55

Can more education be bad? Some simple analytics on financing better education for development

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While the model in this paper remains close to the Heckscher-Ohlin tradition, it is shown that, contrary to the standard results, it is the net effect of prices, taxation, and accumulation of endowments that determines the Rybczynski-type growth effects, which may help explain the lack of consensus in the empirical literature on education and growth. A central feature of the model is that the accumulation of endowments depends on the output of education, while the changes in labour supply, which determine the effective production possibilities frontier, also depend on individuals' decisions on allocation of time, affected by relative prices and fiscal policy. On the one hand, in the model the composition of the output of education depends on education quality, so the composition of the inflow of entrants to the labour market can be upgraded by suitable policies. On the other hand, the risks of a skill supply-reducing government intervention are discussed. The analysis has implications for policymakers in developing countries where both the economy's production possibilities and the education sector need to be enhanced, as it reveals the possibility of a 'bad reform' where the expected benefits of government's interventions in education can be contradicted by the general equilibrium effects of the policy. A sufficient condition to avoid this situation is identified in the paper.

1 Introduction

Almost all governments, both in developed and developing countries, allocate significant amounts to finance public education. For instance, in 2005, the United States allocated 5.3% of its GDP to public education; the United Kingdom, 5.6%; France, 5.7%; and Italy, 4.5%. In Latin America, the fraction of GDP allocated to public education in general is not that high but is still significant. For instance, in 2004, for Brazil it was 4%; Argentina, 3.8%; Chile, 3.7%; Mexico, 5.4%; Paraguay, 4%; and Uruguay, 2.6% (UNESCO, 2008). Moreover, in all cases, the vast majority of education provision is public (UNESCO, 2007). These facts seem to show that relevance of education activities are not overlooked by any government.

However, even when the importance of education for growth has been highlighted by the endogenous growth literature (for instance, Romer, 1986; Lucas, 1988), the evidence of effects on

growth is mixed: the empirical literature on the contribution of education to growth is surveyed for instance by Temple (2000). So, what's the matter? Could education be good, neutral, or bad, depending on the case? It could be any of them; in particular, it could be bad for two reasons: inefficient educational expenditure (see, for instance, Clements, 1999; Hanushek, 2002) and a distorting tax system to finance education (see, for instance, Glomm and Ravikumar, 1998; Blankenau and Simpson, 2004; Blankenau et al., 2007). This paper focuses on the latter aspect, identifying the general equilibrium effects of taxation in a simple model, making it possible to deal with some analytics. Moreover, a sufficient condition for a growth-enhancing government intervention is identified.

A central feature of the modelling of the education sector in this paper is the presence of systemic inefficiencies in terms of expected results (i.e., successful students and production of labour), which is the typical situation in developing countries. As education is publicly provided, systemic inefficiencies can be targeted by policymakers, and thus the process of accumulation of endowments can be enhanced by education policy. However, the way in which an increase in the education budget is financed affects the net effects on the economy of enhanced education, and such channels have been identified in this paper. The effects of indirect and income taxes are made explicit by means of some simple analytics; it is shown that taxation affects the consumption-leisure choice by changing the relative prices, thus modifying the labour supply. This, in turn, determines the actual production possibilities.

The paper is organised as follows. Section II describes the model. Section III describes the properties of the model as well as some policy implications. Section IV presents the conclusions. The Annex presents additional details for the household modelling.

2 Model description

The model presented here remains close to the standard Heckscher-Ohlin tradition, which is extended to include the public education activities that produce endowments (skilled and unskilled labour). The pattern of endowment growth (skilled and unskilled labour) is the result of the output of education, leaving aside demographic considerations and retirement rates. In addition, people make a consumption-leisure choice, so that the supply of labour is endogenous. The government raises revenue from taxes to provide education.

2.1 The education sector

Education is publicly provided, with a budget exogenously determined. The government raises revenue from taxes to finance the provision of education. The government runs a balanced budget, financed via income and indirect taxes. Following the tradition in the education production function literature (for a review, see Levačić and Vignoles, 2002), the output of education activities

is given by $Q = F(G,E)$, Q is the output of the activity given the resources G , and E is the enrolment.

The function F is subject to constant returns to scale, so the output per student can be written as $q = Q/E = F(g)$, where g measures the resource intensity per student, and $\partial q/\partial g > 0$. For each student, q is the amount of knowledge embodied in him/her on the successful completion of schooling, which builds his/her human capital. Following Hanushek (1979), students' acquired knowledge defines 'school quality', therefore, the output per student (q) measures school quality.

Education 'produces' both unskilled workers and skilled workers, according to time of exit. School quality (output per student) is modelled as a major determinant of students' path, as Barnes (1999) who points out that students drop out of school if they 'fail to learn', then, students' achievement is taken as a determinant of early exit rates, $\theta = \theta(q)$, where $\partial\theta/\partial q < 0$ and $\partial^2\theta/\partial^2 q > 0$

The accumulation of endowments in the economy depends on time of exit. Thus, the composition of the inflow of labour to the market are given by dL_Z , i.e.,

$$dL_U = \theta E$$

$$dL_S = (1-\theta)E$$

where θ is the early exit rate, and dL_U and dL_S are the inflow of unskilled and skilled labour, respectively, which determine endowment growth. Thus, the rate of endowment growth in the economy is given by

$$\hat{L}_S = dL_S / L_S$$

$$\hat{L}_U = dL_U / L_U$$

where L_S and L_U are the stocks of skilled and unskilled labour, respectively, and a hut (^) placed over the variables denotes rate of growth.

Then, the production of skills may be hindered by inefficient education systems, which is the typical situation in developing countries where education quality is in general low. Thus, a government intervention consisting in an increase in the educational budget could enhance the process of production of skill formation, by allowing a higher resource intensity per student and thus a higher education quality, improving the productivity of the activity (in terms of graduates), and also causing a shift in the composition of educational output toward skilled labour.

2.2 Households

There are two representative households: one that owns only unskilled labour and the other that owns only skilled labour. Their decisions are taken in a two-stage process. In the first stage, households make a consumption-leisure choice, so that the total supply of labour is endogenous. In the second stage, households allocate all their income (post-tax for formal activities) to all the consumption goods (see Annex for details).

It is assumed that each household's utility function is an increasing function of consumption goods and leisure time. In the description that follows, the same subscript associates households and factors: $z = S, U$ for skilled and unskilled, respectively. Let L_z be the stocks of units of labour of type z. H_z represents the units that the household chooses to work (so, leisure time is $R_z = L_z - H_z$), and C_z is a composite of consumption goods. The CES utility function for household z is $U_z = \left(\alpha C_z^{\mu_z} + (1-\alpha)(L_z - H_z)^{\mu_z}\right)^{1/\mu_z}$, where $\alpha > 0$, and the elasticity of substitution is $\sigma_z = 1/(1-\mu_z)$, $\mu_z < 1$. At the top level, consumers choose C_z and H_z to maximise utility subject to their budget constraint $P_{C_z} C_z = w_z H_z$, where w_z is the wage rate for one unit of H_z and P_{C_z} is the price index of the composite consumption good for household z computed at consumer's prices (see Annex for details). The optimal values for consumption and labour supply are

$$C_z = \frac{w_z}{P_{C_z}} \frac{\alpha_{C_z}^{\sigma_z} P_{C_z}^{1-\sigma_z}}{\alpha_{C_z}^{\sigma_z} P_{C_z}^{1-\sigma_z} + \alpha_{R_z}^{\sigma_z} w_z^{1-\sigma_z}} L_z \qquad (1)$$

$$H_z = \frac{\alpha_{C_z}^{\sigma_z} P_{C_z}^{1-\sigma_z}}{\alpha_{C_z}^{\sigma_z} P_{C_z}^{1-\sigma_z} + \alpha_{R_z}^{\sigma_z} w_z^{1-\sigma_z}} L_z \qquad (2)$$

From (1) and (2) the elasticities may be derived. The elasticity of time worked with respect to the wage rate is $\eta_{H_z w_z} = (\sigma_z - 1)(L_z - H_z)/L_z$, which is positive provided σ_z >1. The elasticity of demand for C_Z with respect to prices is given by $\eta_{C_z P_{C_z}} = -(\sigma_z (L_z - H_z)/L_z + H_z/L_z)$, which is negative.

2.3 Producers

There are two tradable sectors and that use skilled and unskilled labour, the exporting activities are unskilled-intensive, whereas the import-competing activities are skilled-intensive. There are competitive markets for goods and factors. All production functions are subject to constant returns to scale; in the long run, equilibrium profits are zero, so prices are equal to unit costs.

3 Properties and policy implications

The economy's supply of skills is affected by changes in real wages and in the output of education. It is easy to show that the increase in the supply of skills, totally differentiating (2), is given by

$$\hat{H}_S = \eta_{H_S w_S} \left(\hat{w_S / P_{C_S}} \right) + \hat{L}_S \qquad (3)$$

Expression (3) shows that changes in total labour supply are determined by changes in the output of education ($\hat{L}_S$) and changes in real wages (which are affected by international prices and tax policy), depending on the elasticity of labour supply to the wage rate.

So, fiscal policy has general equilibrium effects on individuals' decisions on labour supply and consumption. According to (3) increases in income and indirect taxes have a negative effect on labour supply, by reducing the real wage.

Property 1: The net effects of taxation and education output on factor supply (for constant international prices) determine the 'Rybczynski effect' on productive sectors, causing a biased shift in the production possibilities frontier.

The model merits the reinterpretation of the standard growth effects from changes in stocks of endowments (see Rybczynski, 1955) using expression (3). This is, changes in stocks of endowments (second term in the right-hand side of expression (3)), jointly considered with the effects from taxation (first term in the right-hand side of expression (3)), determine the effective supply of factors, and thus, the actual possibilities of expansion of productive sectors.

Policy implication 1: Given prices and taxes, a better performance in education activities leads to increased growth rates in the labour supply and thus, in the economy production possibilities.

Also from expression (3) it can be shown that, for constant prices and taxes, an increase in the output of education not mainly based on expanded funds (for instance, improving efficiency and/or effectiveness of schools) determines the changes in the supply of factors, equal to the changes in endowments. Thus, only in this case, education *alone* determines the standard Rybczynski-type growth effects.

Policy implication 2: 'Common sense rule': Considering the economy as a whole, the government would engage in a tax reform intended to finance an increase in the economy's availability of skills by enhancing education activities only if the expected expansion of endowments more than compensates the effects of taxation on factor supplies.

It can be shown that factor supplies rise, recalling (3), when

$$\hat{L}_S > -\eta_{H_S w_S} \left(\hat{w_S / P_{C_S}} \right) \qquad (5)$$

A tax reform designed to finance an increase in the education budget may undermine the benefits intended to be reaped from higher production of skills, by causing a fall in the supply. A condition to avoid this situation is given in expression (5), thus this is a ***sufficient condition*** for a skill supply-enhancing government intervention.

4 Conclusiones

A central feature of the model is that the accumulation of endowments depends on the output of education, while the changes in labour supply, which determine the effective production possibilities frontier, also depend on individuals' decisions on allocation of time. It is shown that, in contrast to the standard approach, it is the net effect of prices, taxation, and accumulation of endowments that determines the Rybczynski-type growth effects, which may help explain the lack of consensus in the empirical literature on education and growth.

A main contribution of the model is that it allows the discussion of the general equilibrium effects of an expansion of education by means of some simple analytics. It is shown that the overall effects of the expansion of educational activities depend on how the government finances such an expansion. The analysis has policy implications for developing countries where skill formation is deficient due to inefficiencies in the education sector, which may justify a government intervention to enhance the sector. In particular, the risks of a skill supply-reducing government intervention are highlighted, as the way in which the government finances the budget may undermine the benefits from enhanced education. That is, a tax reform designed to finance an increase in the education budget may undermine the benefits from higher production of skills by causing a fall in the supply. So, it would be convenient to follow a 'common sense rule': considering the economy as a whole, the government should engage in a tax reform to raise the revenue needed to expand the availability of skills by enhancing education, only if the expected expansion of skills produced more than compensates for the effects of taxation on the supply. But, interesteringly, the analysis also shows that any improvement in the efficiency/effectiveness of providing education not mainly based on expansion of resources (as those coming from better organization of schools or teaching processes) will unambiguously expand production possibilities.

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6 Annex: The composite consumption good

The composite consumption good C_z is 'produced' by h tradable goods, its price being equal to the cost of its inputs. The composite good expressed as a CES function is

$$C_z = \left(\sum_h \delta_{hz} D_{hz}^{\phi_z} \right)^{\frac{1}{\phi_z}} \quad \delta_{hz} > 0 \,,\; \sum_h \delta_{hz} = 1$$

where D_{hz} is the demand for h by household z. The elasticity of substitution is $\varphi_z = 1/(1-\phi_z)$, ϕ_z <1. The household spends its (post-tax) income on consumption goods. Y_z is the (post-tax) income of household z, $Y_z = \sum_h P_h D_{hz}$, where P_h are consumer prices.

So, the problem to solve is

$$\underset{D_{hz}}{Min} \sum_h P_h D_{hz}$$

$$s.t. C_z = A_z \left(\sum_h \delta_{hz} D_{hz}^{\phi_z} \right)^{\frac{1}{\phi_z}}$$

where C_z is the composite consumption good and A_z is a scaling term used to ensure that the price of the composite equals the cost of 'producing' it. From the first-order conditions, the optimal demands are

$$D_{hz} = \frac{\delta_{hz}^{\varphi_z} P_h^{-\varphi_z}}{A_z \left(\sum_h \delta_{hz}^{\varphi_z} P_h^{1-\varphi_z} \right)^{\frac{\varphi_z}{\varphi_z - 1}}} C_z$$

Using this expression, the price of C_z, P_{C_z}, may be derived manipulating the equivalence $\sum_h P_h D_{hz} = P_{C_z} C_z$, resulting

$$P_{C_z} = \frac{1}{A_z} \left(\sum_h \delta_{hz}^{\varphi_z} P_h^{1-\varphi_z} \right)^{\frac{1}{1-\varphi_z}}$$