is empirical evidence (Schultz, 2005; Cai and Kalb, 2006) that healthier workers have more physical and mental energy, being more creative and productive. Health also affects labour supply since health problems cause many times *absenteeism* at work (Bloom *et al.*, 2001; Bloom and Canning, 2008) but also *presenteeism*, a relatively recent concept meaning those individuals that even feeling too ill still go to work although being less productive (Productivity Commission, 2006).

(ii) Life expectancy

One important outcome of health status improvements is the raise of life expectancy, which has consequences on education and investment/saving decisions. It makes investment in education more attractive and at the same time it is an incentive to save more for retirement,

[4] See Sala-i-Martin (2005), among others.

since individuals expect to live longer (Kalemli-Ozcan *et al*., 2000). Therefore an increase of life expectancy should raise schooling qualifications and saving rates[5]. An increase of life expectancy has also effects on the demographic structure of the population. By reducing infant mortality, a higher life expectancy will be reflected on a raise of the proportion of working age population. However, in the long term it is expectable that a decrease in the fertility rate will have the opposite effect, so the final result will depend on the predominance of these two forces[6]. In what concerns the OECD countries, the evidence shows that the prevailing factor is the decrease in fertility rate leading to a higher dependency ratio and lower proportion of the working age population[7].

(iii) Learning capacity

At a microeconomic level many studies empirically support the idea that an improvement on health status and nutrition are responsible for better cognitive capacities and educational outcomes. Miguel (2005), using panel data methods for rural areas of Kenya and India, shows that both children health status and parent's death have an important impact on education, namely on school attendance. Case *et al*. (2005), using a panel data for the Great Britain, analyzed the impact of health (measured by prenatal and childhood health) on educational outcomes and found a strong relation between poor children's health and lower educational returns. In general it is expected that healthier people have higher learning capacity explained not only by showing less absenteeism at school or at work but also for being more capable to assimilate and accumulate more knowledge.

(iv) Creativity

Health improvements induce better educational achievements, which are likely to have additional effects on the country's creativity and innovation activity. This idea is supported by Nelson and Phelps (1966) who showed that educational improvement speeds technological diffusion since educated individuals are likely to become good innovators and to be more flexible to technological changes. In this context, it is assumed that healthier workers are more able to have positive reactions to change, which is a determining factor for a successful change implementation. Healthier and more educated workers will be more receptive to technological change and innovation processes.

(v) Inequality

Investment on human capital qualification is one important explaining factor of wage differentials[8]. Having this in mind, promoting health can be seen as a vehicle to reduce income inequalities, since health policies will affect more the less favoured population. As Howitt (2005) notes, a reduction of income inequality will allow a higher proportion of

[5] It is expectable that increased life expectancy at 65 years old will influence consumer's life-cycle behaviour, leading to higher saving rate in the "middle age", since individuals probably will live more years being retired.

[6] For a discussion on this issue and possible consequences on economic growth, see Prettner *et al*. (2010).

[7] This is in fact a most relevant issue that justifies an increasing interest by policy decision makers. On this issue, see for instance a special report by The Economist (2009).

[8] According to Mincer (1994: 8), human capital investments consider, beyond years of schooling, "formal and informal job training and learning as well as job mobility involving search on and off the job".

individuals to finance their education and their health needs, being therefore more able to improve their economic situation. Since the link between health and income is reversal, a decrease of income inequality will cause a reduction on health inequality. Investing in the health sector is a way to reduce income inequalities, to increase labour productivity and therefore growth.

Having all these linkages in mind it is important to notice that the health sector gains a growing share in the economy especially in the most developed countries. In fact, the health sector (including social services) is responsible for an increasing proportion on total employment in the OECD countries.

3. METHODS: MODELING GROWTH TO INCLUDE HUMAN AND HEALTH CAPITAL

The economic literature that studies the macroeconomic impact of health on economic growth usually follows two different methods: the aggregate production function approach or the economic growth framework based on the regression analysis. The first approach carries out an accounting decomposition of the different sources that affect aggregate output and was primarily followed by Klenow and Rodríguez-Clare (1997) and more recently by Bloom and Canning (2005)[9]. Some of the restrictions of this method are that it imposes technology parameters based on microeconomic evidence[10] and it assumes an aggregate production function that works in a similar way as the production function at the firm level. The economic growth regression approach (which is also based on the production function) has a more solid theoretical background than the production function accounting decomposition approach and it is in fact the most used in the broader literature of economic growth.

3.1 The MRW (1992) model

The growth model

Empirical research that uses the growth regression approach traditionally follows the augmented Solow-Swan model as proposed by Mankiw, Romer and Weil (MRW, 1992). As Islam (2003) points out, with this version of Solow's model, MRW showed that it is possible to reconcile sustained growth rate differences between countries. From the theoretical point of view, this model reflects the conditional convergence hypothesis, showing that the Solow model only predicts absolute convergence in special conditions.

In this model the growth equation to estimate is given by:

$$gy_{i,t} = b\ln\left(y_{i,t-1}\right) + c_1\ln\left(n_{i,t} + g + \delta\right) + c_2\ln\left(k_{i,t}\right) + c_3\ln\left(E_{i,t}\right) + c_4\ln\left(H_{i,t}\right) + \varepsilon_{i,t} \quad (1)$$

[9] In this study, based on a panel of countries for the period 1965-1995, the authors show that health in the form of adult survival rates has a positive and statistically significant contribution to aggregate output.

[10] These parameters are used to calibrate the size of the effects at the aggregate level. For further reading, see Bond *et al*. (2001).

where $\varepsilon_{i,t} = \alpha_i + u_{i,t}$, with α_i denoting the country-specific effects or measurement errors and $u_{i,t}$ refers to the idiosyncratic error term.

The dependent variable, $gy_{i,t}$, is the growth of per capita income considering three year intervals. We regress $gy_{i,t}$ on $y_{i,t-1}$, the initial per capita income of each period whose coefficient reflects the convergence hypothesis[11] when appears with negative sign; $n_{i,t}+g+\delta$ is the annual growth rate of population plus the rate of technological progress (g) and the rate of capital depreciation (δ); $K_{i,t}$ denotes the investment share, $E_{i,t}$ is human capital (proxied by) and $H_{i,t}$ represents the health capital[12].

Having in mind the advantages in adopting panel data estimation techniques, this is the approach used in most empirical studies in the economic literature, and this will be the approach adopted in this paper.

We estimate this equation using panel data for 20 OECD countries (given by the subscript *i*) over the period 1980-2005. Having in mind our aim – to capture the impact of different dimensions of health on economic growth – we opt to consider several health proxies (one at a time to avoid possible colinearity) that we consider pertinent to characterize two different dimensions of health in the OECD countries: (*i*) the health care resources measured by the availability of practice physicians[13] (*physicians*) and (*ii)* the health status of the population, using potential years of life lost for males and females which is a measure of preventable mortality (*pyllmales* and *pyllfemales*, respectively) and life expectancy at birth (*lifexpect*).

4. FINDINGS

Table 1 shows the empirical results obtained from the estimation of growth models using panel data for OECD countries and for the period 1984-2007, using fixed effects methods.

[11] Barro and Sala-i- Martin (1992) developed this idea.

[12] In the Annex we explain the set of variables considered in our empirical study and the data sources.

[13] Practising physicians are those seeing patients either in a hospital or elsewhere (OECD, 2009).

Table 1: Growth regressions for OECD countries - Panel data, Fixed Effects

Variables	***Growth regressions OCDE countries, 1980-2005***				
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**
$ln(y_{t-1})$	-0.2537***	-0.3192***	-0.3048***	-0.2890***	-0.3190***
	(-6.122)	(-7.242)	(-6.157)	(-6.099)	(-6.068)
$ln(n_{i,t} + g + \delta)$	0.0198***	0.0128**	0.0198***	0.0208***	0.0163**
	(3.004)	(2.452)	(2.979)	(3.149)	(2.599)
$ln(s_{i,t})$	0.3061***	0.3193***	0.3146***	0.3040***	0.3333***
	(7.317)	(8.211)	(7.763)	(7.426)	(8.389)
$ln(educ_{i,t})$	0.4829***	0.2923*	0.4390***	0.4256***	0.3303***
	(4.452)	(1.924)	(3.697)	(3.298)	(2.762)
$ln(phisicians_{i,t})$		0.1542**			
		(2.498)			
$ln(pyll\ male_{i,t})$			-0.0901*		
			(-1.809)		
$ln(pyll\ females_{i,t})$				-0.0781	
				(-1.466)	
$ln(life\ expectancys_{i,t})$					0.8622*
					(1.895)
constant	1.3202***	1.3202***	1.7367**	1.4894*	-2.4377
	(2.986)	(2.986)	(2.008)	(1.676)	(-1.594)
Notes:					
Nr Observations	158	125	154	154	156
Nr Countries	20	20	20	20	20
R2	0.399	0.539	0.446	0.442	0.440
F	22.25	23.34	20.79	20.40	20.62

t-statistics in parentesis

*** p<0.01, ** p<0.05, * p<0.1

As Table 1 shows, by comparing "R2" coefficient of the traditional growth model (Model 1) to the other models, we can conclude that assuming health factors in the growth regressions increases their explaining power.

Another important aspect to notice is that the coefficient of the initial per capita income is negative and statistically significant (at 1% level) in all regressions and this is evidence that a convergence process has been taking place across the OECD countries. Our results also show that all the explanatory variables considered in the growth regression have their expected sign and show statistical significance, except "*pyllfemales*", although it has the expectable negative impact on growth.

Our empirical results highlight that capital investment (highly statistically significant in all models) and education are important driving forces of growth performance. With the exception of Model (2), education shows a very significant impact (at the 1% statistical significance level) on economic growth which is in line with what human capital theory predicts.

Another significant result from the estimation approach is that the variable "$n_{i,t}+g+\delta$" has a positive impact on growth at the 1% (models 1, 3 and 4) and 5% (models 2 and 5)

significance level, showing that population growth is an important conditioning factor of growth.

Table 1 also shows that health factors are important to explain the growth and convergence process among OECD countries. The most important role comes from health care resources - measured by "*physicians*"- showing a positive impact on growth at the 5% statistical significance level. As expectable, improvements on life expectancy at birth have an economic positive effect, while potential years of life lost has a negative impact on growth (both "*life expectancy*" and "*pyllmales*" statistical significant at the 10% level). The fact that "*pyllfemales*" has no statistical significance may be related to the fact that women already have a higher life expectancy and so it is more difficult to obtain further reductions on "*pyllfemales*".

5. DISCUSSION

Our empirical analysis shows that human capital is a very important conditioning factor of growth and convergence processes among OECD countries which is in line with human capital theory and new growth theories. As (Sianesi e Van Reenen, 2003) note, human capital enhances productivity, not only through the knowledge or competencies incorporated on individuals but also through the stimulation of physical investment and adoption of technological development. It is also important to take into account externalities related to education that can enhance growth, namely a better health status, better job opportunities and wages, lower unemployment levels or criminality rates.

Our results also evidence that including health factors in the model is important to a deeper understanding of the growth and convergence processes. So, omitting health factors in the growth regression may lead to biased results. Human capital should be considered in a broad notion that includes both education and health dimensions.

6. CONCLUSION AND IMPLICATIONS

It is now consensual that health, along with education, is a determining factor of workers' productivity and, consequently, of per capita income growth. Therefore, for a more complete understanding of economic growth and the convergence processes, economic theory has incorporated health as a component of human capital.

With this paper our main scope was to present an empirical application of the Solow-Swan neoclassical approach adapted to the evolution of the human capital concept. This approach considers health dimension as an extra input – and so it is known as "the augmented Solow-Swan model" – on the production function and highlights its impact on the level of output.

In this perspective, health improvements lead to higher human capital accumulation, higher productivity and so to a higher economic growth. On the other hand, better education contributes to improve health conditions. In what concerns economic growth, as countries improve their economic performance they have the capacity to invest more on education and health services.

Having in mind the important challenges OECD countries have to face in the near future, namely the ageing population and the burden of chronic diseases, with this paper our aim was to reinforce the idea that human capital encompasses not only the education dimension but also health factors. In this context, it is important to emphasize that health improvements are crucial for a better economic performance. Health prevention must be seen as an individual, organizational and police decision makers' responsibility. Therefore, it is important the implementation of educational policies that may influence lifestyles and contribute to more conscious risk behaviour. At the individual level education plays a major role. At the organizational level, human resources management should privilege labour environment and employees' health wellbeing. Hence, promoting job quality should be a priority of developed countries' policy decision makers and also of employers. This strategy would result in a healthier workforce, higher productivity and better economic performance.

ANNEX

Table 2: Description of variables and data sources

Variable	Description	Source
y	Real GDP per capita (Laspeyres), dollars in 2000 constant price – RGDPL	Penn World Table 6.2.
n	Annual average growth rate of population	Penn World Table 6.2.
k	Investment share as a percentage of RGDPL in 2000 constant prices	Penn World Table 6.2.
Education	Number of patents per million of inhabitants aged 25 or over	Arnold *et al*. (2007)
life expectancy	Life expectancy at birth, in years	OECD, Health Data 2009
pyll males	Potential years of life lost, all causes, males (Years lost per 100 000 females aged 0-69 years)	OECD, Health Data 2009
pyll females	Potential years of life lost, all causes, females (Years lost per 100 000 females aged 0-69 years)	OECD, Health Data 2009
physicians	Practising physicians, density per 1 000 population	OECD, Health Data 2009

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