

# Investment in Education: Do Economic Volatility and Credit Constraints Matter?

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## Abstract

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## 1. Introduction

This paper studies the empirical link between income volatility and the accumulation of human capital in the presence of credit constraints and income inequality. We also analyze the role played by public investment in education in this context.

Recent empirical studies (Ramey and Ramey, 1995; Aizenman and Marion, 1993) found a negative relationship between economic volatility and growth. Ramey and Ramey (1995) also noted the “apparent absence of a role for the investment share (in physical capital) in the relationship between volatility and growth;” from which they concluded that the cost of volatility can be traced to “uncertainty-induced planning errors by firms.” Aizenman and Marion (1993) found that there is a negative relationship between investment and uncertainty. However, neither of these papers explores the link between income volatility and human capital accumulation, even though investment in human capital has been widely recognized in theoretical and empirical research as an important determinant of economic growth (Lucas, 1988; Romer, 1990; Barro, 1991). The effect of volatility on the formation of human capital, and the importance of human capital in determining growth in the long run, suggest that the negative relationship between volatility

and growth could work through the effect of volatility on human capital accumulation. This reasoning motivates the paper.

Our evidence, drawn from cross-country is that average secondary enrollment in the period 1970 – 1972 is negatively affected by: the lack of financial markets, income or employment volatility, and income inequality. We test the robustness of our results to: different specifications of volatility, the inclusion of public expenditure in education, and different sets of regressors. We check our results also for country-specific effects by using panel regressions. Finally, we use our estimates to evaluate the effects of lack of financial markets, income inequality, and income volatility on secondary education in Latin America. These three factors explain almost half of the educational gap of Latin America vis-a-vis the industrialized countries.

The effects of uncertainty on investment in physical capital have been studied for a long time (for a recent overview, see Dixit and Pindyck, 1994). However, extending this type of analysis to investment in human capital is not trivial. Human capital has several properties that make it different from investment in physical capital: investment in human capital is irreversible in the sense that it cannot be sold; human capital cannot serve as collateral because it is not possible to expropriate; investment in human capital implies moral hazard because the

effort that an individual puts into studying is difficult to observe by a third party; and investment in education has returns over the long term.<sup>1</sup>

All these properties make it difficult the development of markets where resources are mobilized to finance education: imperfect information raises the costs of monitoring, the impossibility of using human capital as collateral makes lenders more cautious, the irreversibility of investment in human capital makes investors more cautious, and the fact that returns are spread over the long run makes all of these problems more severe.

The absence of resources to finance education has particularly adverse effects on the accumulation of human capital when income or wealth are unequally distributed or volatile.<sup>2</sup> Furthermore, the adverse effects will be long lasting, because investment in human capital generally takes place at a critical age, and it cannot be postponed. Note that in the case of physical capital there is an option value to waiting. In the case of education, the option to wait is much lower; moreover, it is possible to invest twice in physical capital during good times while it is not possible to invest twice in education.<sup>3</sup>

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<sup>1</sup>Levhari and Weiss (1974) introduced uncertainty into the analysis of the formation of human capital and concluded that its effect is ambiguous.

<sup>2</sup>Loury (1981) and Galor and Zeira (1993) present a model in which unequal distribution of wealth (or income) leads to lower accumulation of human capital.

<sup>3</sup>A more extensive theoretical discussion of the channels through which volatility may affect the decision to acquire education can be found in an expanded version of this paper— Flug

The simple cross-country relationship between school enrollment and volatility (standard deviation of the growth rates of employment and of real income per capita), as well as the relationship between fixed capital formation (as share of GDP) and volatility, are shown in Figure 1.<sup>4</sup> As is clear from this figure, income volatility has a stronger correlation with investment in human capital than with investment in physical capital.

Although, all the arguments mentioned above suggest that volatility has a negative effect on the private incentive to invest in education, there are at least two reasons that could mitigate the negative effects: the role of education as insurance, and the role of opportunity cost.

First, individuals could see investment in education as an insurance because the educated can apply to a broader range of jobs than uneducated. The magnitude of the insurance effect depends on how the individuals perceive uncertainty about the future and on the credit constraints. The evidence on the “insurance effect” is mixed. On the one hand, Behrman and Birdsall (1983) found that in Brazil the incomes of the educated were less affected in downturns. Similarly, the *World Development Report* (1990) reports that in very low income countries, the incomes

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Spilimbergo and Wachtenheim (1996).

<sup>4</sup>The original data on employment come from the ILO statistical yearbook; the original source of the remaining variables is the World Bank’s *World Tables*.

of the uneducated may drop sharply during recessions due to the very limited social safety net, especially during recessions. On the other hand, Groot and Oosterbeek (1992) found in a cross section study, that in the Netherlands the standard deviation of earnings increased with the education level, while in the United States the relationship was less uniform. Thus, from the empirical evidence it is unclear whether acquiring education is an effective insurance strategy against volatile incomes.

Second, volatility can influence the decision on whether to get an education, by directly affecting the opportunity costs. An upturn is associated with an increase in the opportunity cost of obtaining an education, while a downturn reduces it, causing an increase in the amount of schooling (Anderson et al., 1995). This would imply an effect of volatility on the amount of investment in human capital to the extent that the effects in the upturn and downturn are asymmetric. This reasoning is more relevant for higher-income countries (see Pissarides (1982) for a time-series analysis).

The possible shortage of private resources to finance education in context of unequal distribution of income and/or volatile environment makes the role of public financing particularly important. Thus, we incorporate into the analysis the effects of volatility on public expenditure on education, and, in turn, the effects of

public investment on the overall investment in education. From a demand perspective, a more volatile environment implies that the need for government financing of education is more severe. From a supply perspective, volatility could decrease the resources available for public expenditure on education because a more volatile economy means that the tax capacity is more limited and income per capita is lower (Ramey and Ramey, 1995). On the other hand, a more volatile economy could cause the expansion of the state; this effect results from an asymmetric adjustment of the government to shocks and a countercyclical public expenditure policy: during a downturn public expenditure expands but it does not contract during an upturn. In sum, volatility has an ambiguous effect on the size of the public education sector and thus the relationship between the two is an empirical question.

Some macroeconomic determinants of investment in human capital, and in particular, the effect of the imperfections of the capital market on the decision to invest in education has been the subject of theoretical research going back to Becker (1964). However, empirical research on the effects of these macroeconomic variables is relatively scarce; De Gregorio (1995) finds a negative effect of credit constraints on school enrollment; Birdsall, Ross, and Sabot (1995a), using a cross-country regression analysis, describe a feedback effect in which education lowers

inequality, which in turn stimulates investment in education.<sup>5</sup>

## 2. Empirical Analysis

In our empirical analysis, we estimate the effects of volatility, inequality, and the lack of developed credit markets on investment in education controlling for initial per capita income, initial educational level, and public expenditure. Based on the considerations and channels presented in the introduction, we expect to obtain the following results:

- Where the credit market is more developed, school enrollment will be higher.
- Where wealth (or income) is distributed more equally, school enrollment will be higher.
- The effects of volatility on school enrollment are ambiguous.

We first present the sources of our data. In the sub-section 2.2, we present our regressions.

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<sup>5</sup>Birdsall, Ross, and Sabot (1995b) compare the virtuous circle of high educational performance stimulating growth and reducing inequality, which in turn increases the demand for and supply of education, as experienced by the East Asia countries, to the vicious circle in which a relatively uneducated labor force in many Latin American countries contributes to slower growth and high inequality, which in turn further limits the supply of and demand for education.



## 2.1. The data

We use the following variables in our empirical analysis. The dependent variable is secondary school enrollment (average during the period 1970 – 1992) as a proportion of secondary school-age population. We focus on secondary school enrollment because primary schooling is compulsory in most countries and has relatively low opportunity costs.<sup>6</sup>

The level of per capita income in 1960 is an initial condition reflecting the difference in the level of development across countries.<sup>7</sup> Educational attainment in 1960 is an initial condition that represents country-specific attributes of the educational system, as well as a measure of the educational level of the parents' generation.<sup>8</sup>

The financial depth variable, following King and Levine (1993), is measured as the ratio of the financial system's liquid liabilities to GDP, and represents the extent to which the credit market is developed. It proxies the severity of the credit constraints faced by individuals in the economy. Income inequality is defined as the ratio of the income shares of the top quintile to the bottom two quintiles

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<sup>6</sup>The data on enrollment come from the World Bank's *World Tables*.

<sup>7</sup>These data are from Summers and Heston (1994).

<sup>8</sup>Data from Barro and Lee (1993).

of the population.<sup>9</sup> Employment volatility is defined as the standard deviation of the annual growth rate of employment over the period 1970-1992, and income volatility is defined as the standard deviation of the growth rate of nominal income deflated by the Consumer Price Index. Fiscal volatility is defined as the standard error from an AR(1) process of fiscal deficits as a fraction of GDP.<sup>10</sup>

We use the proportion of public expenditure on secondary education in GNP as the variable representing the public involvement in the financing of secondary education; the variable is constructed by averaging the data for the years 1970, 1980 and 1992, for which data is available.<sup>11</sup>

Summary statistics of all the variables used are provided for the entire sample, in table 1a and regional averages in 1b.

The panel data analysis uses a similar data set, dividing the period of analysis into three sub-periods (1972 – 78, 1979 – 85, 1986 – 92). Due to the unavailability of income data for many countries, we use GDP growth volatility as a proxy for income volatility for the panel analysis. We define GDP growth volatility as the

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<sup>9</sup>The source for these data is the World Bank's *Social Indicators of Development* (1994). Other measures of income inequality in the early 1970s severely limit the size of the sample and do not change significantly the results.

<sup>10</sup>The original source for the data on employment is the ILO statistical yearbook. The original source of the data for the nominal income, CPI, and fiscal deficits is the World Bank's *World Tables*.

<sup>11</sup>These data are from UNESCO statistics.

standard deviation of the annual growth rate of GDP in each sub-period.<sup>12</sup> We do not use employment volatility because the data are not available for most countries in the three sub-periods.

## **2.2. Estimation and results**

The main results of our empirical analysis are reported in Table 2. First, we discuss this set of regressions; afterwards, we present other regressions to check the robustness of our results to: the level of income, country-specific effects, public expenditure, and different measures of volatility.

The initial conditions expressed by the educational attainment variable and the initial per capita income are highly significant in explaining secondary educational enrollment, and together account for more than 70 percent of its variance across countries. The financial depth variable, representing the extent of access to credit, has a significant positive effect, at the 10 percent level, on school enrollment. This result is robust to various specifications of the equation and for most specifications, it is significant also at the 5 percent level.

Income inequality – representing the lack of resources to self-finance education as well as indicating the limitation on access to the credit market – has a significant

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<sup>12</sup>This data are from the World Bank's *World Tables*.

negative effect when the volatility variables are not included.

The two variables representing volatility in the economy – employment volatility and income volatility – have negative effects on secondary school enrollment (equations 4 and 5 in Table 2). The former is statistically significant, the latter is not.

The causality between level of education and volatility of an economy could go either way, because a less educated work force may be associated with more volatile activities, e.g., agriculture. We can reasonably rule out this possibility because in such a case, the direction of causality would be from the *stock* of education of the labor force to volatility rather than from the *flow* of education of the labor force to volatility. Therefore, we use school enrollment, which is a flow variable, as a dependent variable; while we use school attainment, which is the stock of education, as a control variable.

The level of education could affect the development of financial markets, through its effect on economic growth; in order to correct for this possible endogeneity, we ran the regressions reported in Table 2, substituting the financial depth at the beginning of the period (1970) for the financial depth variable. The results are qualitatively very similar to those reported in Table 2.

Financial depth and volatility variables could have a different effect, depending on the level of income in an economy. In order to check this, we split our sample into high and low-income countries (we divide the sample into countries with more or less than US\$ 3000 per capita income in 1970, which leaves about the same number of countries in each category). The regressions for each subgroup of countries (Table 3) confirm that the financial depth variable remains positive and significant at least at the 10 percent level in all the regressions for both the high-income and low-income countries. Employment volatility has a significant negative effect on school enrollment in the low-income countries, while it has a positive and non-significant effect in the high-income countries. Income volatility has a non-significant effect in both low and high-income countries. Income inequality has a significant and negative effect only in the rich countries. These results suggest that in poor countries, where unemployment insurance is virtually non-existent, employment becomes the main indicator for the ability to undertake investment in education, while in rich countries, where credit markets are more developed, individuals can borrow, or draw on their savings to finance education in “bad times” and thus school enrollment is not affected by the volatilities of income or employment.

Our result could be driven by country-specific effects that are correlated with

the volatility variables. In order to check whether our results are robust to country-specific characteristics, we constructed panel data comprising 122 countries with three observations for each country (subperiods 1972-78, 1979-85, and 1986-92). The results of the fixed-effects regression, which are presented in Table 4, confirm that the financial depth variable has a significant positive effect on school enrollment, while GDP volatility has a significant and negative effect.

An alternative method to deal with country specific effects is using first differences. Using this method, we obtain results that are qualitatively similar, but with lower levels of significance. This is not surprising because the bias of the first difference estimators downwards (toward zero) is greater than the bias of the within estimators, in the presence of errors in measurements (Griliches and Hausman, 1986).

As we discussed in the introduction, the state could have a significant effect on school enrollment in mitigating the effects of volatility. We use data on the share of public expenditure on secondary education to GNP as a proxy for the government effort in secondary education. As can be seen from Table 5, equations 1 and 2, public expenditure on education has a positive but not significant effect on overall enrollment in secondary education. The other variables have similar coefficients as previously reported except that the coefficient of income volatility

is not significant. Public expenditure in education depends on income per capita but is not correlated with income or employment volatility (see Figure 2); this confirms that volatility has an ambiguous effect on the supply and demand for public expenditure on education. However, public expenditure in education may not be an exogenous variable, so we re-run the same regressions instrumenting public expenditure on secondary education with the other variables including fiscal volatility; the results are reported in Table 5, equations 3 and 4.<sup>13</sup> The magnitude of the coefficient on public investment is unstable and is always positive with the exception of equation 4.<sup>14</sup> The other coefficients are qualitatively similar to those in table 2.

To illustrate the order of magnitude of the effects of the variables used in our regression analysis on school enrollment, we compared the regional averages of secondary school enrollments between Latin America and the Industrial countries. Latin America has been known to be subject to particularly large external and internal shocks, which cause considerable fluctuation in income; on the other hand, it is also known for an educational system which is not very efficient even though it

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<sup>13</sup>For the exact definition of these two instruments and the data source, see the regression table.

<sup>14</sup>The significance of the coefficient of public expenditure on education is sensitive to the inclusion of the GDP per capita variable, with which it is highly correlated. When the latter is excluded, the former turns significant.

absorbs a great deal of resources. Thus, we compare the regional averages of secondary school enrollments between the Latin American and industrial countries. The difference in the enrollment rates between the two regions –48 percentage points – is broken down according to the contribution of each of the factors explaining enrollment (the results are summarized in Table 6). After controlling for the initial conditions in 1960 (per capita income and that of the educational level of the population), the three variables we focus on in our analysis – credit market imperfection, income inequality, and volatility – together account for 45 percent of the difference in enrollment rates, or 21.4 percentage points.

### **2.3. Concluding remarks**

The main results of our empirical analysis are that where the credit market is more developed, school enrollment is higher, where wealth (or income) is distributed more equally, school enrollment is higher and where macroeconomic volatility is stronger school enrollment is lower. Our results are robust to alternative specifications of volatility, and they hold when we control for the role of the government. The effect of development of the credit markets, income distribution and macroeconomic volatility is substantial: for example, these three factors together account for some 45 percent of the difference in the school enrollment rate



between Latin America and the industrial countries.

The channels through which an unequal income distribution and the lack of credits markets lead to lower school enrollment is quite clear. Further research should concentrate on the reasons why income volatility leads to lower school enrollment. One possible explanation is that there is a critical time to get educated so education opportunities lost during bad times are not fully made up during good times. An alternative explanation is that lower volatility raises average wealth, which raises investment in education.

Future research on the links between macroeconomic volatility and growth should explicitly consider the effect of volatility on the formation of human capital. From a policy perspective, policy makers should consider reforms of the capital markets that facilitate the financing of investments in human capital.

## References

- [1] Aizenman, Joshua, and Nancy, Marion (1993). "Policy Uncertainty, Persistence, and Growth" *Review of International Economics*. Vol.1(2), 145-163.
- [2] Anderson, H. Kathryn, Haeduck Lee, and Samuel Morley (1995). "*The Effect of Recession on Teenage Labor Force Participation in Argentina: 1980-1992,*" in "*In Search of the Human Being, The Economy of the New Order.*" Fundacion Centro de Investigaciones Economicas de Cordoba, Cordoba - Argentina.
- [3] Barro, J. Robert (1991). "Economic Growth in a Cross Section of Countries," *Quarterly Journal of Economics*, 407-443.
- [4] Barro, J. Robert and John-Wha Lee (1993). "International Comparisons of Educational Attainment," *Journal of Monetary Economics*, 32, 363-394.
- [5] Becker, Gary (1964). *Human Capital*.
- [6] Behrman, Jere and Nancy Birdsall (1983). "The Quality of Schooling: Quantity alone is misleading." *American Economic Review*. Vol. 73. No. 5.
- [7] Birdsall, Nancy, David Ross and Richard Sabot (1995a). "Inequality and Growth Reconsidered," forthcoming: *World Economic Review*. September.
- [8] Birdsall, Nancy, David Ross, and Richard Sabot (1995b). "Inequality as a Constraint on Growth in Latin America," in *Social Tensions, Job Creation, and Economic Policy in Latin America*, edited by David Turnham, Colm Foy, and Guillermo Larran, 175-207, OECD.
- [9] De Gregorio, José (1995). "Financial Factors in Education and Economic Growth." Mimeo.
- [10] Dixit, Avinash and Pindyck, Robert (1994). "Investment under Uncertainty." Princeton University Press.
- [11] Flug, Karnit, Antonio Spilimbergo and Erik Wachtenheim (1996). "Investment in Education: Does Economic Volatility Matter?" Inter-American Development Bank Working Paper Series no. 301.
- [12] Galor, Oded and Zeira Joseph (1993). "Income Distribution and Macroeconomics," *Review of Economic Studies*, 60, 35-56.

- [13] Griliches, Zvi and Hausman, Jerry A. (1986). "Errors in Variables in Panel Data." *Journal of Econometrics*, Vol. 31, No.1, 93-118.
- [14] Groot, Wim and Oosterbeek, Hessel (1992) "Optimal Investment in Human Capital under Uncertainty," *Economics of Education Review*, Vol. 11, No. 1, pp. 41-49.
- [15] Inter-American Development Bank (1995). "Overcoming Volatility." Special chapter in the *Economic and Social Progress in Latin America*.
- [16] King, Robert G., and Ross Levine (1993). "Finance and Growth: Schumpeter Might be Right," *Quarterly Journal of Economics*.
- [17] Levhari, David and Yoram Weiss (1974). "The effects of risk on the investment in human capital," *American Economic Review*. Vol. 64. 950-963.
- [18] Loury, C. Glenn (1981). "International Transfers and the Distribution of Earnings," *Econometrica*, Vol. 49, No. 4.
- [19] Lucas Jr., Robert E. (1988). "On the Mechanics of Economic Development," *Journal of Monetary Economics* 22, 3-42. North Holland.
- [20] Pissarides, C. (1982). "From schooling to university: the demand for post-compulsory education in Britain," *Economic Journal*, Vol. 92, 654-667.
- [21] Ramey, Garey and Ramey Valerie A. (1995)." Cross-Country Evidence on the Link Between Volatility and Growth," *The American Economic Review*, Vol. 85, No. 5, pp 1138-1151.
- [22] Romer, Paul M. (1990). "Human Capital and Growth: Theory and Evidence," Carnegie-Rochester Conference Series on Public Policy 32, pp 251-286, North Holland.
- [23] Summers, Robert and Alan Heston (1994). "The Penn World Tables (Mark 5.6)" Center for International Comparisons at the University of Pennsylvania, Department of Economics.
- [24] UNESCO, World Education Report, Statistical Yearbook, UNESCO publishing.
- [25] World Bank (1990). *World Development Report on Poverty*.

[26] World Bank (various issues). *World Tables*.

[27] World Bank (1994). *Social Indicators of Development*.