Documentos de Trabajo

Can more education be bad? Some simple analytics on financing education

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Documento No. 17/09
Setiembre 2009

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Resumen

La evidencia empírica sobre los efectos de la educación sobre el crecimiento no es concluyente. ¿Esto significa que la educación puede ser buena, neutra o mala, según el caso? Mientras que el modelo en este documento se mantiene próximo a la tradición Heckscher-Ohlin, se muestra que contrariamente a los resultados estándar de este tipo de modelos, es el efecto neto de precios, impuestos y acumulación de factores que determina los efectos de crecimiento de tipo Rybczynski, lo que puede explicar la falta de consenso en la literatura empírica sobre educación y crecimiento. Un rasgo central del modelo, es que la acumulación de factores depende del producto de la educación, mientras que los cambios en la oferta de trabajo, que es lo que efectivamente determina la frontera de posibilidades de producción, dependen de las decisiones de los individuos sobre la asignación del tiempo. En el documento son discutidos los riesgos de una intervención que reduzca la oferta laboral, y por tanto las posibilidades de producción. El análisis tiene implicaciones para los hacedores de política en los países en desarrollo, donde el sector educación necesita ser fortalecido, ya que revela la posibilidad de una 'mala reforma impositiva' donde se obtienen los resultados contrarios a los esperados. En el documento se identifica una condición suficiente para evitar esta situación.

Palabras clave: educación, política fiscal, países en desarrollo

Clasificación JEL: I22, F16

Abstract

The evidence of effects of education activities on growth is mixed. So, could education be good, neutral, or bad, depending on the case? 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. In the paper, the risks of a labour supply-reducing government intervention are discussed. The analysis has implications for policymakers in developing countries where education needs to be enhanced, as it reveals the possibility of a 'bad tax reform' where the intentions of reformers are not met by the results. A sufficient condition to avoid this situation is identified in the paper.

Key words: education, fiscal policy, developing countries

JEL classification: I22, F16

I. 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.

II. 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. However, there is a substantial informal sector in the economy, as there are people who have a preference for working informally (evading taxes). The standard leisure-work option is modified so that people make a choice between earning income in the informal sector and in the formal sector, the choice being based on the untaxed wage from the former and the taxed wage from the latter, with the propensity to work informally varying across skill groups (higher for unskilled workers).

a) 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 both types of labour is endogenous. In the second stage, they make two further decisions. By the one hand, they choose between working formally and informally (see Annex for details). By the other hand, 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 (see Annex for details). 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). From the first-order conditions, the optimal values for consumption and labour supply are

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

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

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.

b) Producers

There are two tradable sectors and two non-tradable sectors, informal and education. All sectors use skilled and unskilled labour; the exporting and informal activities are unskilled-intensive, whereas the import-competing and education activities are skilled-intensive (education will be discussed separately). 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. Informal activities are non-tradable and the main feature of these activities is that they are not subject to direct or indirect taxes, mainly owing to evasion. It follows that wages and prices differ between informal and formal activities.

c) The education sector

Education is publicly provided, with a budget exogenously determined. 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 $Q_j = F_j(G_j, E_j)$, where $j = B, H$ represents the level (basic and higher education), Q_j is the output of the activity given the resources G_j, and E_j is the enrolment.

The function F_j is subject to constant returns to scale, so the output per student can be written as $q_j = Q_j / E_j = F_j(g_j)$, where g_j measures the resource intensity per student, and $\partial q_j / \partial g_j > 0$. For each student, q_j is the amount of knowledge embodied in him/her on the successful completion of level j, which builds his/her human capital. Following Hanushek (1979), students' acquired knowledge defines 'school quality', therefore, the output per student (q_j) measures school quality. The accumulation of q_j during schooling is measured by f_j, where j is the last level passed, which determines the productivity when entering the labour market.

Education is a two-level activity: basic education 'produces' both unskilled workers and students qualified to enter higher education, and higher education 'produces' skilled workers from qualified student inputs. School quality (output per student) is modelled as a major determinant of students' path, in a similar vein to Heckman and Masterov (2004) who suggest that previous achievement enables future success, Barnes (1999) who points out that students drop out of school if they 'fail to learn', and Hanushek (2004) who shows that 'higher student achievement keeps students in school longer'. Then, students' achievement is taken as a determinant of early exit rates, $\theta = \theta(q_B)$, where $\partial\theta / \partial q_B < 0$.

The accumulation of endowments in the economy (units of each type of labour produced) depends on time of exit and on school quality. Thus, the size and the composition of the inflow of labour (in efficiency units) to the market are given by dL_Z, i.e.,

$$dL_U = \theta E_B f_B$$

$$dL_S = E_H f_H$$

where θ is the early exit rate, and dL_U and dL_S are the inflow of units 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 endowments 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 endowments, by allowing a higher resource intensity per student and thus a higher education quality, improving the productivity of the activity (in terms of labour produced), and also causing a shift in the composition of educational output toward skilled labour.

d) Fiscal policy

The government raises revenue from taxes to finance the provision of education. The government runs a balanced budget, financed via income and indirect taxes in formal markets, as follows: a) *Income taxes:* In the formal sector, the determination of wages is tied to international prices, and two factor returns must be considered: pre- and post-tax. The firms' expenditures on factors include taxes, and household incomes consist of post-tax returns. In the informal sector, where workers

evade income taxes, the wages paid to and received by workers are equal; b) *Indirect taxes:* Goods in the formal private sector (i.e., tradable goods) are subject to indirect taxes, which increase the prices faced by the household above the unit costs of producers.

III. PROPERTIES AND POLICY IMPLICATIONS

Property 1: *The economy's effective 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

$$\hat{H}_Z = \eta_{H_Z w_Z} \left(w_z \hat{/} P_{C_z} \right) + \hat{L}_Z \tag{3}$$

As seen in section II.c), human capital accumulation ($\hat{L}_Z$) depends on the output of education. Expression (3) shows that changes in total labour supply are determined by changes in the output of education 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: income taxes affect the labour-leisure choice reducing incentives to work; indirect taxes change relative prices making leisure relatively cheaper. Additionally, taxes generate a stimulus to informal activities, thus the general equilibrium effects from taxation also imply that the tax base is eroded, reducing the government's capacity to finance its activity.

Property 2: *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 general equilibrium 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 growth possibilities.*

Also, considering 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, improved efficiency) determines the changes in the supply of factors, equal to the changes in endowments. Thus, only in this case, education *alone* determines the Rybczynski-type growth effects, recovering the standard results.

Moreover, total differentiation of expression (1) shows that

$$\hat{C}_Z = -\eta_{C_Z P_{C_Z}} \left(\hat{w_z} / \hat{P}_{C_z} \right) + \hat{L}_Z \tag{4}$$

So, expressions (3) and (4) show that labour supply and consumption are increasing in the education output and real wages, and that, if prices and taxes are constant, $\hat{H}_Z = \hat{C}_Z = \hat{L}_Z$.

Policy implication 2: *'Common sense rule': Considering the economy as a whole, the government would engage in a tax reform intended to raise money to expand education activities only if the expected expansion of endowments more than compensates for the distortionary effects of taxation on factor supplies.*

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

$$\hat{L}_Z > -\eta_{H_Z w_Z} \left(\hat{w_z} / \hat{P}_{C_z} \right) \tag{5}$$

A tax reform designed to finance an increase in the education budget may undermine the benefits intended to be reaped from higher production of endowments, by causing a fall in factor supplies. A condition to avoid this situation is given in expression (5). So, a government intervention under condition (5) ensures a higher

factor supply, despite the presence of increased distortions and irrespective of the effects of the reform on productive sectors. Thus, (5) is a ***sufficient condition*** for a labour supply-enhancing government intervention.

IV. CONCLUSIONS

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 the production of endowments 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 labour supply-reducing government intervention are highlighted, as the way in which the government finances the education budget may undermine the benefits from education when labour supply is elastic. That is, a tax reform designed to finance an increase in the education budget may undermine the benefits from higher production of endowments, by causing a fall in factor supplies. 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 education activities only if the expected expansion of endowments more than compensates for the distortionary effects of taxation on factor supplies. But, interesteringly, the analysis also shows that any improvement in the efficiency 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.

REFERENCES

Barnes, D. 1999, 'Causes of Dropping Out from the Perspective of Education Theory', in Randall, L. and J. Anderson (eds.) *Schooling for Success. Preventing Repetition and Dropout in Latin American Primary Schools*, M. E. Sharpe, New York.

Blankenau, W., Simpson, N., and Tomljanovich, M. 2007, 'Public education expenditures, taxation and growth: linking data to theory', *American Economic Review Papers and Proceedings*, vol. 97, no. 2, pp, 393-397.

Blankenau, W. and Simpson, N. 2004, 'Public education expenditures and growth', *Journal of Development Economics*, vol. 73, no. 2, pp. 583-605.

Clements, B. 1999, 'The efficiency of education expenditure in Portugal', IMF Working Paper no. 179.

Glomm, G. and Ravikumar, B. 1998, 'Flat-rate taxes, government spending on education, and growth', *Review of Economic Dynamics*, vol. 1, pp. 306-325.

Hanushek, E. 2004, 'Some simple analytics of school quality', NBER Working Paper no. 10229.

Hanushek, E. 2002, 'Publicly provided education', NBER Working Paper no. 8799.

Hanushek, E. 1979, 'Conceptual and empirical issues in the estimation of educational production functions', *Journal of Human Resources*, vol. 14, no 3, 351-388

Heckman, J. and Masterov, D. 2004, 'Skill policies for Scotland', The Allander Series.

Levačić, R and Vignoles, A. 2002, 'Researching the links between school resources and student outcomes in the UK: a review of issues and evidence', *Education Economics*, vol. 10, no. 3, pp. 313-331.

Lucas, R. 1988, 'On the mechanics of economic development', *Journal of Monetary Economics*, vol. 22, pp. 3-42.

Romer, P. 1986, 'Increasing returns and long run growth', *Journal of Political Economy*, vol. 94, pp.1002-1037.

Rybczynski, T. M. 1955, 'Factor endowments and relative commodity prices', *Economica*, 22, pp. 336.341.

Temple, J. 2000, 'Growth effects of education and social capital in the OECD countries', OECD, Countries Economics Department Working Paper no. 263.

UNESCO, 2008, Finance indicators by ISCED level, UNESCO Reports, webpage http://stats.uis.unesco.org/unesco/TableViewer/tableView.aspx?ReportId=172 accessed 04/10/08.

UNESCO, 2007, 'What do societies invest in education? Public versus private spending', UNESCO Institute for Statistics, Periodical no. 4, October. Webpage http://www.uis.unesco.org/template/pdf/EducGeneral/Factsheet07_No4_EN.pdf accessed 28/03/09.

ANNEX

1) The composite consumption good

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

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

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

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

2) Formal and informal labour supply

The choice between working formally or informally depends on preferences as well as on the relative wages in the two sectors. In both skill groups, there is a degree of preference for working informally. Each type of labour is allocated between the two sources of employment, formal and informal, according to a CET function $H_z = B_z\left(\beta_{Fz} L_{Fz}^{\rho_z} + \beta_{Iz} L_{Iz}^{\rho_z}\right)^{1/\rho_z}$, with $\beta_{Fz}>0$, $\beta_{Iz}>0$ and $\beta_{Fz}+\beta_{Iz}=1$, where L_{Fz}, L_{Iz} are the labour supplied to the formal and informal market, respectively. The elasticity of transformation is $\eta_z = 1/(\rho_z - 1)$, $\rho_z >1$.

The two types of labour are allocated so as to maximise the total wage income from the allocation of one unit of H_z. The problem to be solved is

Max $w_{Fz} l_{Fz} + w_{Iz} l_{Iz}$

s.t. $B_z\left(\beta_{Fz} l_{Fz}^{\rho_z} + \beta_I l_{Iz}^{\rho_z}\right)^{\frac{1}{\rho_z}} = 1$

where w_{Fz} and w_{Iz} are the wages of each type of labour (post-tax for formal labour) and l_{Fz} and l_{Iz} are the inputs of formal and informal labour to one unit of the composite H_z. From the first-order conditions, the optimal values for l_F, l_I are obtained. The wage of the composite H_z is $w_z = w_{Fz}.l_{Fz} + w_{Iz}.l_{Iz}$, which gives

$$w_z = \frac{1}{B_z}\left(\beta_{Fz}^{-\eta_z} w_{Fz}^{1+\eta_z} + \beta_{Iz}^{-\eta_z} w_{Iz}^{1+\eta_z}\right)^{\frac{1}{1+\eta_z}}$$

The total supplies of formal and informal labour are given by $L_{Fz} = l_{Fz} H_z$ and $L_{Iz} = l_{Iz} H_z$. Then, household income is $Y_Z = w_z H_z = w_{Fz} L_{Fz} + w_{Iz} L_{Iz}$. Given that households spend all their income on consumption goods, it also follows that $w_z H_z = P_{C_z} C_z$.