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**HEALTHY, EDUCATED AND WEALTHY:  
IS THE WELFARE STATE  
REALLY HARMFUL FOR GROWTH?\***

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**Abstract**

In this paper, we study how public and private expenditures in health and education affect economic growth by their influence on people's health, abilities, skills and knowledge. We consider a growth accounting framework in order to test whether welfare expenditures more than offset the efficiency losses caused by distortionary taxation, and whether the effects of public expenditure on economic growth differ from those of private expenditure. Our empirical analysis is based on a panel of 19 OECD countries observed between 1971 and 1998. The results are consistent with the hypothesis that the contribution of welfare expenditures more than compensates for the distortions caused by the tax system; and the estimated positive impact is stronger for health than for education. We also find some evidence that public expenditure influences GDP growth more than private expenditure.

**JEL classification:** H51, H52, I38, O47

**Keywords:** health, education, public and private expenditure, economic growth

**Resum**

En este trabajo se estudia cómo el gasto público y privado en sanidad y educación afectan el crecimiento económico a través de su influencia en la salud, las habilidades y el conocimiento de los individuos. Se considera un modelo de contabilidad del crecimiento para verificar si los beneficios de los gastos sociales compensan las pérdidas de eficiencia generadas por la imposición; y si los efectos del gasto público difieren de los efectos del gasto privado. El análisis empírico se basa en un panel de 19 países de la OCDE estudiados entre el periodo de 1971 y 1998. Los resultados son consistentes con la hipótesis que afirma que la contribución del gasto social compensa las distorsiones causadas por los impuestos; y que el impacto positivo del gasto en sanidad es superior al observado para la educación. También se observa que el gasto público tiene un efecto superior sobre el crecimiento del PIB que el gasto privado.

## 1. Introduction

The Welfare State has been the subject of several discussions and reform proposals among scholars and politicians over the last thirty years. Political support has been declining recently, especially in Europe, where a great deal of resources are devoted to its funding. Following a standard neoclassical approach, many authors have argued that a reduction in the size of the Welfare State would stimulate economic growth. The usual argument is that distortionary taxes are needed to finance public intervention, which discourages entrepreneurship, capital and labour supply. Needless to say, this argument gains greater support whenever public intervention is perceived as inefficient, so individuals' common belief is that everyone would be better off if the tax burden were reduced.<sup>1</sup>

However, as Atkinson (1995a, 1995b, 1999) suggests, the above argument is somewhat distorted, since it shows only one side of the coin. In fact, together with distortionary taxes, the Welfare State makes *productive* public expenditure available that might reasonably have a positive impact on people's health, skills and knowledge and, through this channel, on economic growth. Naturally, not all public interventions traditionally included under the definition of the Welfare State have a positive effect on human health and abilities. Nevertheless, the provision of health and education at least should reasonably contribute to this end: a healthy and educated worker may be reasonably expected to be more productive than one who is uneducated and in poor health. As Streeten (1994) points out, "a well nourished healthy, educated, skilled, alert labour force is the most productive asset".<sup>2</sup> By considering both the loss arising from distortionary taxation and the benefits accruing to society through *productive* public expenditure, the overall effect of the Welfare State on economic growth is not theoretically obvious.

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<sup>1</sup> Another reason recently emphasised by the political economy literature to explain why the political climate has varied, focuses on the effects of skill biased technical change and the resulting increase in wage inequality, which determines a political equilibrium characterised by social preferences towards a downsizing of redistributive policies (e.g., Hassler *et al.*, 2003).

<sup>2</sup> From Streeten's perspective, societies should consume health and educational services regardless of their effect on economic growth: "... it is odd that Hondas, beer, and television sets are often accepted without questioning as final consumption goods, while nutrition, education, and health services have to be justified on grounds of productivity... The World Bank's 1993 Development Report on health has the sub-title "Investing in Health" as if good health had to show economic returns higher than the cost of capital. What if the returns to investment in health are zero?"

From a theoretical standpoint, the arguments mentioned above in favour or against the Welfare State are not even conclusive. For instance, Gintis and Bowles (1982) suggest that both the “human capital” approach and the standard neoclassical argument do not take the institutional aspects related to the Welfare State into account. From their perspective, the Welfare State guarantees positive and productive relations between capital and labour, thus shaping an economic and social environment in which private investments are stimulated. This argument is to some extent related to the concept of “social capital”, which has recently received considerable attention in the literature on the determinants of growth.<sup>3</sup>

The argument put forward by Gintis and Bowles implicitly maintains that a more equal distribution of resources favours output growth. This idea has gained theoretical foundations and empirical support over the last ten years, as can be seen by the papers by Persson and Tabellini (1994) and Alesina and Rodrik (1994), among others.<sup>4</sup> These latter contributions provide empirical evidence that the more distribution of resources is unequal, the more investments in human and physical capital are discouraged, since it becomes more likely that governments will be called to implement policies that reduce the appropriability of the expected gains from such investments. It is worth noting that in addition to the standard textbook argument which builds on the presence of positive externalities, the positive relation between equality and growth mentioned above may also be used as a basis for justifying the public provision of goods such as health or education. In fact, it has been shown (see Balestrino, 1999, for a survey), that a more equal distribution of resources can be achieved more efficiently if the public provision of such goods is used by governments as well as (distortionary) tax instruments.

By considering the discussion above, it can be seen that no definitive theoretical argument can be made in favour or against the Welfare State from a growth perspective. Its overall effect on economic performance should therefore be assessed on empirical grounds. However, this conclusion is not encouraging given the mixed results shown by the literature which has addressed the issue in this way (e.g.,

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<sup>3</sup> For example, Knack and Keefer (1997), arguing that “trust and norms of civic cooperation are essential to well functioning societies and to the economic progress of those societies”, find measures of social capital that are positively related to economic growth. However, the concept of social capital is highly controversial, with the literature providing various definitions and measures (see Durlauf, 2002, for a critical discussion).

<sup>4</sup> See also Putterman *et al.* (1998) for a critical survey.

Devarajan *et al.*, 1996; Kneller *et al.*, 1999; Zagler and Dürnecker, 2003, for a survey).

A point that - quite surprisingly - has not been considered yet in the debate is that reducing public intervention would probably imply a higher allocation of goods such as health or education by means of private markets. However, the effect this could have on people's health, skills and knowledge, is questionable, as substituting public with private provision might entail a *level* and a *distribution* of consumption of health and educational services that is sub-optimal from the social point of view. Moreover, as Gintis and Bowles (1982) point out, "the alternative to the Welfare State is ... not simply less redistribution, but includes possible institutional transformation. The possible patterns of economic evolution consistent with the no-welfare-state option ... include chaos, stagnation, and the development of new and perhaps unprecedented economic systems".

In this paper, we study how public and private expenditure in health and education affect economic growth as a result of their influence on people's health, skills and knowledge. We consider a growth accounting framework to explore an issue which is at the core of the academic and political debate on the Welfare State. We are particularly interested in ascertaining whether public welfare expenditures more than offset the efficiency losses caused by distortionary taxation, and whether the effects of public expenditure on economic growth differ from those of private expenditure. The empirical analysis is based on a panel of 19 OECD countries observed from 1971 to 1998. Our results are consistent with the hypothesis that the contribution of public welfare expenditures more than compensates for the distortions caused by the tax system, and that the estimated positive impact is stronger for health than for education. We also find some evidence that public expenditure influences GDP growth to a greater extent than private expenditure.

The remainder of the paper is organised as follows. In section 2, we survey theoretical and empirical papers linking expenditure in health and education to economic growth. We make a distinction between the two concepts of "human development" and "human capital", and discuss their proxies used in the empirical works. In section 3, we describe our empirical approach and our sample, and discuss our results. Section 4 concludes this study.

## 2. Linking expenditure in health and education to economic growth

The theoretical economic literature mentions several ways of linking *expenditure* in health and education to economic growth. Most of these links are related to the idea that a healthy and educated worker is expected to contribute more to production than one who is uneducated and in poor health. An initial strand of literature concentrates on *human development*, a concept introduced by Amartya Sen (e.g. Sen, 1987, 2000) and accepted by the *United Nations Development Programme* (1990) as a basis for the *Human Development Report*. The concept of human development is basically related to a person's ability to enjoy achievements in welfare (e.g., Ranis, 2004, for a recent survey). This approach rightly acknowledges that the potential opportunities for healthy and educated workers, their abilities to function, are different from those of people who are uneducated and in poor health (Anand and Ravallion, 1993). A second interrelated strand of literature concentrates on *human capital*, which is a somewhat stricter concept since it refers only to the skills and knowledge that individuals acquire and which can be exploited in their role of workers in the labour market. Both these strands of the literature, despite their peculiarities, emphasize what may be called the "human factor" contribution to economic growth, and are consistent with two approaches. One of these works using a positive effect on labour productivity (the "Lucas approach"), while the other using through a positive impact on the rate of innovations (the "Nelson and Phelps approach"). Both these approaches can be formalised by considering an aggregate production function with the following general form

$$Y_t = F(K_t, L_t, A_t)$$

where  $Y$  is aggregate income,  $K$  is physical capital,  $L$  broadly represents workers,  $A$  is the level of technology, and  $t$  is an index for time. The "human factor" contribution to economic growth is embodied in either  $L$  or  $A$ . In the first case,  $L$  is usually dubbed as "effective units" of labour, while in the second case,  $A$  is split into two components, one of which is related to "pure technical change" and the other to "labour induced technical change".

In terms of empirical strategies, there are at least two different methodologies for estimating the contribution of the “human factor” to economic growth. The first is based on an economic model of growth which takes exogenously given growth rates of the labour force and technology. This methodology provides an equation which links the aggregate product to the steady state values of the growth determinants (e.g., Mankiw *et al.*, 1992). The second strategy is based on a growth accounting framework that - by assuming that the production factors are paid their marginal productivity - considers the GDP growth rate as a function of the inputs’ growth rates and output shares (e.g., Barro, 1998). Within this latter strategy, there are two further methods for estimating the contribution of the “human factor” to economic growth. The first is the traditional method based on the *observed* factor shares, and the second is based on regression analysis, where the factor shares represent the coefficients to be estimated.

Since the choice of the proxy measure is severely constrained by data availability, it is not surprising that the variables used to account for the “human factor” – in both the human development and the human capital approaches - are to a large extent similar. In the *human development* approach, for instance, the Human Development Report (1990) combines three variables (life expectancy, adult literacy and command over resources needed for a decent living) to construct a human development index. Aturupane *et al.* (1994) also recommend a basic set of three indicators which covers the same general categories - infant mortality, primary school enrolment, and per capita income. Although the human development approach acknowledges the role of economic growth in enhancing the performance of the most commonly used indicators of human development, what really matters in this approach is not economic growth in itself, but the way in which its benefits are distributed among people and the extent to which growth supports public services (Anand and Ravallion, 1993). The conviction is that only those countries which devote an increasing amount of resources to these services (mainly health and education) may expect to move along a sustainable growth path. As Ranis (2004) puts it: “human development seems to be a necessary prerequisite for long-term sustainable growth ... the old-fashioned view of grow first and worry about human development later is not supported by the evidence”.

As mentioned previously, the proxies used to account for the “human factor” within the *human capital* approach are basically the same. On the one hand, in their attempt to take into account the human capital within the standard neoclassical growth model,

Mankiw *et al.* (1992) proxy human capital with the percentage of the working age population enrolled in secondary school (explicitly ignoring the health status of the workers). Basing themselves on the same methodology provided by Mankiw *et al.* (1992), Knowles and Owen (1997) and Webber (2002) consider a more complex measurement of human capital, which tries to include both the health status and the educational level of the workforce. Knowles and Owen (1997) use life expectancy as a proxy for health status, and the average numbers of years of schooling attained by the population aged over 25 as a proxy for educational achievement. Webber (2002) proxies education with three different measures (namely the percentage of the relevant population enrolled in primary, secondary and higher school) and uses an index of under-nutrition based on calorie intake as a proxy for the health status.<sup>5</sup> On the other hand, within the growth accounting strategy, Bloom *et al.* (2001) model human capital using a non-linear combination of three terms. These are schooling (measured as the average total years of schooling of the population aged 15 years and older), aggregate work experience (measured as the amount of time spent in the labour force), and health (proxied by life expectancy), whereas Herbertsson (2003) obtains the factor share that remunerates human capital by the estimation of a structural model, in which the externality produced by public spending in education affects human capital with a certain lag.<sup>6</sup>

In more general terms, Le *et al.* (2003) and Wößmann (2003), in their surveys on the most commonly used proxies for human capital, classify these measures into three broad approaches - a cost-based approach; an income-based approach, and an educational stock-based approach. The cost-based approach basically proxies the human capital stock by considering both the costs of producing the physical human being (in other words, the costs of rearing a child) and the costs of increasing labour productivity (e.g. expenditures in health and education). The income-based approach measures human capital by considering the total income that could be generated by an

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<sup>5</sup> The results concerning the link between human capital accumulation and economic growth are mixed. Knowles and Owen (1997), using a cross-section of 77 countries selected from those considered by Mankiw *et al.* (1992), find a strong positive relationship between health status and economic growth, whereas the relationship between economic growth and education is found to be not significant. By contrast, Webber (2002) finds that education is consistently more important than health in stimulating economic growth in a cross-section of 46 countries, 26 of which are classified by the World Bank as low- or middle-income countries.

<sup>6</sup> As before, the results are somewhat mixed. Bloom *et al.* (2001), using data for a panel of countries from the Penn World Tables, find a positive impact by health on economic growth, whereas no clearcut results for schooling and experience are found. Herbertsson (2003), considering data for five Nordic European countries, finds that human capital makes a contribution of between 12 and 33% to explaining economic growth.

individual during her lifetime. Finally, the educational stock-based approach considers the educational attainment of the labour force (i.e. the average years of schooling or the adult literacy rates). Since we are interested in assessing the contribution of the welfare expenditure (both public and private) to economic growth, we work here within a cost-based approach.

### **3. The empirical analysis**

#### *3.1. Methodology*

In this section, we describe our empirical methodology, grounded on a cost-based approach to the measurement of the contribution of the “human factor” to economic growth. The key point we wish to stress is that we model the “human factor” as a function of *total* (i.e. public and private) expenditure in health and education. In other words, the “human factor” stems from the *consumption* of educational and health services. In particular, like Grossman (1972), we model the differences between health capital and other forms of human capital, by assuming that only *current* consumption of health services influences health status, whereas *current* and *past* consumption of educational services influence the amount of knowledge. Like all the other proxies, our cost-based type measure is also subject to some criticism. For example, Hanushek (1996) argues that expenditure in education cannot be considered consistently linked to acquired cognitive skill. In a similar vein, Le *et al.* (2003) point out that “there is no necessary relationship between investment and quality of output ... an innately less able and less healthy child is more costly to raise”. However, our choice can be justified on different grounds. To begin with, as Wößmann (2003) has also recently clarified, all the most commonly used measures of human capital (or human development) are inevitably imperfect and (more importantly) linked to data availability. Moreover, contrary to the above mentioned view, there is a growing body of empirical evidence supporting a causal relationship between expenditure on health care (education) and health status (education attainment) (e.g., Gupta *et al.*, 2002). Furthermore, this correlation is found to increase with the quality of governance (Rajkumar and Swaroop, 2002). This may raise the doubt that the correlations between most of the commonly used measures of human capital or human development (e.g. adult literacy, life expectancy, school enrolment ratios) and output growth are spurious. These variables may indeed be correlated with expenditure in health or education, and expenditure may have a genuine causal relationship with growth. Finally, expenditure must necessarily be correlated with the

internal rate of return of investments (IRR) in health and education, which constitutes the basis for deriving a Mincer formulation to specify human capital stock. In fact, assuming that choices are rationally taken by individuals, the IRR equals costs and benefits of investments (e.g., Wößmann, 2003), hence total spending in health and education can be obtained by capitalising annual benefits with the IRR.

Our empirical analysis considers both private and public expenditure in health and education. There are at least four arguments suggesting differences between the effects of the two types of expenditure. The first argument rests on the answer given to the question of whether private and public expenditure should be considered substitutes or complements. In the former case, public provision may simply crowd out private expenditure. As Filmer *et al.* (2000) point out, “changes in the price or availability of government interventions may induce a private supply response that can mitigate any actual impact on health outcomes”. In the latter case, private expenditure can simply be thought of as topping up public expenditure, therefore being less productive if diminishing returns to health and education are assumed. A second argument is that public intervention takes the presence of positive externalities in consumption of health and education into account, whereas private markets typically do not. Since the distribution of consumption of these goods among individuals would be different with private provision, a third argument is that the overall effect on the “human factor” may significantly diverge, depending on the relative composition of total spending. A fourth and final argument is related to the fact that public intervention could contribute to improving the social environment (e.g. Gradstein and Justman, 2000). Previous contributions generally considered public expenditure in isolation, or considered either expenditure in health or expenditure in education. Unlike these approaches, we consider *both* public and private expenditure. To the best of our knowledge, this point has never been considered before.

For our purposes, let us start by differentiating Eq. (1) with respect to time. Dividing by  $Y$  yields:

$$\frac{\Delta Y}{Y} = \left( \frac{F_K K}{Y} \right) \frac{\Delta K}{K} + \left( \frac{F_L L}{Y} \right) \frac{\Delta L}{L} + \left( \frac{F_A A}{Y} \right) \frac{\Delta A}{A}, \quad (2)$$

and assuming each input is paid its marginal product, we obtain:

$$\frac{\Delta Y}{Y} = s_K \frac{\Delta K}{K} + s_L \frac{\Delta L}{L} + s_A \frac{\Delta A}{A}. \quad (3)$$

Note that  $S_A$  is not observable, and therefore we cannot *directly* measure the contribution of technology to output because it cannot be separated from the contributions of physical capital and (broadly defined) labour. The reason for this is that the *observed* factor shares of physical capital and labour also include the remuneration of technology and the contribution of the “human factor” to economic growth (see also Besley, 2001). Following this rationale, Eq. (3) can be rewritten - assuming constant returns to scale at the aggregate level - as:

$$\frac{\Delta Y}{Y} = \sigma_K \frac{\Delta K}{K} + \sigma_L \frac{\Delta L}{L} + \frac{\Delta A}{A}, \quad (4)$$

where  $\sigma_K$  and  $\sigma_L$  are the *observed* factor shares of physical capital and labour respectively.

We now need to define the link between the “human factor” and output growth rate. Let us first follow the “Lucas approach” and assume that expenditure in health and education contributes to define effective units of labour  $L^*$  as follows:

$$L_t^* = f(L_t, E_t^{pu}, E_{t-1}^{pu}, E_{t-2}^{pu}, \dots, HE_t^{pu}, E_t^{pr}, E_{t-1}^{pr}, E_{t-2}^{pr}, \dots, HE_t^{pr} | I), \quad (5)$$

where  $L$  is the number of workers,  $HE$  and  $E$  are expenditure in health and in education respectively,  $pu$  and  $pr$  are mnemonics for public and private, and  $I$  represents the institutional features which may be relevant to explain differences in the *quality* and the *efficiency* of these two types of expenditure (e.g. whether such goods are provided at the central or at the local level, or whether there is any competition between public and private suppliers). Considering the definition of effective units of labour given in Eq. (5) and substituting in Eq. (4), the equation to be estimated can be written as:

$$\begin{aligned} \Delta \ln Y_{it} = & \beta_1 \Delta \ln K_{it} + \beta_2 \Delta \ln L_{it} + \beta_3 \Delta \ln (HE^{pu})_{it} + \beta_4 \Delta \ln (HE^{pr})_{it} + \\ & + \beta_5 \Delta \ln (E^{pu})_{it} + \beta_6 \Delta \ln (E^{pr})_{it} + \beta_7 \Delta \ln (E^{pu})_{it-1} + \beta_8 \Delta \ln (E^{pr})_{it-1} + \lambda_i + \phi_t + \varepsilon_{it} \end{aligned} \quad (6)$$

where  $\lambda_i$  and  $\phi_t$  are country and time fixed effects respectively, and  $\varepsilon_{it}$  represents a standard error term. The time effect  $\phi_t$  includes all those influences on the output

growth rate common to all countries in a given year (e.g. the economic cycle), while the individual effect  $\lambda_i$  picks up the influences specific to each country (e.g. social, religious, climate or geographical factors).  $\lambda_i$  and  $\phi_t$  provide also an additional control for the institutional differences outlined above.

An alternative way of reaching Eq. (6) follows the “Nelson and Phelps approach”, and models the “human factor” using efficiency parameter  $A$ . In particular, we assume that the efficiency parameter is a function of the technology  $TE$  and the labour productivity  $LP$ ; hence:

$$A_t = f(TE_t, LP_t) = f(TE_t, E_t^{pu}, E_{t-1}^{pu}, E_{t-2}^{pu}, \dots, HE_t^{pr}, E_t^{pr}, E_{t-1}^{pr}, E_{t-2}^{pr}, \dots, HE_t^{pr} | I). \quad (5b)$$

In other words, as before, labour productivity stems from the *consumption* of educational and health services. Considering Eq. (5 b), and substituting in Eq. (4), we are then back again to Eq. (6).

### 3.2. Data

In order to empirically estimate Eq. (6), we use annual data on a per capita basis from a sample of 19 OECD countries during the period 1971-1998.<sup>7</sup> Data on macroeconomic variables come from the Penn World Tables 6.1, and include data on population, real GDP per capita at constant prices<sup>8</sup> (GDP) and the investment share of GDP. The labour force in each country was obtained from OECD Health Data. We have constructed a measure of private capital stock for each country using a perpetual inventory method. We initialise the capital stock series setting the capital stock in 1971 equal to the average investment/GDP ratio in the first five years of data, multiplied by the level of GDP in the initialising period, and divided by 0.07, our assumed depreciation rate (Bloom *et al.*, 2001). The capital stock of each subsequent period is calculated using current capital plus the level of current investment, minus the 7% depreciation rate of the current stock. Health expenditure (HE) is measured by using data on public and private spending on health per capita expressed in international PPP dollars from the OECD Health Data. Similarly, we measure education expenditure (EDU) using data on public and private spending on education

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<sup>7</sup>Due to data availability, especially for the data about expenditure in education, we have selected a sample of OECD countries for which we were able to obtain annual series of the variables used in this work.

<sup>8</sup> Constant price values of GDP are calculated using a Laspeyres index.

per capita. However, data on education spending are difficult to obtain for a long time span. As a result, we are forced to consider only *current* expenditure in education. In order to partially overcome this problem and check the robustness of our results, we use two data sources for public expenditure in education. These are the data published by UNESCO and the data from the World Bank database. Finally, the data on private spending in education (covering all levels of education) are from OECD *Education at a Glance*. We also include additional controls for institutional aspects that might influence the effectiveness and the estimated role of spending in different countries. Data on income inequality as measured by the Gini index (GINI) comes from Deininger and Squire (1996). Political variables are taken from DPI2000 (Keefer, 2002), and include: a dummy variable equal to one where Central Government is supported by left-wing parties (EXECRLC), a variable measuring the fraction of seats held by the Government (MAJ) and a dummy variable equal to one in the years of legislative elections (LEGELEC). Data on the degree of fiscal decentralisation, measuring the percentage of taxes collected by the Central Government (CGTAX), are obtained from the OECD *Revenue Statistics 1965-2002*. The descriptive statistics and data sources for all the variables included in our empirical analysis are reported in Appendix 1.

### 3.3. Results

In this section, we present the results of our empirical analysis. The main problem is the lack of data for private expenditure on education, which shortens the time span and reduces the sample of countries, making it difficult to identify the parameters of interest. We therefore start by considering only public and private expenditure on health. We then augment our basic estimation by adding public expenditure on education and, finally, by including private expenditure.<sup>9</sup> As an additional robustness test, we also consider a regression only with expenditure in education.

Table 1 shows our estimates when expenditure in health is considered in isolation. The Breusch-Pagan test and the Hausman (1978) test indicate that the 2-way REM is the preferred model. As expected, most of the coefficients are positive and statistically significant at the usual levels of confidence. The coefficient associated with physical capital is significantly greater than that associated with labour. This result holds for all our models and is at odds with findings by Bloom *et al.* (2001). In

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<sup>9</sup> See the table notes for the definition of the sample of countries and the time span used in each group of estimations.

column *I*, the coefficient for *total* health expenditure is 0.0574: a 1% increase in the  $HE^{tot}$  growth rate increases the per-capita GDP growth rate by 0.06%. In column *II*, we test whether the coefficients associated with public and private expenditure differ. Results show that the coefficients for the two types of expenditure do have a different magnitude, with the coefficient associated with public expenditure greater than that of private expenditure and statistically significant. Columns *III* and *IV* suggest that these two coefficients are robust and well identified. It is worth noting that, as pointed out by Kneller *et al.* (1999), our estimates of the effects of public spending on GDP growth should suffer from a *downward bias* caused by the omission of distortionary taxation. For this reason, our conclusions on the positive impact of public expenditure should then be reinforced. We provide an initial test of the robustness of our findings by adding additional controls for different institutional features to previous regressions. The results for these augmented models are shown in table 2. The main findings are confirmed - the coefficient for *total* health expenditure is now 0.0607, i.e. very close to that previously estimated, and disaggregating public and private expenditure yields coefficients of approximately the same magnitude as before. All of the coefficients for the political variables are statistically insignificant. Only the coefficient for CGTAX appears as marginally insignificant at the usual levels.

Table 3 reports our estimates when augmenting the first set of regressions by also considering public expenditure in education. The Breusch-Pagan test and the Hausman test now indicate that the 2-way FEM is the preferred model. While the coefficient for physical capital remains unaltered, the one for labour is reduced and is statistically insignificant. However, results show an increase in the magnitude of the coefficients on public and private expenditure in health, with both coefficients are now statistically significant. The coefficient for public expenditure in education also shows the expected sign and is statistically significant. According to these results, public expenditure in health seems to have a greater impact on economic growth than public expenditure on education. This result matches the findings of Knowles and Owen (1997). The results are robust for the two variables of public spending on education used (UNESCO and World Bank), with an elasticity of around 2-3%. In this case, we also repeat our exercise by including political variables (table 4). As before, all the main results are confirmed.

We obtain much less firm results when augmenting previous regressions further by adding private expenditure in education (table 5). The estimated coefficient for physical capital rises sharply compared to previous estimates. A somewhat surprising

result is that the coefficient for labour is now negative (although not statistically significant) in almost all estimations. Coefficients on health and education expenditure also appear difficult to identify, and are even negative (but statistically not significant) in some regressions. These conclusions are confirmed when political variables are also added (table 6), and when both public and private expenditure on education is considered in isolation, (table 7 and 8). One possible explanation for these findings may be that the final sample is rather small (almost 60 observations), with only 9 countries included and a very short time span.

One possible criticism of our findings relates to the problems of endogeneity and reverse causality. In fact, a well documented stylised fact is that (total) expenditure in health and education rises with per-capita GDP. Empirical papers trying to address the direction of causality between the Welfare State and economic growth (e.g. Hecce *et al.*, 2001) found inconclusive evidence. We do not address this issue here, and concentrate instead on endogeneity. In order to cope with this problem, we consider the instrumental variable estimation of our previous model, using the GMM estimator. Table 9 shows the GMM estimates. To control for fixed effects, the variables are transformed in terms of orthogonal deviations, and a full set of time dummies is included in the regression to account for factors varying over time but which are common to all units. We report results based on consistent one-step estimators, as proposed by Arellano and Bond (1991). We use the lagged values ( $t-1$  up to  $t-3$ ) of the health expenditure variables as instruments. We also include the Gini index as an additional instrument in the dynamic IV estimations. We check for the validity of instruments using the Sargan test. Given that the GMM estimator uses lagged values of the variables as instruments, under the hypothesis of no autocorrelation in the error term, the series of differentiated residuals should present a significant first-order correlation, while indication of second-order serial correlation should not be present. We provide two statistics,  $m_1$  and  $m_2$ , that test for first and second-order serial correlation in the error term, respectively. As expected,  $m_1$  is statistically significant, while  $m_2$  is not, thus confirming the validity of instruments. We also test whether there is any dynamic structure in our model, by introducing lagged values of the GDP growth rate and the spending variables as regressors. Our main results are substantially unchanged with respect to our previous estimates in table 1. The magnitude of the coefficients associated to labour and health spending increase, with coefficients for  $HE^{tot}$  being now close to 0.10. In this case, the effectiveness of public expenditure on economic growth also appears larger than that of private expenditure. The same type of results holds true in the dynamic version of

our model, which provides an additional robustness check for our results. The coefficient for lagged health expenditure is significant only when considering total expenditure, suggesting that only *current* consumption of health services matters for economic growth.

In order to study the role of spending in health and education in contributing to economic growth further, we decompose the GDP average growth rate at its sources, using the accounting methodology detailed in Herbertsson (2003). We limit ourselves to the estimates reported in tables 1 and 3. Results of these exercises are shown in tables 10 and 11. In both cases, half of the reported GDP growth rate is explained by growth in the stock of physical capital. The role of spending on health is significantly higher than that on education, with the former accounting for between 16.44% and 27.30% of economic growth, with much of this result coming from the contribution by public expenditure. The share of GDP growth accounted for by education expenditure is around 3%, a contribution similar to that by labour once we account for the role of human capital. The TFP component related to pure technological change contributes between 17.59% and 42.58%. Our results are substantially in agreement with findings by Herbertsson (2003).

#### **4. Concluding remarks**

In this paper, we provide an initial attempt to explore issues that should be placed at the core of the ongoing academic and political debate concerning the Welfare State. Is there any evidence that countries which devote a larger amount of resources to the consumption of health and educational services experience higher growth rates? Is there any difference between public and private expenditure in health and education? Are the gains accruing to societies because of public welfare expenditures able to offset the efficiency losses caused by the distortionary taxes necessary to fund the Welfare State? From a theoretical standpoint, we have emphasized the role that expenditure in health and education plays in enhancing what we have called the “human factor”, which affects economic growth via either labour productivity or technical progress. Our empirical analysis, based on a panel of 19 OECD countries observed from 1971 to 1998, shows a robust positive correlation between expenditure in health and education and GDP growth. The estimated positive impact is stronger for health than for education. There is also some evidence that public expenditure influences GDP growth to a greater extent than private expenditure. All these results also appear to be robust after controlling for the potential endogeneity of welfare

expenditures. A simple accounting exercise shows that the contribution to GDP growth of spending on health is significantly greater than that of education, with the former accounting for between 16.44% and 27.30% and the latter accounting for about 3% of economic growth.

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Table 1. Production Function in Growth Form. Health Spending (Public and Private) Dependent Variable: Growth Rate of GDP; 2-way REM using GLS				
<i>Variables</i>	<b>(I)</b>	<b>(II)</b>	<b>(III)</b>	<b>(IV)</b>
<i>Constant</i>	0.0085 (2.517)**	0.0092 (2.740)***	0.0102 (3.217)***	0.0118 (3.982)***
<i>Capital</i>	0.7696 (9.194)***	0.7787 (9.234)***	0.7807 (9.370)***	0.8066 (9.282)***
<i>Labour</i>	0.1436 (2.688)***	0.1391 (2.585)***	0.1384 (2.589)***	0.1421 (2.646)***
<i>HE<sup>tot</sup></i>	0.0574 (2.208)**	---	---	---
<i>HE<sup>pu</sup></i>	---	0.0392 (1.749)*	0.0327 (1.480)	---
<i>HE<sup>pr</sup></i>	---	0.0078 (1.164)	---	0.0074 (1.104)
<i>N (par)</i>	365 (4)	365 (5)	369 (4)	371 (4)
<i>R<sup>2</sup></i>	28.12	28.17	27.96	27.87
<i>B-P (LM)</i>	110.21***	108.93***	100.84***	114.83***
<i>Hausman</i>	3.55 [0.3140]	2.93 [0.5696]	3.17 [0.3659]	0.74 [0.8646]

Notes: *t*-values in parenthesis and *p*-values in brackets. \*, \*\* and \*\*\* indicate significance at 10, 5 and 1 percent levels, respectively. Estimations performed with individual and time random effects (2-way REM model). Results obtained using White robust standard errors. Sample of OECD countries used (18): Australia, Austria, Canada, Denmark, Finland, Germany, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, UK and US (the number of observations, *N*, differs because some series are unbalanced). Time span: 1971-1998. High values of the Breusch-Pagan (LM) test favour FEM/REM over the Pooled Estimator (OLS). High (low) values of the Hausman test favour FEM (REM).

Table 2. Production Function in Growth Form. Health Spending (Public and Private) and Institutional Variables. Dependent Variable: Growth Rate of GDP; 2-way REM using GLS				
<i>Variables</i>	<b>(I)</b>	<b>(II)</b>	<b>(III)</b>	<b>(IV)</b>
<i>Constant</i>	0.0069 (0.566)	0.0099 (0.761)	0.0090 (0.711)	0.0088 (0.701)
<i>Capital</i>	0.7749 (8.933) <sup>***</sup>	0.7848 (8.952) <sup>***</sup>	0.7870 (9.81) <sup>***</sup>	0.8141 (9.524) <sup>***</sup>
<i>Labour</i>	0.1422 (2.648) <sup>**</sup>	0.1378 (2.544) <sup>**</sup>	0.1364 (2.536) <sup>**</sup>	0.1399 (2.590) <sup>**</sup>
<i>HE<sup>tot</sup></i>	0.0607 (2.309) <sup>**</sup>	--.--	--.--	--.--
<i>HE<sup>pu</sup></i>	--.--	0.04254 (1.876) <sup>*</sup>	0.0357 (1.589)	--.--
<i>HE<sup>pr</sup></i>	--.--	0.0082 (1.220)	--.--	0.0076 (1.128)
<i>GINI</i>	-0.0003 (-1.016)	-0.0003 (-0.971)	-0.0003 (-0.985)	-0.0001 (-0.325)
<i>EXECRLC</i>	-0.0003 (-0.159)	-0.0004 (-0.182)	-0.0002 (-0.092)	-0.0000 (-0.034)
<i>MAJ</i>	0.0100 (0.895)	0.0096 (0.846)	0.0095 (0.852)	0.0096 (0.858)
<i>LEGEL</i>	-0.0025 (-1.163)	-0.0026 (-1.186)	-0.0021 (-0.986)	-0.0022 (-1.021)
<i>CGTAX</i>	0.0121 (1.395)	0.0120 (1.323)	0.0115 (1.297)	0.0122 (1.372)
<i>N (par)</i>	364 (9)	364 (9)	368 (9)	370 (9)
<i>R<sup>2</sup></i>	29.35	29.41	29.13	29.05
<i>B-P (LM)</i>	116.54 <sup>***</sup>	115.78 <sup>***</sup>	105.99 <sup>***</sup>	119.5524 <sup>***</sup>
<i>Hausman</i>	6.90 [0.5479]	5.86 [0.7541]	6.75 [0.5638]	4.28 [0.8306]

Notes: see table 1.

Table 3. Production Function in Growth Form. Health Spending (Public and Private) and Education Spending (Public) Dependent Variable: Growth Rate of GDP; 2-way FEM using LSDV					
<i>Variables</i>	<b>(I)</b>	<b>(II)</b>	<b>(III)</b>	<b>(IV)</b>	<b>(V)</b>
<i>Constant</i>	0.0055 (1.754)*	0.0075 (2.551)**	0.0049 (1.321)	0.0055 (1.621)	0.0072 (2.462)**
<i>Capital</i>	0.8599 (6.533)***	0.8719 (6.609)***	0.8146 (6.194)***	0.8188 (6.247)***	0.8318 (6.373)***
<i>Labour</i>	0.0693 (0.765)	0.0467 (0.511)	0.0726 (0.796)	0.0505 (0.551)	0.0425 (0.465)
<i>HE<sup>tot</sup></i>	0.0832 (2.665)***	---	0.0938 (2.327)**	---	---
<i>HE<sup>pu</sup></i>	---	0.0592 (2.128)**	---	0.0772 (2.625)***	0.0679 (2.422)**
<i>HE<sup>pr</sup></i>	---	0.0018 (1.895)*	---	0.0125 (1.045)	---
<i>EDU<sup>pub</sup>(WB)</i>	---	---	0.0299 (2.248)**	0.0293 (2.207)**	0.0292 (2.193)**
<i>N (par)</i>	240 (34)	240 (35)	220 (35)	220 (36)	220 (35)
<i>R<sup>2</sup></i>	52.07	52.06	57.10	57.45	57.20
<i>B-P (LM)</i>	87.21***	83.77***	95.72***	98.48***	99.53***
<i>Hausman</i>	11.35 [0.0099]	10.68 [0.0303]	10.15 [0.0379]	16.13 [0.0064]	12.36 [0.0148]

Notes: *t*-values in parenthesis and *p*-values in brackets. \*, \*\* and \*\*\* indicate significance at 10, 5 and 1 percent levels, respectively. Estimations performed with individual and time dummies (2-way FEM model). Results obtained using White robust standard errors. Sample of OECD countries used (16): Australia, Austria, Canada, Denmark, Finland, Ireland, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and US (the number of observations, *N*, differ because some series are unbalanced). Time span: 1980-1995. High values of the Breusch-Pagan (LM) test favour FEM/REM over the Pooled Estimator (OLS). High (low) values of the Hausman test favour FEM (REM). We performed the same estimations as the ones shown in table 3 with data on public spending in education from UNESCO. The main results (not reported but available upon request) do not change much from the ones presented in table 3. The estimated elasticity for public spending on education is around 2% in all the models.

Table 4. Production Function in Growth Form.  
 Health Spending (Public and Private), Education Spending (Public)  
 and Institutional Variables.  
 Dependent Variable: Growth Rate of GDP; 2-way REM using GLS

<i>Variables</i>	<b>(I)</b>	<b>(II)</b>	<b>(III)</b>	<b>(IV)</b>	<b>(I)</b>
<i>Constant</i>	0.0060 (0.352)	0.0062 (0.351)	0.0113 (0.605)	0.0098 (0.487)	0.0140 (0.751)
<i>Capital</i>	0.7965 (6.721) <sup>***</sup>	0.8199 (6.775) <sup>***</sup>	0.8006 (6.573) <sup>***</sup>	0.8081 (6.513) <sup>***</sup>	0.8207 (6.800) <sup>***</sup>
<i>Labour</i>	0.0817 (0.915)	0.0614 (0.675)	0.0904 (0.643)	0.0395 (0.429)	0.0381 (0.420)
<i>HE<sup>tot</sup></i>	0.0841 (2.647) <sup>**</sup>	---	0.0901 (2.218) <sup>**</sup>	---	---
<i>HE<sup>pu</sup></i>	---	0.0535 (1.778) <sup>*</sup>	---	0.0723 (2.290) <sup>**</sup>	0.0650 (2.114) <sup>**</sup>
<i>HE<sup>pr</sup></i>	---	0.0019 (2.040) <sup>**</sup>	---	0.0125 (0.992)	---
<i>EDU<sup>pub</sup>(WB)</i>	---	---	0.0283 (2.095) <sup>**</sup>	0.0279 (2.047) <sup>**</sup>	0.02784 (2.048) <sup>**</sup>
<i>GINI</i>	-0.0003 (-0.825)	-0.0003 (-0.721)	-0.0003 (-0.730)	-0.0002 (-0.538)	-0.0003 (-0.792)
<i>EXECRLC</i>	-0.0001 (-0.057)	-0.0001 (-0.052)	-0.0017 (-0.513)	-0.0018 (-0.519)	-0.0013 (-0.409)
<i>MAJ</i>	0.0010 (0.064)	0.0029 (0.180)	-0.0136 (-0.745)	-0.0130 (-0.639)	-0.0137 (-0.756)
<i>LEGEL</i>	-0.0022 (-0.743)	-0.0023 (-0.773)	-0.0019 (-0.634)	-0.0020 (-0.681)	-0.0019 (-0.642)
<i>CGTAX</i>	0.0209 (1.531)	0.0207 (1.425)	0.0229 (1.534)	0.0220 (1.329)	0.0234 (1.568)
<i>N (par)</i>	225 (9)	225 (10)	205 (10)	205 (11)	205 (10)
<i>R<sup>2</sup></i>	26.27	26.60	28.05	28.02	28.02
<i>B-P (LM)</i>	76.97 <sup>***</sup>	74.43 <sup>***</sup>	86.51 <sup>***</sup>	89.11 <sup>***</sup>	89.82 <sup>***</sup>
<i>Hausman</i>	8.28 [0.4064]	6.45 [0.6939]	8.73 [0.4630]	8.38 [0.5913]	7.51 [0.5845]

Notes: see table 3.

Table 5. Production Function in Growth Form. Health and Education Spending (Public and Private) Dependent Variable: Growth Rate of GDP; 2-way REM using GLS				
<i>Variables</i>	<b>(I)</b>	<b>(II)</b>	<b>(III)</b>	<b>(IV)</b>
<i>Constant</i>	0.0063 (0.745)	0.0070 (0.579)	0.0128 (1.483)	0.0051 (0.565)
<i>Capital</i>	0.9714 (3.753)***	1.3533 (3.837)***	1.2673 (4.207)***	1.0878 (4.213)***
<i>Labour</i>	-0.0497 (-0.156)	-0.2094 (-0.634)	-0.2323 (-0.688)	0.0021 (0.007)
<i>HE<sup>tot</sup></i>	0.0750 (0.895)	--.--	--.--	--.--
<i>HE<sup>pu</sup></i>	--.--	-0.08104 (-1.041)	-0.0773 (-1.016)	--.--
<i>HE<sup>pr</sup></i>	--.--	0.0649 (1.372)	--.--	0.0862 (1.841)*
<i>EDU<sup>tot</sup>(WB)</i>	0.0809 (1.606)	--.--	--.--	--.--
<i>EDU<sup>pub</sup>(WB)</i>	--.--	0.0685 (2.376)**	0.0688 (2.397)**	--.--
<i>EDU<sup>priv</sup>(WB)</i>	--.--	0.0009 (0.213)	--.--	0.0002 (0.042)
<i>N (par)</i>	55 (5)	55 (7)	55 (5)	55 (5)
<i>R<sup>2</sup></i>	50.39	54.75	50.71	49.56
<i>B-P (LM)</i>	4.37*	9.80***	14.91***	4.44*
<i>Hausman</i>	4.97 [0.2906]	5.22 [0.5155]	5.71 [0.2219]	2.91 [0.5722]

Notes: *t*-values in parenthesis and p-values in brackets. \*, \*\* and \*\*\* indicate significance at 90, 95 and 99 percent level, respectively. Estimations performed with random individual and time effects (2-way REM model). Results obtained using White robust standard errors. Sample of OECD countries used (9): Australia, Canada, France, Germany, Ireland, Netherlands, Spain, Sweden and US (the number of observations, *N*, differ because some series are unbalanced). Time span: 1991-1998. High values of the Breusch-Pagan (LM) test favour FEM/REM over the Pooled Estimator (OLS). High (low) values of the Hausman test favour FEM (REM).

Table 6. Production Function in Growth Form. Health and Education Spending (Public and Private) and Institutional Variables Dependent Variable: Growth Rate of GDP; 2-way REM using GLS				
<i>Variables</i>	<b>(I)</b>	<b>(II)</b>	<b>(III)</b>	<b>(IV)</b>
<i>Constant</i>	0.0086 (0.276)	-0.0048 (-0.139)	0.0052 (0.161)	-0.0100 (-0.288)
<i>Capital</i>	0.9031 (3.353) <sup>***</sup>	1.2398 (3.972) <sup>***</sup>	1.2091 (3.963) <sup>***</sup>	0.9542 (3.394) <sup>***</sup>
<i>Labour</i>	-0.2644 (-0.788)	-0.2769 (-0.792)	-0.2796 (-0.810)	-0.1727 (-0.495)
<i>HE<sup>tot</sup></i>	0.0324 (0.380)	---	---	---
<i>HE<sup>pu</sup></i>	---	-0.0957 (-1.201)	-0.1026 (-1.290)	---
<i>HE<sup>pr</sup></i>	---	0.0517 (1.044)	---	0.0729 (1.483)
<i>EDU<sup>tot</sup>(WB)</i>	0.0894 (1.777) <sup>*</sup>	---	---	---
<i>EDU<sup>pub</sup>(WB)</i>	---	0.0652 (2.194) <sup>**</sup>	0.0691 (2.372) <sup>**</sup>	---
<i>EDU<sup>priv</sup>(WB)</i>	---	0.0007 (0.171)	---	0.0003 (0.071)
<i>GINI</i>	-0.0004 (-0.508)	0.0001 (0.128)	-0.0001 (-0.035)	-0.0001 (-0.061)
<i>MAJ</i>	-0.0131 (-0.440)	-0.0050 (-0.157)	-0.0093 (-0.299)	-0.0049 (-0.157)
<i>LEGEL</i>	-0.0069 (-1.310)	-0.0052 (-0.901)	-0.0067 (-1.191)	-0.0039 (-0.781)
<i>CGTAX</i>	0.0485 (1.933) <sup>*</sup>	0.0306 (1.046)	0.0306 (1.249)	0.0460 (1.644)
<i>N(par)</i>	55 (9)	55 (8)	55 (9)	55 (6)
<i>R<sup>2</sup></i>	54.76	56.87	52.60	54.31
<i>B-P (LM)</i>	10.14 <sup>***</sup>	9.15 <sup>**</sup>	15.84 <sup>***</sup>	7.57 <sup>**</sup>
<i>Hausman</i>	8.73 [0.3651]	9.58 [0.4781]	8.24 [0.4100]	6.05 [0.6418]

Notes: see table 5.

Table 7. Production Function in Growth Form. Education Spending (Public and Private) Dependent Variable: Growth Rate of GDP; 2-way REM using GLS				
<i>Variables</i>	<b>(I)</b>	<b>(II)</b>	<b>(III)</b>	<b>(IV)</b>
<i>Constant</i>	0.0088 (1.372)	0.0100 (1.198)	0.0098 (1.231)	0.00972 (1.398)
<i>Capital</i>	1.0411 (4.400) <sup>***</sup>	1.1701 (4.073) <sup>***</sup>	1.1781 (4.165) <sup>***</sup>	1.0532 (4.275) <sup>***</sup>
<i>Labour</i>	-0.0040 (-0.013)	-0.2151 (-0.629)	-0.2082 (-0.618)	0.0476 (0.151)
<i>EDU<sup>tot</sup>(WB)</i>	0.0816 (1.661) <sup>*</sup>	--.--	--.--	--.--
<i>EDU<sup>pub</sup>(WB)</i>	--.--	0.0691 (2.366) <sup>**</sup>	0.0689 (2.396) <sup>**</sup>	--.--
<i>EDU<sup>priv</sup>(WB)</i>	--.--	-0.0001 (-0.042)	--.--	-0.0001 (-0.138)
<i>N (par)</i>	62 (4)	55 (5)	55 (4)	55 (4)
<i>R<sup>2</sup></i>	49.94	51.16	50.62	46.27
<i>B-P (LM)</i>	4.14 <sup>*</sup>	12.24 <sup>***</sup>	14.04 <sup>***</sup>	5.48 <sup>*</sup>
<i>Hausman</i>	5.91 [0.1161]	6.03 [0.1972]	5.35 [0.1480]	3.74 [0.2912]

Notes: *t*-values in parenthesis and *p*-values in brackets. \*, \*\* and \*\*\* indicate significance at 10, 5 and 1 percent levels, respectively. Estimations performed with random individual and time effects (2-way REM model). Results obtained using White robust standard errors. Sample of OECD countries used (9): Australia, Canada, France, Germany, Ireland, Netherlands, Spain, Sweden and US (the number of observations, *N*, differ because some series are unbalanced). Time span: 1991-1998. High values of the Breusch-Pagan (LM) test favour FEM/REM over the Pooled Estimator (OLS). High (low) values of the Hausman test favour FEM (REM). Results using spending on education from OECD show coefficients around 8-10% for the public spending variable while for private spending we obtain positive elasticities around 1.5%, although these are not statistically significant.

Table 8. Production Function in Growth Form. Education Spending (Public and Private) and Institutional Variables Dependent Variable: Growth Rate of GDP; 2-way REM using GLS				
<i>Variables</i>	<b>(I)</b>	<b>(II)</b>	<b>(III)</b>	<b>(IV)</b>
<i>Constant</i>	0.0099 (0.334)	0.0009 (0.039)	0.0089 (0.280)	0.0027 (0.087)
<i>Capital</i>	0.9301 (3.634) <sup>***</sup>	1.0753 (3.671) <sup>***</sup>	1.0813 (3.690) <sup>***</sup>	0.9276 (3.414) <sup>***</sup>
<i>Labour</i>	-0.2648 (-0.803)	-0.2712 (-0.771)	-0.2823 (-0.803)	-0.1832 (-0.524)
<i>EDU<sup>tot</sup>(WB)</i>	0.0883 (1.779) <sup>*</sup>	---	---	---
<i>EDU<sup>pub</sup>(WB)</i>	---	0.0683 (2.276) <sup>**</sup>	0.0690 (2.322) <sup>**</sup>	---
<i>EDU<sup>priv</sup>(WB)</i>	---	0.0005 (0.111)	---	-0.0001 (-0.031)
<i>GINI</i>	-0.0004 (-0.540)	---	-0.0002 (-0.253)	-0.0002 (-0.293)
<i>MAJ</i>	-0.0135 (-0.466)	-0.0082 (-0.258)	-0.0082 (-0.258)	-0.0098 (-0.317)
<i>LEGEL</i>	-0.0073 (-1.421)	-0.0059 (-1.031)	-0.0059 (-1.039)	-0.0058 (-1.065)
<i>CGTAX</i>	0.0495 (2.073) <sup>**</sup>	0.0319 (1.242)	0.0347 (1.260)	0.0491 (1.964) <sup>**</sup>
<i>N (par)</i>	63 (8)	55 (8)	55 (8)	55 (8)
<i>R<sup>2</sup></i>	54.70	52.98	52.47	51.36
<i>B-P (LM)</i>	10.31 <sup>***</sup>	12.72 <sup>***</sup>	14.61 <sup>***</sup>	10.30 <sup>***</sup>
<i>Hausman</i>	9.01 [0.2519]	6.69 [0.4613]	7.07 [0.4221]	5.46 [0.6038]

Notes: see table 7.

<i>Variables</i>	Static IV estimation				Dynamic IV estimation			
<i>Constant</i>	0.0008 (0.193)	0.0019 (0.466)	0.0061 (1.53)	0.0015 (0.399)	0.0073 (1.78)*	0.0039 (1.08)	0.0270 (5.45)***	0.0062 (1.53)
<i>g-GDP (-1)</i>	--.--	--.--	--.--	--.--	0.0652 (0.311)	-0.1048 (-0.563)	-0.0190 (-0.111)	-0.0201 (-0.138)
<i>Capital</i>	0.7829 (2.37)**	0.6882 (2.02)**	0.9755 (3.46)***	0.8063 (3.78)***	0.7984 (1.86)*	0.7582 (2.05)**	0.7185 (3.99)***	0.8172 (3.10)***
<i>Labour</i>	0.1071 (0.836)	0.2114 (1.31)	0.2852 (3.51)***	0.2015 (3.10)***	0.1087 (0.927)	0.2504 (1.55)	0.2119 (1.93)*	0.2195 (3.31)***
<i>HE<sup>tot</sup></i>	0.1042 (6.13)***	--.--	--.--	--.--	0.0983 (5.91)***	--.--	--.--	--.--
<i>HE<sup>tot</sup>(-1)</i>	--.--	--.--	--.--	--.--	-0.0600 (-1.71)*	--.--	--.--	--.--
<i>HE<sup>pu</sup></i>	--.--	0.0697 (4.15)***	--.--	0.0720 (4.42)***	--.--	0.0718 (3.58)***	--.--	0.0707 (3.85)***
<i>HE<sup>pu</sup>(-1)</i>	--.--	--.--	--.--	--.--	--.--	0.0116 (0.300)	--.--	-0.0084 (-0.208)
<i>HE<sup>pr</sup></i>	--.--	--.--	0.0081 (1.92)*	0.0095 (2.91)***	--.--	--.--	0.0080 (0.857)	0.0144 (1.99)**
<i>HE<sup>pr</sup>(-1)</i>	--.--	--.--	--.--	--.--	--.--	--.--	-0.0136 (-1.39)	-0.0063 (-0.803)
<i>N (par)</i>	347 (23)	351 (23)	353 (23)	347 (24)	328 (24)	332 (24)	352 (25)	328 (26)
<i>RSS</i>	0.11359	0.11493	0.1201	0.11400	0.10840	0.11328	0.12063	0.10989
<i>Sargan (df)</i>	61.01 (54) [0.239]	58.02 (54) [0.329]	55.39 (54) [0.422]	121.6 (110) [0.212]	58.20 (51) [0.228]	53.86 (51) [0.365]	44.55 (71) [0.994]	113.8 (105) [0.263]
<i>m<sub>1</sub></i>	-2.238**	-2.399**	-2.428**	-2.329**	-2.282**	-2.006**	-2.332**	-2.898***
<i>m<sub>2</sub></i>	-0.266	-0.075	-0.222	-0.267	0.3983	0.747	0.1681	0.044

Notes: *t*-ratios in parenthesis, *p*-values in brackets. \*, \*\* and \*\*\* indicates significativity of estimated parameters at 10%, 5% and 1% level of significance, respectively. Instruments: lagged values (t-1 up to t-3) of the health spending variables; in the third column in the dynamic IV estimation we also include the Gini index as a level instrument. Tests: the Sargan tests the validity of instruments; high *p*-values for the Sargan test fail to reject the null hypothesis and hence the instruments used are valid. *m<sub>1</sub>* and *m<sub>2</sub>* test respectively for first and second-order serial correlation in the error term.

Table 10. Health (Public and Private) Spending.  
Sources of Growth of Output, expressed as percentages

	<i>Capital</i>	<i>Labour</i>	<i>HE<sup>tot</sup></i>	<i>HE<sup>pu</sup></i>	<i>HE<sup>pr</sup></i>	<i>TFP</i>
<i>All Countries</i>						
<i>Model (I)</i>	47.09	6.02	16.44	--.--	--.--	30.42
<i>Model (II)</i>	47.65	5.83	--.--	12.89	2.20	31.41
<i>Model (III)</i>	47.77	5.80	--.--	10.75	--.--	35.66
<i>Model (IV)</i>	49.36	5.96	--.--	--.--	2.08	42.58
<i>Model (I) for countries:</i>						
<i>AUSTRALIA</i>	41.94	7.56	13.53	--.--	--.--	36.93
<i>AUSTRIA</i>	46.50	7.08	17.67	--.--	--.--	28.73
<i>CANADA</i>	77.78	8.84	17.23	--.--	--.--	-3.86
<i>DENMARK</i>	13.55	4.15	19.37	--.--	--.--	60.91
<i>FINLAND</i>	22.14	1.31	15.43	--.--	--.--	61.11
<i>GERMANY</i>	45.90	12.69	19.15	--.--	--.--	22.25
<i>IRELAND</i>	58.96	4.29	10.95	--.--	--.--	25.78
<i>ITALY</i>	33.58	1.73	15.18	--.--	--.--	49.49
<i>JAPAN</i>	61.92	4.87	15.80	--.--	--.--	17.39
<i>LUXEMBOURG</i>	45.89	5.91	10.79	--.--	--.--	37.39
<i>NETHERLANDS</i>	31.59	12.07	17.82	--.--	--.--	38.50
<i>NEW ZEALAND</i>	32.23	14.07	22.02	--.--	--.--	31.65
<i>NORWAY</i>	38.65	4.64	16.59	--.--	--.--	40.11
<i>PORTUGAL</i>	75.08	4.10	20.88	--.--	--.--	-0.08
<i>SPAIN</i>	40.31	6.28	22.39	--.--	--.--	31.00
<i>SWEDEN</i>	26.13	1.44	16.84	--.--	--.--	55.58
<i>UK</i>	42.59	2.89	19.51	--.--	--.--	34.98
<i>US</i>	73.18	7.10	17.14	--.--	--.--	2.56

Table 11. Health (Public and Private) and Public Education Spending. Sources of Growth of Output, expressed as percentages							
<i>All Countries</i>	<i>Capital</i>	<i>Labour</i>	<i>HE<sup>tot</sup></i>	<i>HE<sup>pub</sup></i>	<i>HE<sup>pr</sup></i>	<i>EDU<sup>pub</sup></i>	<i>TFP</i>
<i>Model (I)</i>	51.18	3.06	24.22	--.--	--.--	--.--	21.52
<i>Model (II)</i>	51.90	2.06	--.--	17.01	0.63	--.--	28.38
<i>Model (III)</i>	48.49	3.20	27.30	--.--	--.--	3.39	17.59
<i>Model (IV)</i>	48.47	2.23	--.--	22.18	--.--	3.33	23.50
<i>Model (V)</i>	49.51	1.87	--.--	19.51	--.--	3.31	25.77

Note: In model (IV), the point estimate for private spending in health has been considered as 0 given that is not significant in the estimation

## Appendix 1

### *Descriptive Statistics of the main variables used*

Name	Definition	Source	Mean	St. Dev.
$\Delta \ln Y_{it}$	Gross Domestic Product growth rate	PWT 6.1	0.02867	0.02573
$\Delta \ln K_{it}$	Private capital stock growth rate	PWT 6.1 and o.c.	0.01714	0.01518
$\Delta \ln L_{it}$	Employment growth rate	PWT 6.1	0.01242	0.02350
$\Delta \ln(HE^{tot})_{it}$	Total health spending growth rate	OECD Health Data	0.07731	0.04486
$\Delta \ln(HE^{pu})_{it}$	Public health spending growth rate	OECD Health Data	0.07664	0.04932
$\Delta \ln(HE^{pr})_{it}$	Private health spending growth rate	OECD Health Data	0.08126	0.06602
$\Delta \ln(HE^{tot})_{it}$	Total education spending growth rate	WB and UNESCO	0.03399	0.05651
$\Delta \ln(HE^{pu})_{it}$	Public education spending growth rate	WB and UNESCO	0.01522	0.11203
$\Delta \ln(HE^{pr})_{it}$	Private education spending growth rate	WB and UNESCO	0.03967	0.69596
<i>GINI</i>	Gini Index	Deininger and Squire (1996)	32.555	4.1081
<i>EXECRLC</i>	Dummy =1 if government is left-wing	DPI2000	0.3941	--
<i>MAJ</i>	Fraction of seats held by government	DPI2000	0.5455	0.1001
<i>LEGELEC</i>	Dummy =1 if general election to be held in the year	DPI2000	0.3095	--
<i>CGTAX</i>	% of taxes collected by Central Gov't	OECD Revenue Statistics	0.5950	0.1558

Notes: o. c.: own calculations. PWT 6.1: *Penn World Tables Mark 6.1*. WB: World Bank. Descriptive statistics for education spending are taken from World Bank data. DPI2000: Database of Political Institutions: Philip Keefer (2002), The Development Research Group World Bank. See notes on tables presenting regression results with each of the variables presented for details on countries and data spans. Statistics for macroeconomic variables are for countries and data spans for regressions including health spending variables.