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POLICY RESEARCH WORKING PAPER 1504

Savings and Education

A Life-Cycle Model Applied to a Panel of 74 Countries

Jacques Morisset
César Revoredo

In the long run, education improves the national saving rate and hence growth. But this positive effect takes time to be completely realized, and it varies across regions and levels of development.

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Summary findings

Morisset and Revoredo analyze how education contributes to savings. There are many reasons to believe that education and savings may be linked, either positively or negatively. It is generally expected that people with higher education will earn greater income, thereby leading to higher savings, even if the positive relationships between education and income and between income and savings take time to be completely realized. The relationship between education and income can be negative at first because education expenses initially increase consumption and reduce current disposable income. Another argument for a negative link concerns precautionary savings. If there is a precautionary motive for savings, education should reduce income volatility because educated people are less likely to be unemployed, or, if unemployed, they are covered by unemployment insurance. With less need for precautionary saving among the more educated, education and savings would be negatively correlated.

The authors' major findings for a panel of 74 countries over the period 1960–90 are:

- Education positively influences savings in the long run. For each percentage point increase in education stock, the savings rate increases 0.37 percent. But it takes more than five years for the positive effect, through income, to compensate for the initial negative impact on savings.
- The lagged effect (five years) of a change in the stock of education appears positive in all regions except Latin America. The negative correlation in this region can be explained by the worsening quality of education, which reduces the ability to implement new technologies, and by the traditional focus on university education instead of primary and secondary education. Moreover, well-educated people in Latin America seem to have a lower precautionary motive for saving than in other regions.
- People are more productive, invest more, or are a better complement to physical capital in an environment where many people are well-educated. Accordingly, the positive effect of education on savings appears higher in industrial countries, given their higher initial stock of human capital, than in developing countries.
- The effects of primary and secondary education on savings are positive and significant in all regions, while the effect of university education is positive only in industrial countries. One explanation might be that industrial countries tend to invest in new projects rather than to adopt existing technology.

Morisset and Revoredo derive several policy recommendations from their conclusions. First, the positive effect of education on savings is enhanced by a reduction in the cost of education, which automatically increases disposable income. In many countries, the unit costs of education may be reduced by exploiting economies of scale and by developing incentives for greater cost-consciousness among consumers and providers. Many education systems may also need to upgrade their internal efficiency.

Second, a focus on primary education should be encouraged, specifically in developing countries. The empirical results indicate that the positive long-run effect associated with primary education is twice as large as that for secondary and tertiary education. Latin America's traditional neglect of primary education contrasts sharply with the policy of Asian countries.

Finally, it is important to increase the coverage of education, not only for equity but also for efficiency reasons. Indeed, how much a child learns is influenced by the nature of the learning environment, as supported by the role played by externalities and the initial level of education in the relationship between education and savings.

This paper — a product of the Country Operations Division, Latin America and the Caribbean, Country Department I — is part of a larger effort in the region to understand the determinants of domestic savings. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Nancy Cuellar, room Q7-116, telephone 202-473-7892, fax 202-522-3131, Internet address ncuellar@worldbank.org (30 pages). August 1995.

SAVINGS AND EDUCATION

A Life-Cycle Model Applied to A Panel of 74 Countries[1]

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Introduction

For a long time economists have argued that the accumulation of human capital, through increases in the coverage and the quality of education, constitutes one of the pillars of successful development strategies. This idea has gained renewed popularity with the recent literature on long-term endogenous economic growth. The favorable influence of the stock of human capital is generally justified by its positive impact on labor productivity and technology. The level of education not only enhances the ability of a country to develop its own technological innovation, but also its ability to adopt and implement technologies developed elsewhere. Recent empirical studies (e.g. Barro and Lee (1994)) have illustrated that higher education attainment, relative to the level of income, leads to higher economic growth rates in an extensive set of countries.

Little attention, however, has been paid to the relationship between the stock of human capital and savings. This relationship is important for sustainable economic growth for at least two main reasons. First, human capital may be engine for attracting other inputs, such as physical capital, which in turn require higher savings rates (see Romer (1990) or Benhabib and Spiegel (1994) for some evidence). Second, the savings rate has to increase gradually in order to finance the increasing educational needs of future generations and to keep growing the stock of human of capital over time. This intergenerational aspect of the relationship between human capital and savings has been recently emphasized by Azariadis and Drazen (1990).

There are many reasons to believe that education and savings may be linked, either positively or negatively. For example, it is generally expected that higher education attainment will increase savings through its positive effect on expected income. Nevertheless, the relationship between the two can be negative, particularly in the short run, because education expenses initially increase consumption and reduced current disposable income, and the positive relationships between education and growth as well as between growth and savings take time to realize completely. Another argument for a negative link concerns precautionary savings. If there is a precautionary motive for savings, education should reduce income volatility because educated people are less likely to be unemployed or, if unemployed, they are covered

by an unemployment insurance. In that context, education and savings would be correlated negatively.

In this paper we conduct an analytical and empirical analysis of the relationship between education and savings. A simple three-period model is developed in order to identify the principal factors affecting this relationship. The model is then applied to a panel of 74 countries, as well as to different subsets of industrialized and developing countries, and regions. The empirical results show that the relationship between the stock of human capital and savings is far from uniform across regions. In particular, it appears strongly positive in Asia but negative in Latin America over the last three decades. The level of economic development and the type of education matter, with a positive bias in favor of primary and secondary education in comparison with tertiary education, at least in developing countries.

The paper proceeds as follows. In the first section, the analytical framework is developed. The second section presents empirical evidence on the relationship between education and savings for an extended set of countries over the period 1960-90. Finally, the last section contains our main conclusions and policy recommendations.

1. A Simple Three-Period Model

Since an increase in education increases the level of income, the intuition is that saving will also increase. As the following analysis shows, the effect of education on savings is more complex than this argument suggests, and its conclusion holds only if the positive effect of education on income is sufficiently elastic or if certain threshold effects prevail.

The model presented below is in the tradition of the life-cycle hypothesis. It is general enough to provide intuition for the empirical results presented in the next section, though it contains some simplistic assumptions such as the form of the utility function and the absence of bequest motive. These limitations are discussed in the text and three directions for future research are presented in the conclusion of this section.

Consider an individual living for at most three periods who only invests in education (e_0) in the first period.[23] In order to obtain education, he has to borrow or to receive financing (eventually from parents) for an amount equals to b_0. In the second period, the individual will work and receive income (y_1), consume (c_1), save (s_1) and reimburse his loan and/or parents ($(1+r)b_0$). Finally, in the third period, saving is used for consumption during retirement (c_2). The three budget constraints can be expressed as follows:

$$(1) \quad e_0 = b_0$$

$$(2) \quad y_1 - (1+r)b_0 = c_1 + s_1$$

$$(3) \quad (1+r)s_1 = c_2$$

where r equals the interest rate. The individual chooses c_1 and c_2 to maximize expected lifetime utility (Eu). Thus:

$$(4) \quad Eu = E[u(c_1)] + (1+ß)^{-1}E[u(c_2)]$$

subject to (1)-(3) where ß is the discount rate.[4] An internal solution with $c_1, c_2 > 0$ is given by:

$$(5) \quad E[u'(c_1)] - E[(1+ß)^{-1}(1+r)u'(c_2)] = 0$$

At this stage of the presentation, the relationship between education and savings appear to be negative. The decision to spend more time in school or in training

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2. This framework is adapted from d'Autume and Michel (1994) and Buiter and Kletzer (1991).

3. Notice that education expenditure should be considered as an investment rather than current consumption due to their effect on future income, but it is not in the data (see Gersovitz (1988) for a fuller discussion).

4. The individual's utility of consumption in each period is assumed to be conformed to the following conditions: $u' > 0$ and $u'' < 0$.

when young reduce savings because it shortens the length of the earning life and increases the debt to be reimbursed. In the tradition of the life-cycle approach, the model assumes that people are selfish because they only care about their own welfare excluding that of the next generation (see Modigliani (1980)). However, this assumption does not affect the sign of the relationship between education and savings. A similar negative correlation would be obtained if selfish parents "purchase," in exchange for education financing, a promise by children to provide assistance in old age (see Kotlikoff and Spivak (1981)). In that case, people would reduce savings, other things equal, because they expect old-age support from their children. If altruism parents care about the welfare of their children and thus behave as if their planning horizon is infinite, they would provide free education financing (grant) to their children. [5] The resulting impact on savings is again likely to be negative, because they will consume less during their earning life or reduce their financial bequest. Reduced bequest would lower the disposable income of the young and, thus, decreased their savings. [6] We do not here intend to confront these three hypothesizes which would require desegregated (household or individual surveys) data, generally unavailable in developing countries.

So far the model is similar to the life-cycle hypothesis with the exception that the individual will invest in education in the first period of his life. Notice that, for simplicity, the level of investment in education is assumed to be exogenous. Rather than to make endogenous the individual choice by using the approach developed by Azariadis and Drazen (1990) or d'Autume and Michel (1994), we prefer in this paper

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5. In the absence of voluntarily intergenerational altruism, this role can be played by the government which may subsidize education through lump-sum taxes, implying a financial transfer from the current to the next generation (see Lucas 1988). The intervention of the government may also modify individual choices as recently discussed by Glomm and Ravikumar (1992), in particular taxes on production or on consumption may have different impacts on savings. This issue is beyond the scope of this paper, but it would interesting for further research to examine closely the impact of public and private education on national savings.

6. This is traditional discussion (e.g. Blinder (1976)) whether human or financial wealth is the medium for intergenerational transfers. In a macroeconomic perspective, this is important because bequests in human form (education) entail either consumer expenditures in the national income, or withdrawals from the labor force, whereas financial bequests constitute national savings.

to explore further the implications of education on savings through two additional channels.

The first channel, extensively debated in the recent literature, is based on the positive long-run relationship between the stock of human capital and the expected level of income.[7] A simple specification between education and expected income ($E(y_1)$) would be the following:

$$(6)\ E(y_1) = \mu e_0^{\tau}, \qquad \mu > 0 \text{ and } \tau > 1$$

The positive effects of education on expected income is captured by the parameters μ and τ, which represent the technology level and externalities associated with education respectively. The linear technology, which is a common feature of a class of endogenous growth models (see Romer (1986)), ensures that the rate of return to human capital does not decline as the stock of capital increases. Externalities ensure that the income growth rate is higher than the education growth rate following the argument that educated people are more productive, invest more, or are better complement to physical capital in a well-educated environment (see Lucas (1988)).

Little attention has been paid, however, to the second channel, which consists in the effect of education on income volatility. More educated people are less likely to be unemployed or, if unemployed, they are generally covered by an unemployment insurance, therefore reducing their income uncertainty. Similarly, insurance is usually thought less available in countries with lower educational attainments, although the extended family may substitute for various forms of insurance. Empirically, Psacharopoulos (1985), for example, has found that the higher the degree of education, the lower the vulnerability of earnings with cyclical fluctuations in the economy. To account for this effect, the following relationship can be written:

$$(7)\qquad \sigma^2(y_1) = \lambda(e_0), \qquad \lambda < 0$$

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7 This positive relationship has been empirically confirmed by several cross-country studies (e.g. Barro and Lee (1994) and Benhabib and Spiegel (1994)) or households' surveys (Caroll and Weil (1994). Other studies (e.g. Schultz (1975)) have also emphasized the positive correlation between education and labor income because qualified people are more mobile and have a greater wage bargaining power than less educated people

where $\sigma^2(y_1)$ represents the volatility of income.

It is well known that the effect of income uncertainty on savings will depend on the form of the utility function. In order to ensure a positive relationship between these two variables --i.e. a decrease in income uncertainty is expected to reduce precautionary savings-- the utility function for the typical individual is of Constant Relative Risk Aversion (CRRA) form: $u(c_i) = (-1/\alpha)\exp(-\alpha c_i)$. This form assures that savings increase with an increase in the riskiness of y_1 because $u'''(c) > 0$.

Substituting equations (6) and (7) into (1)-(3) and using the first-order condition (5), we obtain the following saving function[8]:

$$(8)\ s_1 = \frac{1}{(2+r)}\left[\frac{\ln(1+\beta)^{-1}}{\alpha} + \left(\alpha\frac{\lambda}{2} - (1+r)\right)e_0 + \mu e_0^{\tau}\right]$$

The impact of variation in the stock of human capital on savings is therefore equals to:

$$(9)\ \frac{ds_1}{de_0} = \frac{1}{(2+r)}\left[\mu\tau e_0^{(\tau-1)} + \alpha\frac{\lambda}{2} - (1+r)\right]$$

and the sign of equation (9) is positive only if:

$$(10)\ \mu\tau e_0^{(\tau-1)} > 1 + r - \alpha\frac{\lambda}{2}$$

Equation (9) shows that the effect of variations in the stock of human capital on savings cannot be determined *a priori*. A positive relationship between these two

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8. In deriving the saving equation, we makes use of the fact that if y_1 is normally distributed with mean $E(y_1)$ and variance $\sigma^2(y_1)$, $E(\exp(y_1))=\exp(E(y_1) + \sigma^2(y_1)/2$.

variables exists through the increase in expected income, but the effects associated with precautionary savings and education costs simultaneously reduce savings. The positive effect only holds if certain threshold effects prevail: (a) the educated force is good at creating, implementing, and adopting new technologies (μ); (b) there exist high externalities associated with education (τ); (c) the cost of education is low (as captured by the interest rate (r)); (d) savers have a low relative aversion for the risk (α); and (e) the increase in the education level fails to reduce income volatility (λ).

Interestingly, externalities played an important role in the relationship between education and savings since they affect the level of savings directly and indirectly through the initial level of education on savings (if $\tau > 1$). This role has been emphasized by Azariadis and Drazen (1990) who have shown that an initial high level of education is required to ensure a positive sustainable economic growth path over time. A second interesting feature of the above model is that the cost of education (as captured by the interest rate) should be low enough to ensure a positive effect on savings. Recently, Lucas (1988) has argued that government intervention, through subsidized credit for example, might be required to achieve a socially optimal growth path or, in terms of the above model, to reduce the cost of education so that the saving rate will be high enough to finance the future needs in physical and human capital investments.

Before proceeding with the empirical application of the above model, it is worth underscoring that at least three extensions can be considered for future research. First, we assume that individuals are not subject to borrowing constraints, which is unlikely to be the case in many developing countries or for low-income workers . Borrowing constraints would affect the relationship between education and savings because, in that context, individuals have incentive to work, instead of increasing their human capital. At the same time, it has been well documented that the saving rate increases in the presence of liquidity constraints. Consequently, a negative correlation between education and saving is more likely to exist in countries where individuals are subject to strong borrowing constraints.[9] Second, it is worth exploring if the initial level of

9. See de Gregorio (1993) for some convincing tests on OECD countries.

income or the discount rate influence the relationship between education and savings. Educated people may have a different price for the future than less educated people. Finally, it might be interesting to examine to what extent educated people, or countries with a higher average level of education, have access to a greater range of savings instruments. A broader portfolio choice may reduce the individual aversion for the risk and the precautionary motive for savings, two important parameters in the above model. In that case, the positive effect of education on savings is likely to be reduced.

2. An Application to A Panel of 74 Countries

This section presents empirical evidence on the relationship between education and savings for an extended sample of 74 countries over the period 1960-90. In order to account for different levels of economic development and regional characteristics, this relationship will be also examined in several subsets of industrialized and developing countries. Not only will the effect of the overall level of education be explored, but also that associated with the primary, secondary, and tertiary education stocks since they may have distinct impact on the economic growth rate as recently suggested by Barro and Lee (1994).

The basic following saving function is tested:

$$(\frac{s}{y})_t = \eta_0 + \eta_1 g_t + \eta_2 (dep)_t + \eta_3 e_t + \eta_4 (\frac{s}{y})_{t-1}$$

where s is domestic saving, Y the level of GDP per capita, g the GDP per capita growth rate, dep the dependency ratio, and e the stock of education. All variables are expressed in logs except for the GDP growth rate. The saving rate, rather than the absolute level of saving, is used as the dependent variable for three reasons. First, there is no adequate deflator for saving that can be used to constant-price savings series. Second, by using ratios, instead of levels, cross-country comparisons can be made

without having to choose appropriate exchange rates. Third, savings rates tend to be stationary, whereas absolute saving flows grow over time, so that, by using rates, spurious correlation with time-trended explanation variables can be minimized.

In addition to the level of education, two other explanatory variables have been introduced in the savings function. First, the GDP per capita growth rate has been included because the relationship between the two has been extensively emphasized in the economic literature. There are different channels through which savings and growth are related, but the effect of a variation in economic growth is generally expected to be positive on savings rates.[10] The life-cycle hypothesis argues that because productivity growth makes the young richer than the old, the young will be saving more than the old is dissaving and, therefore, leads to a positive impact on aggregate private savings. An additional argument is that consumers desire to hold a fixed target wealth/income ratio, then if income is growing faster, wealth must grow faster. To make wealth grow faster, it is necessary to save more. Finally, it is often argued that investment opportunities are greater in a growing environment, leading to a higher propensity to save.

Second, demographic factors play an important role in the life-cycle models as both young and old people are expected to save less than middle-age working people (see Deaton and Paxson (1992) for a review). The correlation between the dependency ratio, defined as the percentage of the population lesser than 15 years and older than 65 years to total population, is expected to be negative, though empirical results are often ambiguous in most existing studies.

The data has been drawn from the World Bank's data base for the period 1960-1990. The annual data has been expressed as five-year average in order to capture the long-term trend. For each of the 74 countries in our sample, the gross domestic product per capita and the gross domestic saving have been defined in nominal terms and in local currency. The real GDP growth rate has been calculated using as a basis the year 1987. The dependency rate ratio was extracted from the data base of the International Economic Department from the World Bank.

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10. For an opposite view, see the recent survey by Caroll and Weil (1994).

In practice, data for human capital is not available for large cross-country samples. Nevertheless, there exist now several attempts to measure proxies for the human capital stock, such as in Barro and Lee (1992) and Kyriacous (1991). In this paper, we prefer to use the data base developed by Nehru, Swanson and Dubey (1993) which certainly improves the two other existing measures.[11] Educational stocks are measured as mean school years of education of the labor force and they are built from enrollment data using the perpetual inventory method, adjusted for mortality.[12] This construction takes account of the variations across countries in the typical duration of primary, secondary, and tertiary education. We should stress, however, that the data do not take account of differences in the quality of schooling across countries or over time.

The basic model has been applied to a panel of 74 countries (the list is presented in the Appendix) over the period 1960-90. We used the Two-Stage Least Squares (TSLS) estimation technique to account for the simultaneity between growth and savings, while heteroskedasticity has been corrected by using the consistent estimate of the covariance matrix developed by White (1980).[13] Notice that the instruments of the growth equation are those defined by Barro and Lee including lagged GDP per capita growth, the dependency ratio, the lagged savings rate and the initial GDP level in 1960. Finally, the basic model incorporates fixed country-specific effects in the intercept term, which seems to be an appropriate choice due to the marked differences in the economic features of the countries used in our sample. The differences among countries can be explained not only by the variables used in the

11. Briefly, these authors argue that Barro and Lee series present three major caveats: (a) the average number of years of education received is arbitrary because there is no information on those who completed only part of each schooling stage; (b) the few number of observations in many countries of their sample (only 77 countries out of 129 have three or more observations); and (c) the estimates only refer to the population aged 25 and over. The last caveat may be the most serious because " this can lead to a serious downward bias in the estimates of the education stock because in most developing countries the segment of the population between the ages of 15 and 25 is usually large and growing over time" (p.3, Nehru and al.).

12. Estimates are corrected for grade repetition among school-goes and country-specific drop-out rates for primary and secondary students.

13. We prefer this method rather than the weighted least square in the absence of appropriate information on the variable which would be proportional to the residual variance.

Table 1:
Savings Functions for the Panel Data of 74 countries, 1960-90

Dependent Variable: Savings rate
(t-Statistics in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita growth	4.255 *(3.98)*	5.217 *(5.99)*	4.558 *(4.37)*	5.412 *(6.46)*	4.637 *(3.95)*	5.523 *(5.86)*	4.495 *(3.77)*	5.674 *(6.04)*
Lagged GDP growth per capita		1.922 *(1.94)*		1.956 *(1.99)*		1.979 *(1.87)*		1.239 *(1.30)*
Dependency ratio	-0.566 *(-3.42)*	-0.378 *(-2.74)*	-0.409 *(-2.78)*	-0.266 *(-2.21)*	-0.552 *(-2.84)*	-0.357 *(-2.20)*	-0.535 *(-2.41)*	-0.317 *(-1.74)*
Lagged Savings Rate		0.287 *(3.36)*		0.290 *(3.35)*		0.292 *(3.15)*		0.322 *(3.51)*
Overall Education Stock	-1.848 *(-3.67)*	-1.625 *(-3.30)*						
Lagged Overall Education Stock	1.508 *(3.62)*	1.395 *(3.39)*						
Primary Education Stock			-1.832 *(-3.68)*	-1.688 *(-3.45)*				
Lagged Primary Education Stock			1.489 *(3.61)*	1.429 *(3.50)*				
Secondary Education Stock					-0.846 *(-2.67)*	-0.580 *(-2.20)*		
Lagged Secondary Education Stock					0.726 *(2.70)*	0.517 *(2.26)*		
Tertiary Education Stock							0.013 *(0.13)*	-0.006 *(-0.07)*
Lagged Tertiary Education Stock							-0.039 *(-0.54)*	-0.001 *(-0.01)*
$Adj R^2$	0.153	0.301	0.151	0.303	0.143	0.283	0.112	0.272
DW	1.88	2.11	1.87	2.15	1.85	2.11	1.89	2.10
Observations	369	369	369	369	369	369	369	369

All variables are expressed in log (with the exception of the GDP growth rate) and in 5 year average. The TSLS have been used in all regression and fixed-effects have been introduced to account for countries' characteristics.

regressions but also by specific historical factors.[14] In the last part of this section, a cross-country regression based on the average of the variables over the period 1960-90 is presented in order to help us to distinguish the cross-country effects from the time-effects.

Table 1 contains the regression results for the saving rate per capita. For the basic formulation, all countries are included for 1960-90. Overall, the results are satisfactory since all estimated coefficients have the anticipated sign and appear to be robust for different specifications. The most interesting aspect of the results is the positive but lagged effect of education on savings, while the contemporaneous correlation is negative. The estimated coefficients mean that an additional year of schooling (measured as a five year average) will reduce the savings rate per capita by 1.6-1.8 percent initially, but it will increase it by about 1.4-1.6 percent after five years. This finding suggests that it takes more than five years for the initial negative effect to be compensated by the positive effect of an increase in the stock of education on savings through economic growth.

The same pattern can be observed for primary and secondary education; though the magnitude of the measured effects is greater for primary than for secondary education. In contrast, (university) tertiary education does not appear significant neither immediately nor after a five-year interval. This finding contradicts Romer (1990) who argued that a country with a well-developed research system and a good university system will invest more in capital goods and, thus, save more. Notice that Barro and Lee (1994) were also unable to find a significant correlation between tertiary education and growth in their set of developing countries.

There exist significant regional differences about the effect of variations in the stock of education on the saving rate. Tables 2 and 3 report the estimated impact of education on savings in industrialized and developing countries. If the sequencing implied by a change in the average years of schooling on savings does not differ between these two groups of countries, the magnitude of the effects is somewhat

14. See Johnston (1984) for guidelines about the use of different estimation techniques in panel data models.

Table 2:
Savings Functions for the Panel Data of Developing Countries, 1960-90

Dependent Variable: Savings rate
(t-Statistics in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita growth	4.634 (3.88)	5.634 (5.87)	4.723 (4.01)	5.701 (6.01)	5.094 (4.04)	5.855 (5.74)	4.928 (3.81)	5.952 (5.79)
Lagged GDP growth per capita		2.289 (2.03)		2.243 (2.00)		2.342 (2.00)		1.439 (1.31)
Dependency ratio	-0.898 (-4.16)	-0.735 (-3.48)	-0.772 (-3.80)	-0.630 (-3.18)	-0.903 (-3.79)	-0.748 (-3.21)	-0.844 (-3.18)	-0.701 (-2.73)
Lagged Savings Rate		0.273 (2.84)		0.271 (2.77)		0.268 (2.58)		0.298 (2.84)
Overall Education Stock	-1.695 (-3.18)	-1.750 (-3.38)						
Lagged Overall Education Stock	1.334 (3.00)	1.490 (3.40)						
Primary Education Stock			-1.762 (-3.37)	-1.732 (-3.40)				
Lagged Primary Education Stock			1.363 (3.16)	1.447 (3.40)				
Secondary Education Stock					-0.965 (-2.60)	-0.777 (-2.52)		
Lagged Secondary Education Stock					0.810 (2.60)	0.671 (2.53)		
Tertiary Education Stock							0.054 (0.47)	-0.027 (-0.26)
Lagged Tertiary Education Stock							-0.082 (-0.98)	-0.002 (-0.02)
$AdjR^2$	0.157	0.286	0.160	0.285	0.155	0.271	0.124	0.252
DW	1.85	2.05	1.86	2.06	1.82	2.05	1.88	2.05
Observations	259	259	259	259	259	259	259	259

All variables are expressed in log (with the exception of the GDP growth rate) and in 5 year average. The TSLS have been used in all regression and fixed-effects have been introduced to account for countries' characteristics.

Table 3:
Savings Functions for the Panel Data of Industrialized Countries, 1960-90

Dependent Variable: Savings rate
(t-Statistics in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita growth	2.318 (2.92)	3.365 (4.60)	2.793 (4.50)	3.569 (5.71)	2.359 (1.98)	4.273 (5.42)	0.020 (0.01)	4.146 (4.94)
Lagged GDP growth per capita		0.273 (0.42)		0.109 (0.18)		0.174 (0.24)		0.003 (0.01)
Dependency ratio	-0.028 (-0.25)	0.020 (0.26)	-0.010 (-0.15)	0.031 (-0.60)	-0.150 (-0.81)	0.087 (1.24)	-0.434 (-1.72)	0.090 (1.06)
Lagged Savings Rate		0.273 (5.38)		0.336 (5.20)		0.442 (9.66)		0.449 (11.08)
Overall Education Stock	-2.623 (-3.99)	-0.756 (-1.58)						
Lagged Overall Education Stock	2.882 (5.79)	0.865 (5.38)						
Primary Education Stock			-1.448 (-1.63)	-0.690 (-1.43)				
Lagged Primary Education Stock			2.087 (3.19)	0.861 (2.47)				
Secondary Education Stock					-0.791 (-2.34)	0.069 (0.47)		
Lagged Secondary Education Stock					0.806 (2.57)	-0.012 (-0.09)		
Tertiary Education Stock							-0.445 (-2.82)	-0.018 (-0.24)
Lagged Tertiary Education Stock							0.367 (3.16)	0.048 (0.78)
$AdjR^2$	0.587	0.741	0.611	0.746	0.194	0.727	0.194	0.730
DW	1.63	2.16	1.86	2.15	1.35	2.23	1.23	2.24
Observations	110	110	110	110	110	110	110	110

All variables are expressed in log (with the exception of the GDP growth rate) and in 5 year average. The TSLS have been used in all regression and fixed-effects have been introduced to account for countries' characteristics.

different. Over the long-run (the sum of the contemporaneous and the lagged effects), the effect of an increase in the level of education appears unambiguously positive in industrialized countries, but negative in developing countries. An explanation, as suggested by the model, is that the initial level of education matters, enhancing the positive impact of education on growth through externalities in industrialized countries.[15] The model also suggests that the wider coverage of unemployment insurance programs in industrialized countries reduces the discriminatory negative effect of education on precautionary savings because most savers are protected against income fluctuations (i.e. the coefficient λ is lower in absolute value), while only well-educated are protected in developing countries. Finally, borrowing constraints are more binding in developing countries, which as explained earlier, will reduce education but increase savings, resulting in a negative correlation between these two variables.

Another difference between industrialized and developing countries is that the impact of tertiary education on the savings rate appears positive in the first group of countries. The reason for this result might be that the positive correlation between university education and growth is certainly higher in industrial countries, which tend to invest fundamentally in new projects rather than adopt lending technology.

Empirical evidence by regions is reported in Tables 4-7. There are two main results emerging from these tables. The first one is that the lagged positive impact in Asia largely offsets the initial negative impact of education on the saving rate. This finding may explain to a large extent the contribution of education to savings and economic growth in Asia during the past three decades.[16] While a full discussion of the regional characteristics of education and savings is clearly beyond the scope of the paper, the model suggests that the high positive impact of education on savings in Asia is explained by the better capacity of the educated force at creating, implementing, and adopting new technologies. At first sight, however, the social rates of return do not

15. This explanation is reinforced by regional differences as reported below. An increase in the stock of education appears higher in Europe than in other regions, with the notable exception, however, of Asia.

16. During the period 1960-90, the stock of human capital has increased by about 66 percent in Asia, explaining therefore a 5 percent of GDP per capita increase in savings during this period.

Table 4:
Savings Functions for the Panel Data of Asian Countries, 1960-90

Dependent Variable: Savings rate
(t-Statistics in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita growth	8.623 (2.93)	11.400 (3.01)	8.610 (2.96)	11.843 (2.97)	9.508 (2.98)	9.777 (2.55)	6.034 (1.81)	10.805 (2.57)
Lagged GDP growth per capita		0.935 (0.52)		0.437 (0.24)		3.798 (1.87)		0.283 (0.14)
Dependency ratio	0.629 (1.70)	0.865 (2.29)	0.574 (1.62)	0.839 (2.26)	-0.200 (-0.42)	-0.060 (-0.11)	-0.726 (-1.24)	-0.159 (-0.25)
Lagged Savings Rate		0.182 (1.42)		0.203 (1.52)		0.050 (0.27)		0.264 (1.62)
Overall Education Stock	-5.550 (-3.30)	-5.296 (-3.24)						
Lagged Overall Education Stock	5.792 (4.00)	5.443 (4.00)						
Primary Education Stock			-5.060 (-3.46)	-4.999 (-3.30)				
Lagged Primary Education Stock			5.304 (4.17)	5.079 (4.03)				
Secondary Education Stock					-2.015 (-2.21)	-2.002 (-2.58)		
Lagged Secondary Education Stock					2.089 (2.76)	-2.069 (3.26)		
Tertiary Education Stock							-0.588 (-1.66)	-0.525 (-1.31)
Lagged Tertiary Education Stock							0.541 (2.22)	0.490 (1.90)
$Adj R^2$	0.449	0.491	0.423	0.468	0.350	0.365	0.217	0.303
DW	1.70	1.87	1.68	1.89	1.75	1.93	1.75	2.06
Observations	60	60	60	60	60	60	60	60

All variables are expressed in log (with the exception of the GDP growth rate) and in 5 year average. The TSLS have been used in all regression and fixed-effects have been introduced to account for countries' characteristics.

Table 5
Savings Functions for the Panel Data of African Countries, 1960-90

Dependent Variable: Savings rate
(t-Statistics in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita growth	3.821 (1.97)	0.494 (3.62)	3.820 (1.97)	4.917 (3.57)	3.760 (1.94)	4.715 (3.38)	3.536 (1.74)	4.892 (3.52)
Lagged GDP growth per capita		2.453 (1.33)		2.405 (1.31)		2.133 (1.21)		0.942 (0.58)
Dependency ratio	-0.602 (-1.43)	-0.055 (-0.15)	-0.451 (-1.07)	0.045 (0.12)	-0.909 (-2.39)	-0.273 (-0.79)	-0.813 (-2.03)	-0.248 (-0.74)
Lagged Savings Rate		0.341 (2.34)		0.335 (2.26)		0.366 (2.64)		0.425 (2.98)
Overall Education Stock	-2.392 (-3.66)	-2.039 (-3.31)						
Lagged Overall Education Stock	1.846 (3.37)	1.860 (3.15)						
Primary Education Stock			-2.536 (-3.84)	-2.074 (-3.18)				
Lagged Primary Education Stock			1.923 (3.52)	1.662 (3.02)				
Secondary Education Stock					-1.580 (-3.26)	-1.116 (-2.71)		
Lagged Secondary Education Stock					1.279 (3.21)	-0.909 (2.62)		
Tertiary Education Stock							0.056 (0.40)	0.024 (0.21)
Lagged Tertiary Education Stock							-0.100 (-1.05)	-0.057 (-0.71)
$AdjR^2$	0.163	0.307	0.170	0.305	0.173	0.297	0.074	0.262
DW	1.67	2.02	1.68	2.02	1.62	2.02	1.85	2.03
Observations	109	109	109	109	109	109	109	109

All variables are expressed in log (with the exception of the GDP growth rate) and in 5 year average. The TSLS have been used in all regression and fixed-effects have been introduced to account for countries' characteristics.

Table 6
Savings Functions for the Panel Data of European Countries, 1960-90

Dependent Variable: Savings rate
(t-Statistics in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita growth	4.813 (5.30)	5.135 (6.18)	5.194 (8.46)	5.085 (7.98)	5.217 (4.94)	5.616 (5.67)	3.794 (4.14)	4.435 (4.26)
Lagged GDP growth per capita		0.711 (0.83)		0.428 (0.53)		1.265 (1.39)		0.890 (0.97)
Dependency ratio	0.225 (2.09)	0.132 (1.55)	0.214 (3.18)	0.072 (1.15)	0.406 (3.68)	0.338 (2.62)	0.267 (2.52)	0.249 (2.16)
Lagged Savings Rate		0.304 (2.08)		0.275 (1.90)		0.317 (1.97)		0.321 (1.99)
Overall Education Stock	-0.932 (-1.55)	-0.392 (-0.70)						
Lagged Overall Education Stock	1.044 (2.23)	0.704 (1.52)						
Primary Education Stock			-0.697 (-1.02)	-0.521 (-0.91)				
Lagged Primary Education Stock			0.926 (1.79)	0.809 (1.68)				
Secondary Education Stock					0.130 (0.64)	0.073 (0.41)		
Lagged Secondary Education Stock					-0.038 (-0.21)	0.847 (0.54)		
Tertiary Education Stock							-0.277 (-1.84)	-0.279 (-1.90)
Lagged Tertiary Education Stock							0.286 (1.87)	0.337 (2.32)
$AdjR^2$	0.332	0.409	0.349	0.410	0.249	0.348	0.263	0.348
DW	1.84	2.03	1.83	2.03	1.81	2.02	1.83	2.05
Observations	95	95	95	95	95	95	95	95

All variables are expressed in log (with the exception of the GDP growth rate) and in 5 year average. The TSLS have been used in all regression and fixed-effects have been introduced to account for countries' characteristics.

Table 7
Savings Functions for the Panel Data of Latin American Countries, 1960-90

Dependent Variable: Savings rate
(t-Statistics in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita growth	4.752 (4.76)	5.613 (5.65)	4.448 (4.29)	5.442 (5.46)	4.652 (4.71)	6.140 (5.81)	4.145 (3.76)	5.433 (5.07)
Lagged GDP growth per capita		0.039 (0.04)		0.299 (0.35)		1.044 (1.11)		0.056 (0.06)
Dependency ratio	-1.259 (-3.90)	-1.201 (-4.32)	-1.370 (-4.72)	-1.227 (-4.78)	-1.032 (-3.13)	-1.005 (-3.20)	-1.210 (-3.96)	-1.126 (-4.28)
Lagged Savings Rate		0.421 (4.10)		0.427 (4.18)		0.469 (4.42)		0.446 (3.97)
Overall Education Stock	3.090 (3.90)	1.525 (2.00)						
Lagged Overall Education Stock	-3.517 (-4.40)	-1.481 (-2.61)						
Primary Education Stock			2.564 (3.31)	1.109 (1.51)				
Lagged Primary Education Stock			-3.189 (-4.03)	-1.698 (-2.31)				
Secondary Education Stock					0.561 (1.31)	0.124 (0.38)		
Lagged Secondary Education Stock					-0.595 (-1.51)	-0.179 (-0.60)		
Tertiary Education Stock							0.720 (4.697)	0.345 (2.07)
Lagged Tertiary Education Stock							-0.816 (-4.75)	-0.458 (-2.65)
$AdjR^2$	0.318	0.439	0.303	0.434	0.194	0.394	0.292	0.422
DW	1.66	2.02	1.65	2.03	1.63	2.08	1.71	2.05
Observations	100	100	100	100	100	100	100	100

All variables are expressed in log (with the exception of the GDP growth rate) and in 5 year average. The TSLS have been used in all regression and fixed-effects have been introduced to account for countries' characteristics.

appear higher in Asia than in other regions, though the focus on primary and secondary education may partially explain the relative success of Asia (see Table 8). The social rates of return of primary and secondary education are generally higher than those associated with tertiary education. The Asia's traditional focus on primary education is evidenced by high subsidies and low private enrollment, in sharp contrast with the situation in Latin America where university education is privileged. A somewhat better measure of school quality is the performance of children on tests of cognitive skills, standardized across economies. In the relatively few international comparisons available from such tests, East-Asian children tend to perform better than children from other developing countries.[17]

The second interesting result is the inverse sequencing associated with the impact of education on the saving rate in Latin America. The initial impact appears positive, while the lagged impact is negative and generally higher than the initial one. Although it can be argued that these empirical results are due to the absence of explanatory variables in the regression or spurious correlation, the model provides some tentative explanations that are briefly explored below. The contemporaneous positive effect of education on the savings rate can be explained by the relatively high stock of education in Latin America which magnifies the externalities associated with education (see equation (9)). The stock of overall education was indeed about 55 percent higher in Latin America than in Asia in 1960, though the difference declined to only 8 percent in 1987 (Table 8). The model also suggests that the positive effect may also be the consequence of the low cost of education in Latin America, but the empirical evidence remains inconclusive on that issue in part because household survey rather aggregated data would be needed for a meaningful analysis. On the one hand, people seems to spent proportionally less on education in Latin America than in Asia because of lower population pressures, including slower population growth and a lower proportion of young people, and public policy. As a result, the stock of education grew by 4.2 percent in Asia against only 2.0 percent in Latin America over

17. A recent study by Wolff (1993) found that the average quality of Latin America's primary education was very poor relative to Asia. For example, a 1992 study on science and mathematics achievement for thirteen years old found out that Brazilian students from Sao Paulo and Fortaleza were outscored by students from Korea, Taiwan, and China as well as by other students from every developed country in the sample.

Table 8
Indicators of Education in Asia and Latin America

	Stock of Human Capital a/ **1987**	Growth Rate of the Stock of Human Capital b/ **1960-87**	Social Rates of Return c/ **1985**	Share of Public Education Expenditures d/ **1985**	Enrollment Ratio e/ **1985**	Share of Enrollment in Private Sector f/ **1980s**
Asia						
Primary	4.4	3.9	19.9		63.0	3.9
Secondary	0.7	9.2	13.3		29.4	26.0
Tertiary	0.0	3.4	11.7		7.6	28.6
Total	5.1	4.2		3.1		20.0
Latin America						
Primary	4.7	4.7	17.9		61.0	17.7
Secondary	0.6	0.6	12.8		29.0	29.1
Tertiary	0.3	0.3	12.3		9.9	3.6
Total	5.5	5.5		3.5		27.0

a/ Source, Nehru, Swanson and Dubey (1993), in school years of education per person between ages of 15 and 64.
b/ Source; Nehru, Swanson and Dubey (1993), OLS growth rate per year over the period 1960-87
c/ Source; Psacharopoulos (1994)
d/ Source: Tan and Mingat (1992), p. 10, in percent of GNP.
e/ Source: Tan and Mingat (1992), p.11
f/ Source: Tan and Mingat (1992), p.13.

the period 1960-87. On the other hand, the level of public education expenditures was higher in that Latin American countries (averaging 3.5 percent of GDP in 1985) than in Asia (averaging only 3.1 percent of GDP), with a higher proportion of private enrollment in Latin America (see Table 8). Nevertheless, the data on financing costs are only a rough guide because no distinction is made between public schools and private-aided schools, and between schools that rely mainly on private contributions..

The medium-run negative effect of a variation in the stock of education on the saving rate can be partially explained by the greater capacity of education in reducing income volatility in Latin America (i.e. a higher parameter λ in absolute value). Some complementary evidence for this hypothesis is that well-educated people have a lower variability of their income as reported by Cox Edwards (1984) in the case of Chile during the past two decades. The argument is that the chronic macroeconomic instability in Latin America has accentuated the benefits of education in reducing income instability because well-educated people have access to financial instruments that allow them to reduce inherent risks and reduce their income volatility. In turn, the reduction in income volatility reduces the need for precautionary savings, and explains the negative correlation between education and savings

The rest of the empirical results are only briefly commented. The estimated coefficients associated with education in Africa are close to the average, while those found for Europe are very similar to those described for industrialized countries.

Finally, since the panel data regression captures both time and countries' specifics, we conduct a cross-country regression based on the average of the variables over the last three decades (Table 9). The results confirm that education and savings are positively and significantly correlated across countries: for each percentage point increase in the stock of education, the saving rate increases by 0.37 percent. The magnitude of the effect associated with primary education appears twice as large as those estimated for secondary and tertiary education, suggesting that externalities associated with the first type of education may be higher, specifically in developing countries.

Table 9
Cross-Country Savings Functions for 74 Countries, Average 1960-90

Dependent Variable: Savings rate
(t-Statistics in parenthesis)

	(1)	(2)	(3)	(4)
GDP per capita growth	9.487 *(2.97)*	9.824 *(3.16)*	9.212 *(2.57)*	8.928 *(2.58)*
Dependency ratio	0.127 *(0.60)*	0.055 *(0.20)*	-0.044 *(-0.12)*	-0.109 *(-0.40)*
Overall Education Stock	0.370 *(4.94)*			
Primary Education Stock		0.374 *(5.02)*		
Secondary Education Stock			0.156 *(2.09)*	
Tertiary Education Stock				0.124 *(2.45)*
AdjR^2	0.404	0.412	0.323	0.333
Observations	74	74	74	74

All variables are expressed in log (with the exception of the GDP growth rate). The TSLS have been used in all regression. All regression were estimated with intercept.

3. Summary and Conclusions

This paper has examined both analytically and empirically the contribution of education to savings. The analysis has been applied to a panel of 74 countries over the period 1960-90. The major findings are the following:

a. In the long run, education influences positively savings as for each percentage point increase in the stock of education, the saving rate increases by 0.37 percent. However, it takes more than five years for the initial negative effect to be compensated for the positive effect through economic growth.

b. The lagged effect (5 years average) of a change in the stock of education appears positive and significant in all regions with the notable exception of Latin America. The negative correlation between education and savings in Latin America can be explained in many ways as suggested by the model. Two explanations are the poor quality of education which reduces the ability to implement new technologies and the focus on university rather than primary and secondary education. Furthermore, well-educated people in Latin America seems to have a lower precautionary motive for savings than in other regions.

c. The initial level of education enhances the positive effect of education on savings through the presence of externalities. Accordingly, the estimated coefficient associated with education appears higher in industrialized countries, with a higher initial stock of human capital, than in developing countries.

d. The effects associated with primary and secondary education are positive and significant in all regions, while the effect of university education is only positive in developed countries. The reason for this result might be that the positive correlation between university education and growth is certainly higher in industrialized countries, which tend to invest fundamentally in new projects rather than adopt lending technology.

Although the approach presented in this paper can be improved in many ways -- household surveys rather than aggregate data are necessary to design country-specific policy interventions-- several policy recommendations are straightforward. First, the positive effect of education on savings is enhanced by the reduction in the costs of education. The unit costs of education may be reduced in many countries by exploiting economies of scale and developing adequate incentives for greater cost-consciousness among consumers and providers. Many education systems may also upgrade their internal efficiency. Second, the focus on primary education should be encouraged, specifically in less developing countries, because the empirical results indicate that the positive long-run effect associated with primary education is twice as large as that estimated for secondary and tertiary education. Latin America's traditional neglect; of primary education contrasts sharply with the policy of Asian countries.. Finally, it is important to increase the coverage of education, not only for equity, but also for efficiency reasons as the savings rate would increase and, thus, the growth rate. Indeed, how much a child learns is also influenced by the nature of the learning environment as supported by the role played by externalities and the initial level of education in the relationship between education and savings..

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Attachment

List of countries (1960-1990)

1.	DZA	Algeria
2.	ARG	Argentina
3.	AUS	Australia
4.	AUT	Austria
5.	BGD	Bangladesh
6.	BEL	Belgium
7.	BOL	Bolivia
8.	BRA	Brazil
9.	CMR	Cameroon
10.	CAN	Canada
11.	CHL	Chile
12.	COL	Colombia
13.	CRI	Costa Rica
14.	CIV	C'te d'Ivoire
15.	DNK	Denmark
16.	ECU	Ecuador
17.	EGY	Egypt, Arab Republic of
18.	SLV	El Salvador
19.	ETH	Ethiopia
20.	FIN	Finland
21.	FRA	France
22.	DEU	Germany
23.	GHA	Ghana
24.	GRC	Greece
25.	GTM	Guatemala
26.	HTI	Haiti
27.	HND	Honduras
28.	ISL	Iceland
29.	IND	India
30.	IDN	Indonesia
31.	IRL	Ireland
32.	ISR	Israel
33.	ITA	Italy
34.	JAM	Jamaica
35.	JPN	Japan
36.	KEN	Kenya
37.	KOR	Korea, Republic of
38.	MDG	Madagascar
39.	MWI	Malawi
40.	MYS	Malaysia
41.	MUS	Mauritius
42.	MEX	Mexico
43.	MAR	Morocco
44.	MMR	Myanmar
45.	NLD	Netherlands
46.	NGA	Nigeria
47.	NOR	Norway
48.	PAK	Pakistan
49.	PAN	Panama
50.	PRY	Paraguay
51.	PER	Peru
52.	PHL	Philippines
53.	PRT	Portugal
54.	RWA	Rwanda
55.	SEN	Senegal
56.	SLE	Sierra Leone
57.	SGP	Singapore
58.	ESP	Spain
59.	LKA	Sri Lanka
60.	SDN	Sudan
61.	SWE	Sweden
62.	CHE	Switzerland
63.	TZA	Tanzania
64.	THA	Thailand
65.	TUN	Tunisia
66.	TUR	Turkey
67.	UGA	Uganda
68.	GBR	United Kingdom
69.	USA	United States
70.	URY	Uruguay
71.	VEN	Venezuela
72.	ZAR	Zaire
73.	ZMB	Zambia
74.	ZWE	Zimbabwe

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