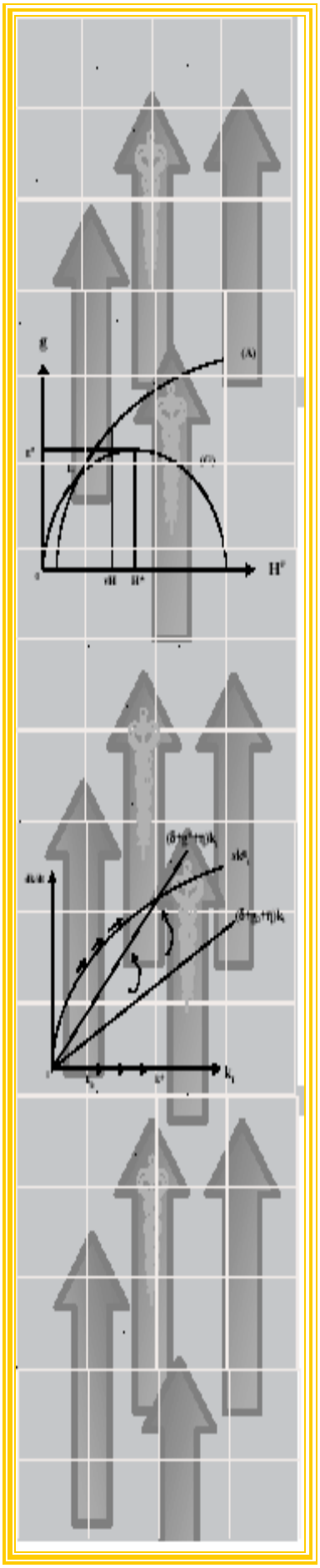


Pan American Health Organization
Regional Office of the World Health Organization
Celebrating 100 years of Health

Health, Human Capital and Economic Growth

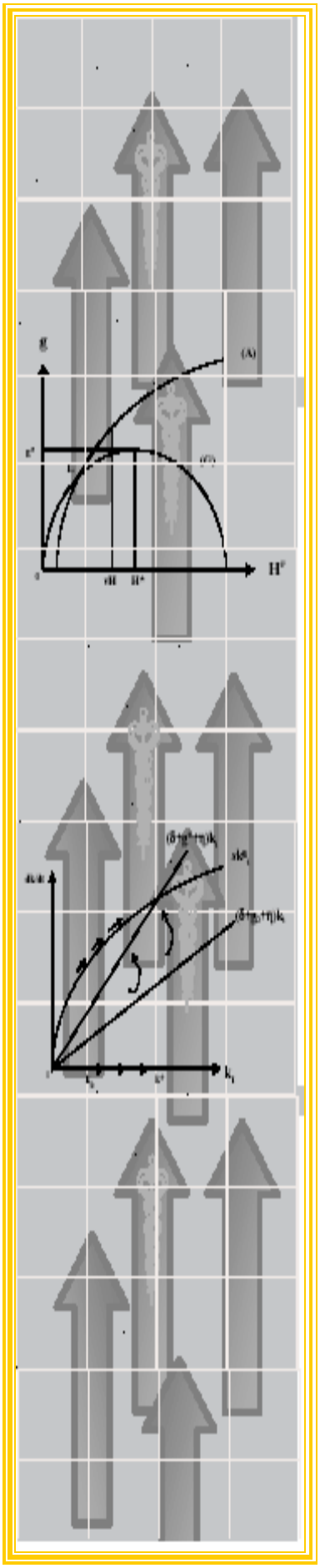
Case Studies:

Market Failures in Health and Education Investment for Mexico's Youth 2000

David Mayer-Foulkes

June 2003

Pan American Health Organization
Regional Office of the
World Health Organization



Pan American Health Organization
Regional Office of the World Health Organization
Celebrating 100 years of Health

Health, Human Capital and Economic Growth

Case Studies:

Market Failures in Health and Education Investment for Mexico's Youth 2000

David Mayer-Foulkes

June 2003

Pan American Health Organization
Regional Office of the
World Health Organization

Market Failures in Health and Education Investment for Mexico's Youth 2000

David Mayer-Foulkes*

* Centro de Investigación y Docencia Económicas, Carretera México-Toluca 3655, Lomas de Santa Fé, 01210, México D.F., México. Telephone: (52) 5727-9800, Fax: (52) 5727-9878, e-mail: david.mayer@cide.edu.

Abstract

Mincerian econometric estimates including health (as indicated by stature), schooling and experience based on ENSA 2000 data show that human capital has increasing returns for adult income in Mexico. Probit estimates show that nutrition and health, as well as to parental education, have substantial and possibly increasing returns in the acquisition of education as measured by school permanence. These are constituent elements for the presence of a poverty trap or prolonged transition in intergenerational human capital accumulation in Mexico, affecting 90% of the population, which calls for strong public support of education. A transition matrix analysis supports the presence of a barrier to education at 9 years of schooling, and a numerical policy experiment shows that a 5 cm average increase in stature (which South Korea experienced in one generation) would overcome this barrier and lead to higher levels of education. Thus nutrition, health and early child development must be integral elements of a program in human resources that must address all levels of education.

Introduction

Human capital accumulation is one of the main motors of economic growth, contributing both to production and to technological change. (Arrow, 1962; Uzawa, 1965; Frankel, 1962; Romer 1986; Lucas, 1988; Romer, 1990; Aghion and Howitt, 1992, Howitt and Aghion, 1998). This is especially true in economies relatively open to trade and investment. The importance of education for population-wide incomes has been verified microeconomically (Mincer, 1962, 1974) and macroeconomically (Mankiw, Romer and Weil, 1992). More recently, health has joined education in a unified conception of human capital. Nobel Prize winning historical studies by Fogel (1991, 1992, 1994[a], 1994[b]) find that a third or even one half of the economic growth in England over the last 200 years is due to improvements in nutrition and health. Arora (2001) finds comparable results for seven advanced countries using 100-125 year health time series. The role of health in raising income and education has been ascertained in a series of microeconomic (e.g. Schultz, 1992, 1997, 1999; Thomas, Schoeni and Strauss, 1997; Strauss and Thomas, 1998; Savedoff and Schultz, 2000;) and macroeconomic studies (e.g. Barro 1991; Barro and Lee 1994; Barro and Sala-i-Martin 1995; Barro 1996; Knowles and Owen 1995, 1997; Bhargava, Jamison, Lau, and Murray 2000; Easterly and Levine 1997; Gallup and Sachs 2000; Mayer, 2001a; Mayer, 2001b; Sachs and Warner 1995; Sachs and Warner 1997).

To understand economic growth, however, it is necessary not only to understand the positive forces that underlie it, such as human capital accumulation, but also the negative forces that hold it back, and that are responsible for the historical and present day divergence of global incomes levels and possible convergence clubs. (Pritchett, 1997; Quah, 1993; Maddison, 2001; Mayer-Foulkes, 2002). These negative forces or barriers, due to market failures or non convexities in production, accumulation or technological change, may be strong enough to induce the existence of deficient equilibria causing poverty traps or slow transitions, that prevent individual and country incomes from converging to higher equilibria. To overcome these barriers, it is necessary to apply public policy. The hallmark of advanced countries' institutions is their ability to promote the functioning of the markets *and* to overcome economy-wide market failures.[1]

Specifically, in the case of human capital, public education and research systems have been crucial to capitalist development throughout its history. Howitt and Mayer-Foulkes (2002) explain the great divergence in incomes that occurred

[1] For a few examples in an endless list consider: Roosevelt's policies to end the Great Depression; the Marshall plan; the welfare state and Keynesian policies in their time (addressing amongst others imperfections in the labor, health and investment markets); US government loan warrantees; legal systems enforcing contracts and limiting corruption and present day regulation of the financial market place.

from the late 19th Century in terms of the presence of such institutions supporting R&D. Maloney (2002) discusses how Latin America's paltry educational systems were one reason why it fell behind in the 19th Century, and conversely, how past and present economic growth successes in Australia, Canada and Scandinavia are related to public support of the education and innovation sectors.

Several kinds of mechanisms through which human capital accumulation is slowed down, and which require public action, have been modeled theoretically in relation to human capital. Galor and Zeira (1993) show that increasing returns in the acquisition of skills may lead to multiple equilibria in the presence of credit constraints to human capital accumulation. Azariadis and Drazen (1990) show that increasing social returns to scale in the accumulation of human capital may also lead to multiple equilibria. Durlauf (1996) and Benabou (1996) show that neighborhood choice in the U.S. according to the availability of quality education may lead to persistent income inequality. Similar phenomena could be involved in private and public schooling in Mexico. Galor and Tsiddon (1997) show that in the presence of credit constrains the distribution of human capital is an important determinant of the pattern of economic development. Howitt and Mayer-Foulkes (2002) show that low technology traps with low capital accumulation (and a non-zero steady state growth rate) may result from knowledge thresholds required for R&D. In more recent work Galor and Mayer-Foulkes (2002) show that threshold effects of nutrition and health on the acquisition of education may lead to persistent educational inequality. Other mechanisms that could lead to poverty traps in human capital accumulation include unequal inheritance of social capital, knowledge, and early child nurture and stimulation. These may be deficient in families with low levels of income and education and unavailable through the school system (Van Der Gaag, 2002) (World Bank document on Early Child Development).

Somewhat weaker than the concept of a poverty trap is the closely related concept of a slow or prolonged transition, in which dynamics may remain for a long-time near what is almost a steady state, as in Kremer, Onatski, and Stock (2001)[2], with faster growth then occurring along the transition to a higher steady state. Such concepts explaining retarded growth are very well established in the literature on poverty and development and are usually based on the existence of market failures. Nonetheless, the empirical counterparts to these concepts are almost absent in the econometric literature. Estimates exist on the determinants and mechanisms of poverty and the discussion includes many references to poverty traps, slow transitions and market failures, but very few, if any, specific empirical demonstrations that these exist. Part of the difficulty lies in the intergenerational nature of human capital accumulation market failures and poverty traps, in which the

[2] These authors propose that countries remain in a poor steady state while they search for the appropriate institutions (poverty rights, a market economy and so on) to foster growth. Once the search is successful convergence to a higher equilibria becomes possible. Here we argue that it is necessary to select not only institutions enabling the positive forces of economic growth to function, but also institutions that can successfully address market failures.

education and health of the young is determined by the wealth, health and education of their parents. These interrelationships which are very difficult to disentangle. The long-term nature of this process means that the appropriate data is not usually available and that the theoretical concept, especially of a poverty trap, is limited to playing the role of a parable. Microeconomic data do not usually include, for example, parental educational level and place of birth for present-day workers.[3] Under these conditions strategies for constructing empirical evidence for possible poverty traps or slow transitions are very much dependent on the available data. Here I decompose the concept of a poverty trap in the acquisition of health and education into its constituent elements, finding empirical support for their existence and, in view of the lack of more specific data on human capital investment problems, appeal to theory to argue that a class of market failures must be present to explain the empirical findings.

Our study additionally focuses on the rate of health in the intergenerational transmission of poverty. Work such as Fogel's (op. cit.) has focused attention on the secular rise in nutrition, health and longevity, its relation to economic growth, and its interconnections with such indicators as stature and weight. It has been found that stature is determined in the early stages of life, and is a predictor of life-long health and longevity. A wave of research has focused on the biological mechanisms through which these interconnections occur. These concerns have led to a focus on early child development (ECD), the combination of physical, mental and social development in the early years of life. Numerous links are now known between malnutrition (even in utero) early infection, and the crucial period of brain development in utero and shortly after birth (Barker 1998; Ravelli, 1999) and such adult ailments as blood pressure, respiratory function, schizophrenia, diabetes and reduced stature as an adult, chronic bronchitis, acute appendicitis, asthma, Parkinson's disease, multiple sclerosis, chronic pulmonary disease, cardiovascular disease, coronary heart disease, and stroke (Van der Gaag, 2002).

Programs in ECD stress the complementary roles that nutrition, health and education have in the formation of human capital. They commonly address nutrition, health, cognitive development, and social interaction of children in the early years (Myers 1992; Young 1997). Children participating in ECD programs receive psychosocial stimulation, nutritional supplementation, and health care, and their parents receive training in effective childcare. The importance of ECD for school performance and for the crucial rapid development of the brain is supported by the following extensive scientific evidence in neurophysics, pediatrics, medicine, child development, education, sociology and economics (Cynader and Frost 1999; McCain and Mustard 1999; Myers 1992; Young 1997). Children who have participated in these programs show higher intelligence quotients and improvements in practical reasoning, eye and hand coordination, hearing and speech, and reading readiness (Myers 1992). Grade repetition and dropout rates are lower, performance at school is

[3] The benefits of including these data, as well as stature, in demographic, health and economic surveys for understanding the intergenerational transmission of poverty would be enormous.

higher, and the probability that a child will progress to higher levels of education increases (Barnett 1995; Barnett 1998; Grantham-McGregor et al 1997; Karoly et al 1998; Schweinhart et al 1993). ECD also benefits life long health. It is associated with decreased morbidity and mortality among children, fewer cases of malnutrition and stunting, improved personal hygiene and health care, and fewer instances of child abuse. ECD also leads to better socially adapted adults who are less aggressive, more cooperative (Kagitçibasi 1996; Karoly et al 1998), and show reduced criminal behavior and less delinquency, (Schweinhart et al 1993; Yoshikawa 1995; Zigler, Taussig, and Black 1992).[4]

The effects of health and nutrition on education in developing countries have been studied in some detail in an attempt to detect specific links which may be addressed cost-effectively (World Bank, 1993). As part of the effort to improve and extend basic education services and to universalize primary schooling conducted by the UNDP, UNESCO, UNICEF and the World Bank, survey studies have been undertaken on the consequences on education that low nutrition can have (Levinger, 1992).[5] The following obstacles that nutrition and health pose to the *achievement of child quality* (a reconceptualization of the objectives of education that echoes the essence of the concept of human capital formation) are documented. Temporary hunger is related to inattentiveness. Protein-energy malnutrition (especially in early childhood), often worsened by a child's parasite load, is significantly related to poorer cognitive and school performance indicators, and to worsened general conceptual ability, problem solving, mental agility and capacity. Micronutrient deficiency disorders also impair school performance. Iodine deficiencies are associated with reduced intelligence, psico-motor retardation, mental and neurologic damage, and cretinism. Iron deficiency anemia, which affects 1.3 billion people, of whom 210 million are school age children, has been associated with lower mental and motor development test scores. Vitamin A deficiencies are associated with eyesight problems and other conditions. Helminthic infection generates very high levels of morbidity associated with impaired cognitive function, absenteeism, under enrollement, and attrition. Untreated sensory impairment, such as vision or auditory problems constitute significant educational risk factors. 42.8% of the children under 5 in 21 Latin American countries[6] show moderate and severe stunting, a clear sign of malnutrition that is likely to be associated with poorer educational performance.

To construct a micro economic database including indicators on early childhood nutrition, schooling, and parental educational and income levels in Mexico, we use the 2000 National Health Survey (ENSA 2000). The indicators that this survey includes are: stature and educational levels for adolescents (12 to 19 year olds) and adults as well as adult income levels, type of work, public health insurance

[4] I closely follow Van der Gaag (2002) in this exposition.
[5] See web page http://www.edc.org/INT/NHEA/index.html.for the study and its references.
[6] Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela.

and preferences for health institutions and household wealth. From the point of view of our econometric objectives, the main deficiency of the database is that the data for a full intergenerational cycle is incomplete. At 19 years of age the educational cycle has not been fully completed for youths pursuing higher education, while for young adults in their 20's and 30's earning an income, their parents' characteristics are mostly unavailable. In addition, since the National Health Survey does not specialize in income, the income data is probably less reliable than can be found in income and expenditure surveys. Finally, the sample of higher-income population with educational levels above 15 years of schooling is small and underrepresented.

To test for the possible presence of a poverty trap or slow transition in the accumulation of human capital in Mexico, we test for and find empirical evidence for the following *constituent elements* of a poverty trap or slow transition.

- Increasing returns to education in adult income (the essential assumption in Galor and Zeira, 1993)
- Substantial and possibly increasing returns to children's health in the acquisition of education, as measured by school permanence (the essential assumption in Galor and Mayer-Foulkes (2002)
- Increasing returns to parental education in the acquisition of education, as measured by school permanence (a poverty trap model could be built on this assumption alone)
- Transmission from parental wealth, health and education to the health and education of their young (an essential assumption in any intergenerational model of human capital accumulation)
- The increasing returns just mentioned above hold at high education levels above those achieved by most of the population

Conceptually, these constituent elements imply there is a functional relationship between parental wealth (including human capital assets) and their children's future income which has a region of increasing returns, as in Figure I. The only remaining distinction between a poverty trap and a slow transition is whether multiple equilibria actually exist or not. We test for this final element by modeling the transition matrix of the distribution of education. Unfortunately the ENSA 2000 sample is very small for higher levels of education so the results can only be considered as tentative. They indicate, however that there may be a barrier to achieving higher education in Mexico. Extrapolation of the current transition dynamics increases the number of junior high school graduates but not the number completing high school or higher education, especially in the case of men. On the other hand this barrier is broken if policies are applied which raise the probability of acquiring a higher education after finishing junior high school. We give evidence that this probability is raised by increasing early childhood human capital assets as indicated by stature. A policy experiment along these lines raising average stature by 5 cm yields a substantial increase in the proportion of children achieving higher

education, to levels between 30% and 40%. This increase in stature was achieved by South Korea in the period 1962-1997 (Weil, 2001).

The empirical evidence thus supports the existence of a poverty trap or at best a very slow transition. The bulk of the population is unable to invest in human capital levels sufficient to benefit from the increasing returns. It is argued theoretically below that the main possible explanations are market failures including the following.

- Imperfect parenting: parents unavailable, malnourished, unhealthy or unknowledgeable.
- Credit constraints, or the impossibility to acquire: nutrition, health, education and complementary inputs to education such as capital, social capital, or early child development;
- Uncertainty or lack of information on the benefits of early child development: nutrition, health and education.
- Excessive impatience due to poverty.
- Unavailability of necessary public goods in health or education.

It is not so surprising that there are market failures in human capital accumulation. Children, who are born without any wealth, must somehow obtain their right measure of investment, and this process can easily be beset with problems. In the historical context when production depended mostly on labor and capital everybody's endowment with one unit of labor was taken for granted.[7] Now that human capital investment is a much more important factor of production, these failures may be even more crucial for development and growth.

With regard to human capital accumulation the main implications of the empirical work are the following:

- Social welfare can be improved by promoting the education of the 90% of the Mexican population that underinvests in human capital.
- Improved early child development, as indicated by stature, is closely associated with school permanence and is an integral part of promoting human capital accumulation.
- Education of the young beyond the level achieved by their parents, at which point there appears to be a barrier to continuing education, must be promoted.

The recognition of market failures in human capital accumulation involving most of the population has important consequences for policy. The main one is that it is a fundamental area for public action in Mexico.

[7] Even in this context there were systematic failures in the endowment of nutrition and health, as can be deduced from Fogel's work (op. cit.).

The support of nutrition and health of the young and poor has been promoted in Mexico by Oportunidades, previously Progresa. This could be expanded to include a fuller program of early child development.

The question of how to efficiently promote education on a large scale is complex, fraught as it is with the problems of educational quality and corruption. Ability, effort and preferences (not included in the present analysis) are aspects which must be taken into account in any program promoting education to a high level of quality.

The recognition of market failures in human capital accumulation has other important consequences for policy. For example, optimal taxation, which usually arrives at the conclusion that capital (as opposed to labor) must not be taxed. This changes when human capital accumulation is considered (Lucas (1990), Pecorino (1994), Stokey y Rebelo (1995), Kim (1998), Hendricks (1999) y Grüner y Heer (2000)). Under these conditions it may be optimal not to tax salaries (Gomez, 2003). However, optimal conditions on educational subsidies will be quite different if credit constraints hold.

It also surely has consequences for optimal macroeconomic policies in the presence of income shocks, since the expenditure of credit constrained families investing as much as possible on their children is much more susceptible to income fluctuations.

It is possible that much of the controversy that exists in Mexico and elsewhere concerning market policies proposed by the leading international economic institutions would be at least partly resolved if their models truly acknowledged the existence of economy-wide market failures.

The rest of this article is organized as follows. First the data is reviewed. Next the estimates are described and presented. On the basis of the results a theoretical argument is made for the presence of market failures. Finally the conclusions stated.

The Data

The 2000 National Health Survey (ENSA 2000) includes the following variables for household members 12 years and older: height; gender; age; income and type of work; health insurance; health institution preference; educational level; first language; as well as household composition; type of construction (walls, roof, floor, finishings, kitchen, number of rooms, water source, bathroom, drainage); electricity; telephone. Other variables related to health are also available but were not used. One of these was weight, because it is much more variable than stature and reflects shorter rather than longer term health. Most other health variables in the survey reflected recent medical treatment and therefore did not cover every individual and were not used.

The importance of stature as an indicator of population-wide welfare has been extensively studied (see for example Steckel, 1995). Height is known to reflect

early childhood nutrition and to predict life long health. Larrea, Freire and Lutter, 2001), for example, show that stunting due to malnutrition becomes established in the first 2 to 3 years of life. Stunting has been shown to be cumulative and non-reversible and therefore provides an excellent measure of chronic malnutrition and its effects. A whole literature exists showing that malnutrition leads to lower longevity, chronic diseases and lower cognitive status (see for example Schürch and Scrimshaw, 1987). That height is related to education in our sample can be seen in Figures II.1 and II.2.

Two databases were constructed using the ENSA 2000 data, one for adults (aged 20 and above) and one for adolescents (12 to 19 year olds) containing 42,970 and 19,493 observations respectively including both health and education. It is worth mentioning that, by comparison with the 2000 National Income and Expenditure Survey (ENIGH 2000), the ENSA 2000 survey underrepresents an already small sample of male household heads with higher education. The ENSA sample contains only 48% of male household heads with 17 years (1,102 observations) and 77% with 19 years of schooling (74 observations) compared to what would be predicted by the ENIGH sample.

Econometric Analysis

The econometric analysis consists of three parts. The first is a Mincerian estimate of adult income in terms of human capital and other variables. The second is a probit estimate of schooling achievements of adolescents aged 17 to 19, evaluated as the probability to complete additional three-year school periods. This probability is estimated in terms of stature, which reflects early child development (nutrition, health and their correlates), and household wealth variables including parental income and education. These two sets of regressions provide strong evidence for the constituent elements for a poverty trap or slow transition. The third part is an intergenerational transitional analysis attempting to distinguish between a poverty trap and a slow transition.

Adult income estimates

The returns to education and health in adult income were evaluated using Mincerian (1962, 1974) regressions. These are carried out for each gender separately. It is customary to instrument health, because this variable may be jointly determined with education (Schultz, 1997; see Savedoff and Schultz, 2000 for details). In this case, however, since the variable representing health is stature, its instrumentation was found to be either unnecessary or infeasible. The reason is that adults stature conveys information about conditions far in the past. The available data on health inputs, specifically social health insurance and health institution preferences, refers to conditions in the present and in any case did not have much explanatory power.

To account for local conditions that could be correlated to both income and health, however, local fixed effects referred to municipal residence were included. It is also customary to correct the estimates for selection bias due to labor participation, using the Heckman correction method for example (again see Savedoff and Schultz, 2000 for details). Two specifications were used for the selection correction, which was nevertheless not very reliable for men or for women. The qualitative nature of the results was robust to all of the specifications.

Because the analysis of income aims at making comparisons across social levels in Mexico and testing for the possible existence of poverty traps or slow transitions, the variables and regressions were defined specifically to obtain society-wide *marginal returns* for human capital assets.

The estimation design begins by supposing that labor income y_i obeys

$$\ln(y_i) = f(\mathbf{X}_i) + u_i, \qquad (1)$$

where $\mathbf{X}_i = (E_i, V_i, Exp_i, Exp_i^2)$ is a vector of human capital assets. E_i is a discrete level of schooling variable defined by

$$E_i = b \text{ if } b \le S_i \le b+2, b = 0, 3, 6, 9, 12 \text{, and}$$
$$E_i = 15 \text{ if } S_i \ge 15,$$

where S_i is the years of schooling of adult i. This discrete level of schooling represents discrete educational levels of 3, 6, 9, 12 and 15 years. The idea is that what matters is *completing* primary, secondary, and tertiary education, to which were added the 3 and 15 year marks. It was decided to use three-year periods because the full years of schooling variable restricted to three-year periods (for example 6, 7 and 8 years of schooling for adults having completed primary but not secondary school) would yield the marginal returns of partially completed courses of study, whose value in the workplace is not equal to completed courses. V_i is the stature ('V' for vitality) of adult i, Exp_i her experience (age minus schooling minus 6). The square Exp_i^2 is included because experience is expected to have decreasing returns, and will be nonlinear.

Define the dummy variables

$$\delta_{bi} = 1 \text{ if } E_i = b, \text{ else } \delta_{bi} = 0,$$

corresponding to the discrete levels of schooling E_i. The sample of adults is subdivided according to this discrete educational level, because this turns out to be a more straightforward criterion for ranking the population than income or stature intervals and because education is the main human capital asset along which increasing returns in income are found. To be able to obtain marginal returns to human capital assets the following variables are defined.

$$E_{bi} = 1 \text{ if } E_b \ge b, \text{ else } E_{bi} = 0.$$

E_{bi} is a dummy for adults with schooling *equal to or above* 3, 6, 9, 12 and 15 years. The coefficient of this variable will be the *marginal* returns of completing primary, secondary, and tertiary education and the other three-year periods, together with their average complementary inputs.

Define the average human capital assets vectors

$$\mathbf{X}^b = \mu(\mathbf{X}_i | \delta_{bi} = 1),$$

where μ is the sample mean, restricted in this expression to adults with educational level b (recall that the whole estimation is repeated for each gender). Expression (1) for income can now be rewritten

$$\ln(y_i) = f(\mathbf{X}^0) + \sum_{b=3,...,15} E_{bi}\left[f(\mathbf{X}^b) - f(\mathbf{X}^{b-3})\right] + \\ + \left[f(\mathbf{X}_i) - \sum_{b=0,3,...,15} \delta_{bi} f(\mathbf{X}^b)\right] + u_i, \qquad (2)$$

To see this notice that for an adult with educational level $E_i = b$, the summation term yields $f(\mathbf{X}^b) - f(\mathbf{X}^0)$. Also, the square bracket is the difference $f(\mathbf{X}_i) - f(\mathbf{X}^b)$ between the returns of an adult's human capital assets and the returns of the average human capital assets for adults with the same discrete educational level E_i. The terms in the summation in equation (2) represent successive marginal contribution of the increases in average human assets held across educational levels, and the last term represents the individual-specific returns as compared to the average in her educational level.

Let V_i represent the stature of adult i. Define education-specific difference to the mean stature variables

$$V_{bi} = \delta_{bi} V_i - \overline{V}_b .$$

V_{bi} is the stature variable for each discrete educational level E_i with the mean $\overline{V}_b = \mu(V_i | \delta_{bi} = 1)$ over this subsample removed. The education-specific experience and experience squared variables Exp_{bi}, Exp_{bi}^2 and their subsample specific means are similarly defined.

For each educational level $E_i = b$, the terms in expression (2) are now modeled as follows. First,

$$f(\mathbf{X}^b) - f(\mathbf{X}^{b-3}) = e_b, \qquad (3)$$

The education-specific constant in the estimation, is the marginal yield of average human capital assets from one educational level to the next. Next,

$$f(\mathbf{X}_i) - f(\mathbf{X}^b) = v_b V_{bi} + \alpha_b Exp_{bi} + \beta_b Exp_{bi}^2 \qquad (4)$$

models differences in returns to human capital assets for adults with the same discrete educational level. Finally, the error term

$$u_i = \boldsymbol{\gamma}\mathbf{W}_i + \eta_{\mathrm{mun}(i)} + \varsigma_i$$

is modeled as a function of a vector of variables $\mathbf{W}_i$, municipal fixed effects $\eta_{\mathrm{mun}(i)}$ defined by residential location, and a residual error term S_i for which a robust estimation method is used. The vector $\mathbf{W}_i$ includes an indigenous language dummy, type of occupation, and wealth variables including types of walls, roof, floors, finishings, water source, bathroom and drainage, as well as kitchen, number of rooms, electricity and telephone. Since many of these variables can be thought of as being identified with specific wealth levels, these were not interacted with educational levels E_i.

Thus the full model which was estimated for each gender is the following:

$$\ln(y_i) = c + \sum_{b=3,\ldots,15} e_b E_{bi} + \boldsymbol{\gamma}\mathbf{W}_i + \sum_{b=0,3,\ldots,15} \left[v_b V_{bi} + \alpha_b Exp_{bi} + \beta_b Exp_{bi}^2 \right] + \eta_{\mathrm{mun}(i)} + \varsigma_i , \qquad (5)$$

The meanings of the coefficients can be read in equations (3) and (4). e_b is the average return of the additional human capital assets held by female (or male) adults of educational level b as compared to adults with educational level b–3, that is, the marginal return obtained from increasing the educational level from b–3 to b.

V_b is the marginal return of health, as represented by stature, for male (or female) adults with educational level $E_i = b$. $\alpha_b + \beta_b Exp_{bi}$ is the marginal return to experience in the same group of people.

The results of the income regressions can be seen in Table I. The main finding is that the returns of additional three-year periods of education and its associated complementary inputs are increasing for both men and women after 9 years of education. Two standard deviation corridors for the coefficients are shown in Figures III.1, III.2.[8] The returns to health are significant and similar to those of other microeconomic studies (Savedoff and Schultz, 2000), yielding about a 2% increase for stature increases between 10 and 20 cm. They show no clear tendency according to educational level (Figures III.3, III.4). The findings mentioned here are common to the OLS regressions and to both applications of the Heckman selection correction model.

The main additional variables used in the selection equation were number of dependent children and number of dependent adolescents, and to these were added the indigenous language dummy and all the variables representing wealth. The first

[8] The t-statistic testing the schooling coefficient relations $C_{15 \text{ or more}} \geq C_{12 \text{ or more}} \geq C_{9 \text{ or more}}$ for the OLS income regressions in Table X are 3.95, 3.025 for women and 8.14, 1.93 for men.

application also includes the human capital variables, while the second does not. The results are in the last four columns of Table I, with the selection equations in Tables II and III. In both cases the selection correction was insignificant for men, as is to be expected since most men work, and therefore the OLS estimates are more efficient and therefore to be preferred. For women, on the other hand, the selection correction was significant in both cases, with different implications with respect to the role of human capital. When human capital is included in the selection model 'Heckman I', it appears significantly and therefore the estimation of the productivity of female human capital is corrected downward. In the second application, 'Heckman II', these variables are on not included in the selection model and are corrected upwards. If it is believed that more educated women participate more in the labor market because they are more productive, this should not be considered to bias the productivity estimates. Then the Heckman II model, whose estimates of female productivity more closely correspond to the estimates of male productivity, is more reliable. If instead it is considered that the educational indicators are signals for ability, and that therefore the productivity estimates are biased upwards, then additional indicators of ability would be needed for the correction, but these are unavailable. The OLS estimates lie in between both Heckman estimates and therefore also seem the most reliable in the case of women. In a study on Mexico by Zamudio and Bracho (1994), the Heckman correction is found to increase the returns for women and urban zones.

The experience variables, when significant, exhibit the expected signs. These variables are not significant for lower levels of education, when health would be expected to be more important and may be inversely related to age. If this is the case, the expected sign for experience would be negative. This can explain the insignificant results for low levels of education, and would also bias the coefficient for stature downwards.

The finding of increasing returns to education is confirmed in several other studies on Mexico. The results of a recent study (Mayer-Foulkes and Stabridis-Arana, 2003) carried out using ENIGH data for the years 1984, 1989, 1992, 1994, 1996, 1998, 2000 and also estimating *marginal* returns to education are shown in Figure IV. These have a very clear increasing structure. Zamudio (1999) and Rojas, Angulo and Velázquez (2000) also finds increasing returns to human capital, Tables IV.1 and IV.2.

Adolescent schooling decision estimates

Preliminary examination of the distribution of schooling by ages for the ENSA 2000 sample of children and adolescents shows that the young drop out of school mostly at the end of primary, secondary or tertiary school. Thus the critical decisions for achieving schooling consist of, at least ex-post, deciding to complete a further three-year period of schooling. What impact do child health and parental schooling, income and wealth have on these decisions? According to Galor and Mayer-Foulkes (2002), for example, nutrition and health status should have an impact on these

decisions, especially for higher levels of education. In the ENSA 2000 survey, stature is only available for adolescents, and not for children. Thus to evaluate the schooling decisions of the young in a homogeneous manner, the sample of 17 to 19 year old adolescents was chosen to analyze the probability with which they embarked on and completed a further three years of study. The stature variable reflects their condition when young, and we thus have a homogenous group of people born between 1980 and 1982 whose educational career can be followed. Most of the people in the sample started primary at 6 or 7, so schooling decisions up to 12 years are well represented in the sample. Probit regressions were estimated to study the determinants of acquiring a further three years of education.

For each adolescent i, the following variables J_{bi} indicate when a further three year period of study was completed:

$$J_{bi} = 1 \text{ if } s_i \geq b+3, J_{bi} = 0 \text{ if } b \leq s_i \leq b+2,$$

with J_{bi} is missing if $s_i < b$, where s_i is the adolescent schooling level, that is, the sample is $s_i \geq b$. Adult schooling was represented by

$$G_{bi} = 1 \text{ if } S_i \geq b, \text{ else } G_{bi} = 0\,,$$

where S_i represents years of schooling of the adolescent's *household head*. The coefficients of G_{bi} indicate marginal returns of parental schooling to the probability of school permanence for schooling over 3, 6, 9 and 12 years. It is slightly different to E_{bi} but more congruent with the school permanence indicator J_{bi}.

The following equation was estimated

$$P(J_{bi}=1) = F(V_i, A_i, A_i^2, \ln(y_i), G_{bi}, S_i^+, S_i^-, Child_i, \mathbf{W}_i, \eta_{\text{mun}(i)}) \qquad (6)$$

where V_i is height (cm), A_i is age, A_i^2 is age squared, y_i is total household income, G_{bi} is the dummy indicating that the household head has completed 'b' years of schooling, with b = 3, 6, 9, 12 or 15, S_i^+ is household head's years of schooling above spouse, S_i^- is spouse's years of schooling above household head, $Child_i$ is the number of children in the household, and $\mathbf{W}_i$ are some variables as in the previous section except that the indigenous language dummy refers to the adolescent and there is no type of work variable. F is the cumulative normal distribution.

Probit estimates (6) were performed for adolescents with schooling $s_i \geq b$ for b = 3, 6, 9 and 12. These estimates were carried out separately by gender, and also jointly, so as to increase the sample size, in which case a gender dummy was included. Because health investments are determined simultaneously with education, following Schultz (1997) and Savedoff and Schultz (2000) health was instrumented using the public health insurance and institutional preference variables, as well as municipal fixed effects. In this case the instrumentation was successful and the resulting coefficients for stature were larger, as expected.

The results of the probit estimates are in Tables V (separately by gender) and VI (jointly). The estimation by gender is preferable, but the joint estimation is reported because the significance of the coefficients may depend heavily on the sample size. The marginal probabilities associated with a 1 cm increase in stature can be seen in Table VII. The estimates for males yield a fairly constant mean 4%. Those for females yield a 7% probability for the secondary to tertiary transition. The joint estimates show an increasing pattern of probabilities. Table VIII shows the mean marginal probability associated with a 1 cm increase in stature by gender and household head schooling. The marginal probability is clearly higher for adolescents whose household head is less educated. Females have a lower marginal productivity for the transitions to higher primary and secondary, but a higher marginal probability from secondary to tertiary.[9] The probabilities in this table are used in the transitional analysis below, which shows that the increases in stature associated with the development processes yield substantive changes in the educational profile of the population. The insignificant coefficient in the case of permanence from 3 to 6 years of primary may be related to the purportedly obligatory nature of primary education in Mexico. The sample size is decreasing in b and was too small to obtain significant results in the cases $b = 12$ referring to continuing schooling from 12 to 15.

It is notable that the household head's educational level is significant at levels closely corresponding to the schooling decision involved. For example, in the joint regression, children whose household head has studied some primary education have a significantly higher probability of studying the second three years of primary. Similarly having a household head who has completed secondary (or tertiary) education made it significantly more probable for the children to complete secondary (or tertiary) education. It is notable in the probit estimate for girls that their probability of continuing education at any level is significantly higher when the spouse has more schooling than the head. The insignificance of the income variable could be due in part to quality problems with this variable.

Market failures

All children are born equal; at least potentially so, for malnutrition can begin in-utero with life-long consequences in health including cognitive development (Van Der Gaag, 2002). For babies to grow up into productive adults realizing their full potential, it is necessary that an investment be made in nutrition, health, early child development, and education. Let us examine how this process of investment occurs. From the point of view of economic theory, the simplest would be if babies were born with a bank account and an omniscient trust manager took their decisions as to how much to invest in food, medicine, stimulation and schooling, so as to maximize their expected utility. According to received theory, *any* important and systematic

[9] Women have more schooling at lower levels of education, because they are spared from work, but may suffer discrimination in school attendance at higher levels of education (Mayer and , 2001).

deviation from this standard is due to some kind of market failure such as imperfect credit or incomplete markets, has important consequences for social welfare, and justifies public policies to bridge the necessary funding. Of course any such attempt must be tempered by the problems of efficiency inherent in public policy implementation.

Do the regressions on adult income and school performance provide evidence that these is an important, and systematic degree under investment in health and education? The evidence is unequivocal. The regression on adult income shows that investment in education and its complementary inputs is highly rewarding. Every additional three years of education gives additional returns and thus has a larger net return than the previous three years investment, assuming that costs are proportional to forgone income.[10] Nobody would doubt that the educational assets of adults in this survey (as a population) resulted mainly from their parents' and public endowments, and only secondarily from ability. Although there may be innate differences in tastes and abilities, from a population-wide perspective these are independent of parental status. The probit estimates on school permanence strongly make this point. Definite differences in children's health, nutrition and their correlates – as measured by 1 cm of stature – imply substantive differences in the probability of continuing education at each crucial decision point beyond the obligatory primary level.

In addition, parental endowment with a higher level of education is a strong determinant of children's permanence in school to achieve similar or further levels of education. Similarly spouses' endowment beyond and above the household head favor girls education.

Summarizing, there are returns to education that go untapped by many children in the population, whose educational decisions depend on their family situation and parental assets. This implies that there are market failures in human capital investment.

Let us now analyze the mechanism through which the market failures occur. The first intergenerational models (Diamond, 1965) simply ignore the problem, because they assume there is no human capital and the young simply start working. Models including human capital conceptualize infinitely lived dynasties or intergenerational altruism. In both cases it is effectively assumed that parents care for their children's welfare, with somewhat different implications about discounting.[11] In reality, the people around the child, or the government, provide for her education. The first problem might of course be that there is nobody to carry out

[10] A more careful argument is needed if the returns do not increase. For example, at a discount rate of 5%, a group of 30 people with a given level of education would pool 10 times their present salary potential for three years to receive the services of an educational institution yielding a return of 10% for this period.

[11] Galor and Moav (2002) consider caring for the young together with preferences about child quality essential evolutionary attributes.

the investment. For example, there are 30 million street children worldwide[12] with minimal access to nutrition, health and education, and a large potential for future social problems.[13]

A second example would be incomplete or dysfunctional, families weakening the altruism and resources from which the child can tap, a phenomenon that may be correlated with poverty. Another example would be children brought up by single mothers. This occurs often in Mexico, with children often left in charge of their grandparents while their single mother works in a different town.

Let us assume, though, that somebody does carry out the investment. Following economic theory, the first step these providers follow is to evaluate the benefits of investment in nutrition, health, child development and education. Systematic problems in this evaluation could lead to under investment. This includes lack of information on the benefits of investment, which is more likely for example if the parents have experienced only a lower level of learning. Uncertainty and risk aversion as to the realization of these benefits, and higher impatience (that could occur due to pressing needs imposed by poverty) than would hold if basic needs were satisfied can also lead to underinvestment. This reasoning is expressed in terms of the child's viewpoint or that of her mentors, but additional reasons for under investment occur from the point of view of social welfare, which may be less risk averse, less impatient, and which may take higher social returns into account.

Once the human capital investment providers have evaluated the investment they must proceed to carry it. Two kinds of problems may occur. The first is that the necessary resources are not available and there is a credit constraint. This might be particularly hard to solve in the case of food and early child development more generally (Galor and Mayer-Foulkes, 2002). The next problem may be that the needed investment goods may not be purchasable. Examples are: public good inputs in health or education that the government may fail to provide; knowledge that mentors transmit to their children or need to take care of them properly, especially at young ages.

Establishing which the main market failures are is important, especially for public policy, but requires better data. Even so, the probit regressions presented here show that health and nutrition, and their correlates, are important determinants of continuing in school. The fact that parental education has an influence after controlling for income and that adult education to a certain level significantly reflects on the attainment of corresponding or further levels by their children suggest that information and knowledge about education, as well as complementary social capital, may play important roles that can be addressed by public policy. The school permanence estimates and the adult income estimates imply the existence of increasing returns to health and education inputs. These indicate the severity of the market failures, since the investments do not occur even in the presence of high

[12] Information from Fundación Junto con los Niños de Puebla A.C., http://www.upaep.mx/juconi/.

[13] It has been confirmed, for example that good quality early child nurture leads to more socially adapted adults (Van Der Gaag, 2002).

returns to them. It also implies that considerable returns may be obtained from appropriate public policy. Human capital accumulation transition is occurring slower rather than faster, with more of the intergenerational steps spent in poverty.

Intergenerational transitional analysis

The empirical and theoretical analysis establish the presence of market failures in the investment on health and education in Mexico. Increasing returns to education in income, and to nutrition and health in schooling, imply that these market failures cause a considerable slowdown in the investment on health and education and that the income of the more educated tends to rise faster than that of the less educated, a temporary divergence in incomes lasting several generations. Thus the transition to an educated society is prolonged. The next question is whether the failures are so severe as to cause a poverty trap. To answer this question an intergenerational transition analysis is carried out. The analysis follows Quah's (1993) method, which proceeds as follows.

First, we define a vector $D_g = (D_{g,0}, D_{g,3}, ..., D_{g,15})$ representing the proportion of the population in generation *g* having educational levels 1-3, 4-6, 7-9, 10-12, and 13 or more. Then we define a transition matrix $M_{b(child),b(adult)}$ representing the proportion of adolescents achieving educational levels *b(child)* whose household head had educational level *b(adult)* for individuals aged 17 to 19. Thus we obtain

$$D_1 = MD_0$$

where D_1 is the distribution of education of those aged 17 to 19 (now mostly parents), and D_0 is the distribution of education of their parents (now mostly grandparents). *M* represents a Markov transition matrix. If it is assumed that the transitional process will be maintained (which implies that educational opportunities will increase proportionally to satisfy the implied demand), the distribution of educational achievement can be written recursively as

$$D_{g+1} = MD_g .$$

A property of Markov matrices is that there is a generically unique ergodic distribution D^e satisfying

$$D^e = MD^e ,$$

which represents the distribution of education that would be achieved in the limit if current tendencies were maintained and people reaching a higher educational status had the same opportunities their counterparts have today.

The resulting estimates are shown in Figure V.1. Under the present conditions a slow transition exists that has almost been completed for women, but

that remains to be completed for males (who would reach a higher level of schooling). The corresponding ergodic distribution peaks at 9 years of schooling, with a higher proportion of men reaching this level eventually. But in both cases the proportion of children reaching higher levels of education has already reached its equilibrium level. Considering that most well-off children study 12 years or more, this is evidence for a poverty trap with a barrier at 9 years of education, for which the database cannot yield clearer evidence: it was impossible to obtain data reflecting the human capital dynamics of the top of the income distribution, which could conceivably be following a separate steady state.

Finally, a policy experiment is conducted in which the probability of remaining in school at each crucial decision point at the end of each three year period is raised according to the predictions of the joint school permanence probit model corresponding to a 5 cm average rise in the stature of the population. This corresponds roughly to the average rise in stature experienced by South Korea, achieved in one generation during the period 1962-1995 (Weil, 2001). The marginal probability of remaining in school used for this experiment is obtained by household head schooling levels (Table VIII), under the additional assumption that the three year period marginal transtion probabilities beyond tertiary education are equal to the one for transition from secondary to tertiary education. This seems a reasonable hypothesis both for females and males. The result of the policy experiment is that the 9 years education barrier is overcome and 30% to 40% of the population complete 12 years of education or more. Thus nutrition and health and their correlates (after controlling for parental income, education, other wealth indicators and municipal fixed effects) can hold the key to a substantial increase in human capital investment in Mexico (Figure V.2).

Conclusions

Our discussion of how children come to be endowed with nutrition, health, early child development and education by their surrounding mentors and society has shown that this process is subject to market failures including mainly: imperfect parenting (one or both parents missing, unhealthy or unknowledgeable); imperfect credit or the impossibility to acquire nutrition, health, education and complementary inputs to education such as capital, social capital, or early child development; uncertainty or lack of knowledge or information on the benefits of early child development, nutrition health and education; excessive impatience due to poverty or unavailability of necessary public goods in health or education.

Our Mincerian estimates on labor income show that there are increasing returns to education in Mexico at levels not achieved by most of the population and therefore that there is a substantial under investment in human capital. The probit estimates show that school permanence improves with higher child nutrition and health, for which there is evidence of substantial and possibly increasing returns, and with parental education status, which tends to encourage the young to achieve at

least similar levels. Thus the market failures are posing an important problem to social welfare and economic growth, since they give rise to substantial under investment in human capital across most of the Mexican population.

The presence of substantial increasing returns implies that a poverty trap or a slow transition exists, with the income of the less educated growing slower. A transitional analysis supports the hypothesis that there is a barrier to education beyond 9 years. A "policy experiment" shows that a 5 cm rise in stature would have a very considerable impact on the resulting ergodic distribution with a much more rapid transition to higher levels of education. The increasing marginal rates of return to education suggest that almost 90% of the population would benefit from increased levels of education. Although this may reflect a premium to higher education caused by the present low supply of human capital, it is unlikely that in today's high technology production environments the demands for human capital will be saturated very soon. On the contrary, the tendency has been for returns to primary, secondary and tertiary education to decrease, while those of higher education increase (Figure IV).

Under these conditions, it cannot be doubted that additional but efficient public support for education in Mexico bridging a series of market failures would yield enormous benefits by leading to large rises in the human capital levels of the country. What is needed, however, is a second generation of policies moving beyond the first generation that simply put up schools everywhere in the country and whose main objectives were literacy and numeracy rather than quality. Today, a broader conception of human capital demands integrated, egalitarian and socially unifying policies that include nutrition, health and early child development and support for all levels of education. To this must be added an intense concern for quality and scrupulous selection by merit and ability so as to promote the efficiency of a system whose returns will be higher the lower are its costs.

In common sense terms, since education is essential for adult income, today's young must be brought up with adequate nutrition and quality education if the cycle of poverty is to be broken.

While it is true that the low institutional quality of the Mexican Public School System has lead to inefficiencies, achieving the *institutional capacity to overcome market failures* must be held as an indispensable objective. In the first place, the advances of the previous generations were based on government action, and can probably only continue if this action responds to the rising educational demands of the young. More generally, optimal economic policies in economic growth must be two-pronged. On the one hand, the appropriate conditions for the markets to function have to be established, for otherwise, who will employ the human capital that is so badly needed? On the other, the main market failures holding back economic growth must be overcome through government policies, for otherwise, where will the human capital needed to rally the productive forces to emerge from poverty come from? Without appropriate policy, public human capital accumulation will be slow, a mass of human potential will be wasted, the coming

generation will continue to be poor and Mexico will experience low rates of development.

References

Aghion, P. and Howitt P. (1992). "A Model of Growth through Creative Destruction." *Econometrica*, (March), 60 (2), pp. 323-51.

Arora, S. (2001). "Health Human Productivity and Long-Term Economic Growth", *Journal of Economic History*; Vol. 61 No. 3 (Sept).

Arrow, Kenneth J. (1962). "The Economic Implications of Learning by Doing." *Review of Economic Studies*, 29 (June), pp. 155-73.

Azariadis and Drazen (1990). "Threshold Externalities in Economic Development." *Quarterly Journal of Economics*, May, 5 (105), 501-526.

Barker, D.J.P. (1998). *Mothers, Babies and Health in Later Life*. Edinburgh: Churchill Livingstone.

Barnett, W.S. (1995). "Long-Term Effects of Early Childhood Programs on Cognitive and School Outcomes," *The Future of Children* 5(3): 25–50.

Barnett, W.S. (1998). "Long-Term Cognitive and Academic Effects of Early Childhood Education on Children in Poverty," *Preventive Medicine* 27:204–07.

Barro, R. (1991). "Economic Growth in a Cross Section of Countries. " *Quarterly Journal of Economics* 196 (2/May): 407–443.

Barro, R. (1996). "Health and Economic Growth", Annex I of the *Convocatoria para propuestas de investigación sobre Inversión en Salud y Crecimiento Económico de la Organización Panamericana de la Salud*.

Barro, R. and Lee, J. (1994): "Losers and Winners in Economic Growth," in *Proceedings of the World Bank Annual Conference on Development Economics, 1993: Supplement to The World Bank Economic Review and The World Bank Research Observer*. Bruno, Michael Pleskovic, Boris, eds., Washington, D.C.: World Bank. pp 267-97.

Barro, R. J. and Sala-i-Martin, X. (1995), *Economic Growth*, McGraw-Hill, Inc.

Benabou, Roland (1996). "Equity and Efficiency in human capital investment: the local connection." *Review of Economic Studies*.

Bhargava, A., Jamison, D., Lau, L., and Murray, C. (2000): "Modeling the Effects of Health on Economic Growth," mimeo.

Bracho, T. (1994). "Gasto Privado en Educación. México, 1984 -1992", CIDE, *Documento de Trabajo DEP 21*.

Bracho, T. y Zamudio, A. (1994a). "Rendimientos económicos a la escolaridad I: Discusión Teórica y Métodos de Estimación", CIDE, *Documento de Trabajo DE 30*.

Bracho, T. y Zamudio, A. (1994b). "Rendimientos económicos a la escolaridad II: Estimaciones para el caso Mexicano 1989", CIDE, *Documento de Trabajo DE 31*.

Cynader, M.S., and B.J. Frost. (1999). "Mechanisms of Brain Development: Neuronal Sculpting by the Physical and Social Environment." In D.P. Keating and C. Hertzman, eds., *Developmental Health and the Wealth of Nations: Social, Biological, and Educational Dynamics*. New York: The Guilford Press.

Diamond, Peter A. (1965). "National Debt in a Neoclassical Growth Model". *American Economic Review* 55, 5 (Dec.), 1126-1150.

Durlauf, S. (1996). "A theory of persistent income inequality." Journal of Economic Growth, 1, 75-94.

Easterly and Levine (1997). "It's Not Factor Accumulation: Stylized Facts and Growth Models,"

Fogel, R. W. (1991). "New Sources and New Techniques for the Study of Secular Trends in Nutritional Status, Health, Mortality, and the Process of Aging", *National Bureau of Economic Research Working Paper Series on Historical Factors and Long Run Growth*: 26, May.

Fogel, R. W. (1994[a]). "Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy", *American Economic Review*, vol. 84 (3), pp. 369-395.

Fogel, R. W. (1994[b]). "The Relevance of Malthus for the Study of Mortality Today: Long Run Influences on Health, Morality, Labour Force Participation, and Population Growth", Lindahl Kiessling, Kerstin; Landberg, Hans, eds. *Population, economic development, and the environment*. Oxford and New York: Oxford University Press, pages 231-84.

Fogel, R. W.; Wimmer, L. T. (1992). "Early Indicators of Later Work Levels, Disease, and Death", *National Bureau of Economic Research Working Paper Series on Historical Factors in Long Run Growth*: 38, June.

Frankel, M. (1962). "The Production Function in Allocation and Growth: A Synthesis." *American Economic Review*, 52, pp. 995-1022.

Gallup, J. and Sachs, J. (2000): "The Economic Burden of Malaria," *Working Paper No. 52*, Center for International Development, Harvard University.

Galor Oded and Omer Moav (2002). "Natural Selection and the Origin of Economic Growth," *Quarterly Journal of Economics*, 117, 1133-1191.

Galor, O. and Mayer-Foulkes, D. (2002). "Food for Thought: Basic Needs and Persistent Educational Inequality", mimeo.

Galor, Oded, and D. Tsiddon(1997). "The distribution of human capital and economic growth." *Journal of Economic Growth*, March, pp. 93-124.

Galor, Oded, and Zeira (1993). "Income Distribution and Macroeconomics." *Review of Economic Studies*, pp. 35-53.

Gómez, Manuel A. (2003). "Reforma Fiscal y Bienestar en la Economía de México", mimeo.

Grantham-McGregor, S.M., S.P. Walker, S.M. Chang, and C.A. Powell. (1997). "Effects of Early Childhood Supplementation With and Without Stimulation on Later Development in Stunted Jamaican Children," *American Journal of Clinical Nutrition* 66:247–53.

Hendricks, L. (1999), 'Taxation and Long-Run Growth', *Journal of Monetary Economics*, 43, 411-434.

Hertzman, C. (1999). "Population Health and Human Development," In D.P. Keating and C. Hertzman, eds., *Developmental Health and the Wealth of Nations: Social, Biological, and Educational Dynamics*. New York: The Guilford Press.

Howitt, P. and Mayer-Foulkes, D. (2002). "R&D, Implementation and Stagnation: A Schumpeterian Theory of Convergence Clubs", *NBER working paper* 9104.

Howitt, P., and Aghion, P. (1998). "Capital Accumulation and Innovation as Complementary Factors in Long-Run Growth." *Journal of Economic Growth*, 3(2):111-30.

Karoly, L.A., P.W. Greenwood, S.S. Everingham, J. Hoube, M.R. Kilburu, C.P. Rydell, M. Sanders, and J. Chiesa. (1998). *Investing in Our Children: What We Know and Don't Know about the Costs and Benefits of Early Childhood Interventions*. Washington, D.C.:RAND.

Kim, S.-J. (1998), "Growth Effects of Taxes in an Endogenous Growth Model: To What Extent Do Taxes Affect Economic Growth?", *Journal of Economic Dynamics and Control*, 23, 125-158.

Knowles, S. and Owen, P. D. (1995). "Health Capital and Cross-country Variation in Income Per Capita in the Mankiw Romer Weil-Model", *Economics-Letters*, vol. 48 (1), April, pp. 99-106.

Knowles, S. and Owen, P. D. (1997). "Education and Health in an Effective-Labour Empirical Growth Model", *Economics-Record*, vol. 73 (223), April, pp. 314-328.

Kremer, M, Onatski, A. and Stock, J., (2001). "Searching for Prosperity." *National Bureau of Economic Research*, Working Paper 8250, (April).

Larrea, C., Freire, W. B. And Lutter, Ch., (2001). "*Equidad desde el principio, situación nutricional de los niños ecuatorianos*". Organización Panamericana de la Salud.

Levinger, Beryl (1992). "Nutrition, Health and Education for All", Educational Development Center, Inc., http://www.edc.org/INT/NHEA/index.html.

Lucas, Robert E., Jr. (1988). "On the Mechanics of Development Planning." *Journal of Monetary Economics*, 22, 1 (July), pp. 3-42.

Maddison, Angus. (2001). "*The World Economy: A Millennial Perspective*". Development Centre Studies. Paris: OECD.

Maloney, William F. (2002). "Missed Opportunities: Innovation and Resource-Based Growth in Latin America" *Economia*, Fall, Vol 3, Num. 1.

Mankiw, N. Gregory, David Romer and David N. Weil (1992). "A Contribution to the Empirics of Economic Growth." *Quarterly Journal of Economics*, 107, 2 (May), pp. 407-37.

Mayer, D. (2001a). "The Long-Term Impact of Health on Economic Growth in Mexico, 1950-1995", *Journal of International Development*, 13(1), pp. 123-126.

Mayer, D. (2001b). "The Long-Term Impact of Health on Economic Growth in Latin America", *World Development*, 29(6) pp. 1025-1033.

Mayer-Foulkes (2002). "Global Divergence," available at http://papers.ssrn.com /sol3/papers.cfm?abstract_id=335140.

Mayer-Foulkes and Stabridis-Arana (2003). "Estimaciones de los Retornos Privados a la Escolaridad y Cálculo Del PIB Educativo para México", mimeo.

Mayer, D. and Cordourier, G. (2001), "La Brecha Salarial y la Teoría de Igualdad de Oportunidades: Un Estudio de Género para el Caso Mexicano" *Trimestre Económico*, Vol. LXVIII (1):269, Jan-March.

McCain, M.N., and J.F. Mustard (1999). *Reversing the Real Brain Drain: Early Years Study, Final Report.* Toronto: Publications Ontario.

Mincer, Jacob (1962). "On the Job Training", *Journal of Political Economy*, vol. 70, pp. 50-79.

Mincer, Jacob (1974). Schooling, Experience and Earnings, *National Bureau Economic Research*.

Myers, R.G. (1992). *The Twelve Who Survive*. London: Routledge.

Pecorino, P. (1994), "The Growth Rate Effects of Tax Reform". *Oxford Economic Papers*, 46, 492-501.

Pritchett, Lant (1997). "Divergence, Big Time." *Journal of Economic Perspectives*, 11(3), Summer 1997, pp. 3-17.

Quah, Danny T. (1993). "Empirical cross-section dynamics in Economic Growth." *European Economic Review* 37(2/3), 426-434.

Ravelli, A.C.J. (1999). "Prenatal Exposure to the Dutch Famine and Glucose Tolerance and Obesity at Age 50," Thela Thesis. Amsterdam: University of Amsterdam.

Rojas, M.; H. Angulo; and I. Velásquez (2000). "Rentabilidad de la Inversión en Capital Humano en México.", *Economía Mexicana*. Nueva Época, 9(2) pages 113-142.

Romer, Paul M. (1986). "Increasing Returns and Long-Run Growth." *Journal of Political Economy*, 94, 5 (October), pp. 1002-37.

Romer, Paul M. (1990). "Endogenous Technological Change." *Journal of Political Economy*, 98, 5 (October), part II, pp. S71-S102.

Sachs, J. and Warner, A. (1997): "Sources of Slow Growth in African Economies," *Journal of African Economies*. 6(3): 335-76.

Sachs, Jeffrey D. and Andrew M. Warner (1997). "Fundamental Sources of Long-Run Growth (in What Have we Learned from Recent Empirical Growth Research?)", *The American Economic Review*, Vol. 87, No. 2, Papers and Proceedings of the Hundred and Fourth Annual Meeting of the American Economic Association. May, pp. 184-188.

Savedoff, W.D., and Schultz, T.P. (eds) (2000). *Wealth from Health: Linking Social Investments to Earnings in Latin America*, Inter-American Development Bank: Washington.

Schultz, T.P. (1992). "The Role of Education and Human Capital in Economic Development: An Empirical Assessment", *Yale Economic Growth Center Discussion Papers* No.670.

Schultz, T.P. (1997). "Assessing the Productive Benefits of Nutrition and Health: An Integrated Human Capital Approach", *Journal of Econometrics*, 77(1):141-58.

Schultz, T.P. (1999). "Health and Schooling Investments in Africa", *Journal of Economic Perspectives*, 13(3):67-88.

Schürch, B. and Scrimshaw, N.S., eds.(1987). \QTRit. "Effects of chronic energy deficiency on stature, work capacity and productivity", *International Dietary Energy Consultancy Group*, Lausanne.

Schweinhart, L.J., H.V. Barnes, and D.P. Weikart (with W.S. Barnett and A.S. Epstein) (1993). *Significant Benefits: The High/Scope Perry Preschool Study Through Age 27*. Ypsilanti, Mich.: High/Scope Press.

Sen, A. (1999). *Development as Freedom*. New York: Alfred A. Knopf.

Smith, J.P. (1999). "Healthy Bodies and Thick Wallets: The Dual Relation Between Health and Economic Status," *Journal of Economic Perspectives* 13(2):145–66.

Steckel, R. (1995). "Stature and the Standard of Living", *Journal of Economic Literature*, 33(4):1903-40.

Stokey, N.L. y Rebelo, S. (1995), "Growth Effects of Flat-Rate Taxes". *Journal of Political Economy*, 103, 419-50.

Strauss, J., and Thomas, D. (1998). "Health, Nutrition, and Economic Development". *Journal of Economic Literature*, 36(2):766-817.

Thomas, D.; Schoeni, R.F., and Strauss, J. (1997). "Parental Investments in Schooling: Gender and Household Resource Allocation in Urban Brazil", *RAND Labor and Population Program*, Working Paper.

Uzawa, Hirofumi (1965). "Optimal Technical Change in an Aggregative Model of Economic Growth." *International Economic Review*, 6 (January), pp. 18-31.

Van Der Gaag (2002). "From Child Development to Human Development" in *From Early Child Development to Human Development: Investing in Our Children's Future*, Young, Mary Eming, Ed., Education Sector, Human Development Network, World Bank, Washington, D.C., available at http://www.worldbank.org/children/ECDtoHumanDevelopment.pdf.

Weil, David N., (2001). "Accounting for the Effect of Health on Economic Growth", mimeo.

World Bank (1993), *World Development Report 1993: Investing in Health*. Washington D.C.

Young, M.E., ed. 1997. *Early Child Development: Investing in our Children's Future*. International Congress Series No. 1137. Amsterdam: Elsevier Science B.V.

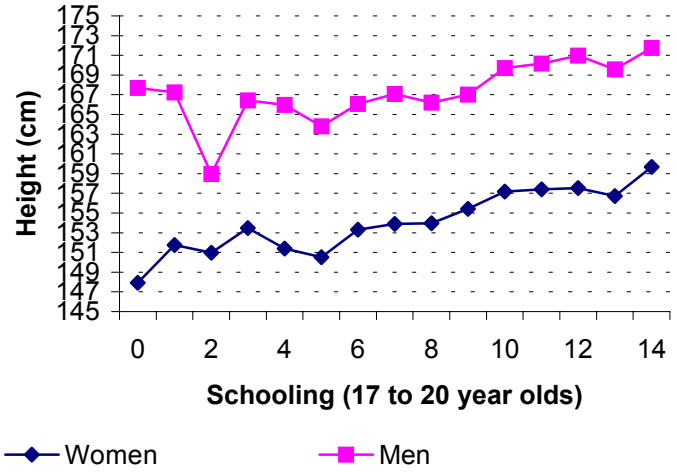
Zamudio, A. y Bracho, T. (1994). "Rendimientos económicos a la escolaridad III: El problema de Sesgo por elección ", CIDE, *Documento de Trabajo DE 32*.

Zamudio, Andrés (1995). "Rendimientos a la educación superior en México: ajuste por sesgo utilizando máxima verosimilitud", CIDE, *Documento de Trabajo DE 44*.

Zamudio, Andrés (1999). "Educación y distribución condicional del ingreso: una aplicación de regresión cuantil", CIDE, *Documento de Trabajo DE 163*.

Figure II. Average Stature by Years of Schooling

II.1 Adolescents



II.2 Adults

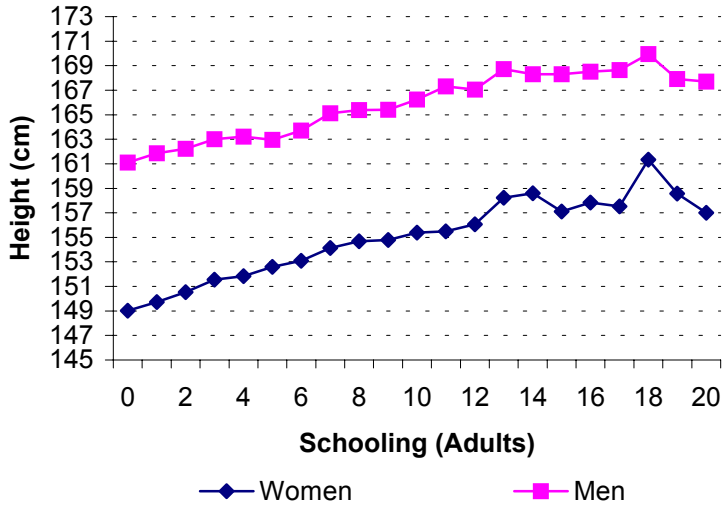
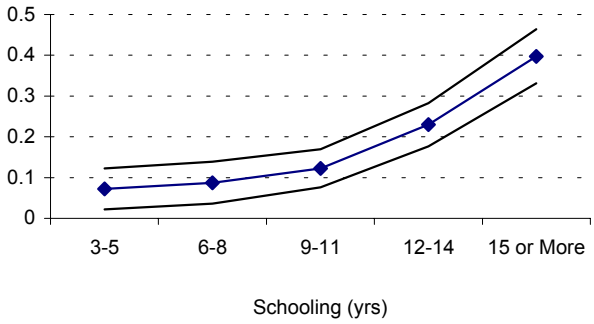


Figure III. Human Capital Marginal Returns for Adult Income by Educational Level

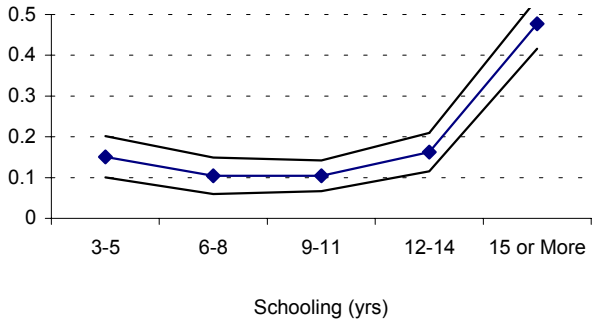
(Two Standard Deviation Corridors for OLS coefficients)

Marginal Human Capital Returns Asociated with Three-Year Periods of Schooling

III.1 Female

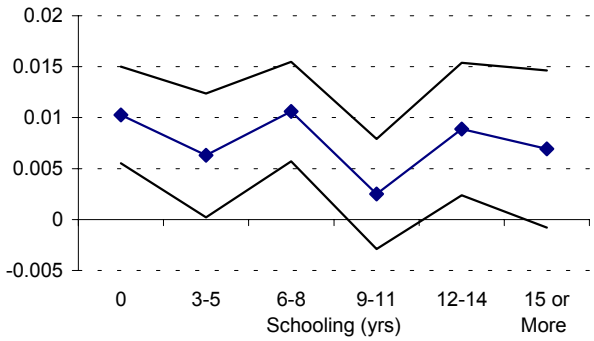


III.2 Male



Marginal Returns of Stature by Schooling Levels

III.3 Female



III.4 Male

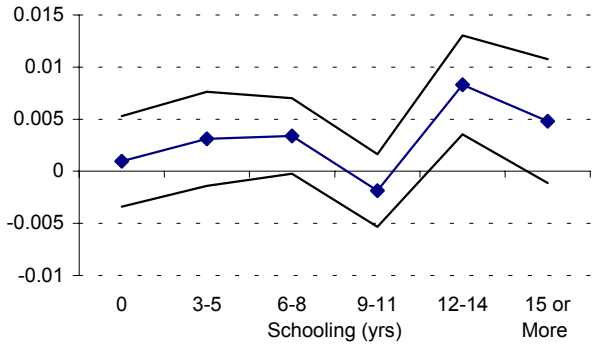
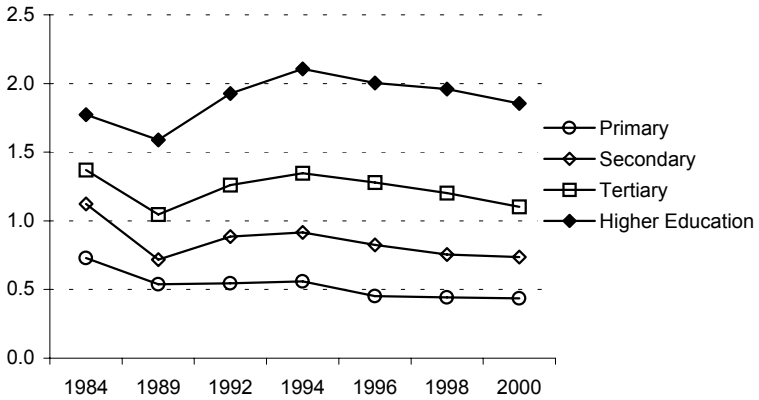


Figure IV. Marginal Returns to Schooling in Mexico, 1984-200

(Estimates based on ENIGH surveys)

OLS

Schooling Wage Factor

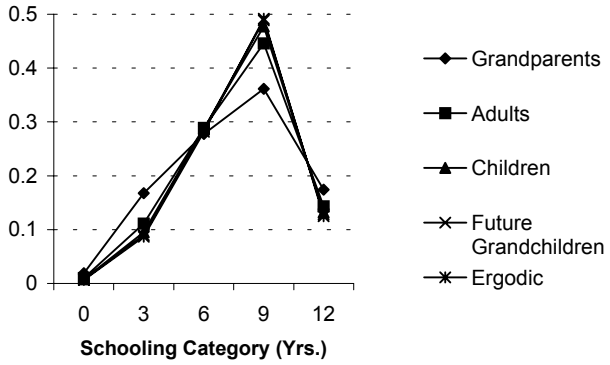


Source: Mayer-Foulkes and Stabridis-Arana (2003)

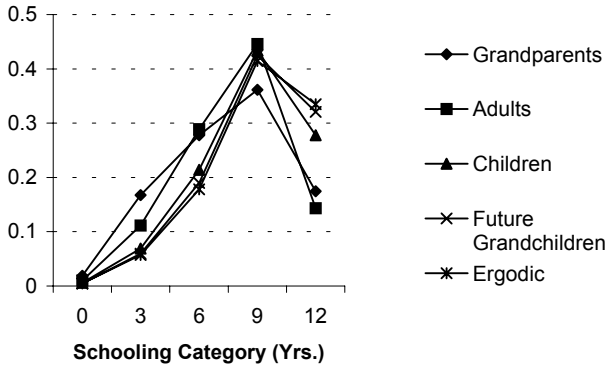
Figure V. Distribution of Educational Levels According to Transition Matrix Analysis

Women

V.1 Extrapolating From Current Transition

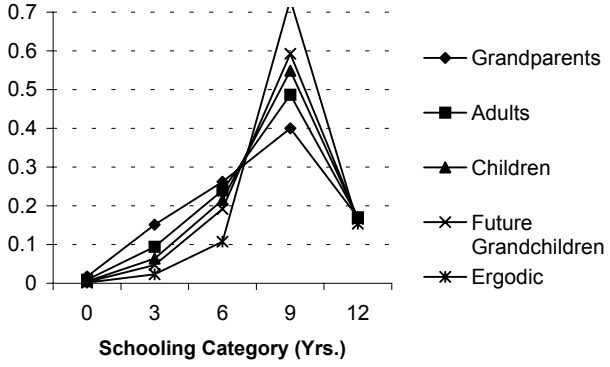


V.2 Increasing Education Probability According to a 5 cm Increase in Stature



Men

V.3 Extrapolating From Current Transition



V.4 Increasing Education Probability According to a 5 cm Increase in Stature

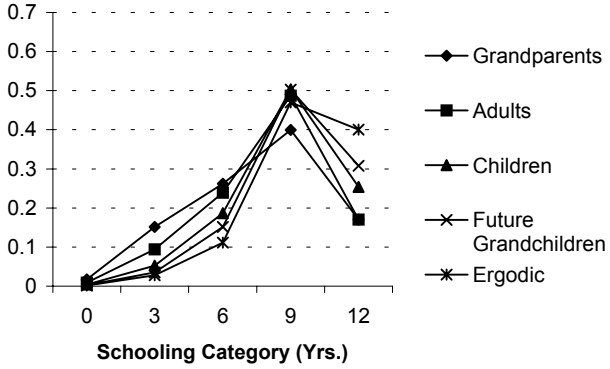


Table I. Adult Income Estimates
(Municipal Fixed Effects)

	OLS		Heckman I		Heckman II	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Stature (cm), 0-2 Years of Schooling	**0.0103** **(0)**	0.001 (0.66)	**0.0115** **(0)**	0.0009 (0.658)	**0.01166** **(0)**	0.00095 (0.659)
Stature (cm), 3-5 Years of Schooling	**0.0063** **(0.038)**	0.0031 (0.167)	*0.0072* *(0.014)*	0.0031 (0.16)	*0.00724* *(0.014)*	0.00312 (0.16)
Stature (cm), 6-8 Years of Schooling	**0.0106** **(0)**	*0.0034* *(0.061)*	**0.0109** **(0)**	*0.0034* *(0.056)*	**0.01081** **(0)**	*0.00341* *(0.056)*
Stature (cm), 9-11 Years of Schooling	0.0025 (0.355)	-0.0019 (0.288)	0.0024 (0.371)	-0.0018 (0.281)	0.00237 (0.369)	-0.00185 (0.282)
Stature (cm), 12-14 Years of Schooling	**0.0089** **(0.006)**	**0.0083** **(0)**	**0.0092** **(0.004)**	**0.0083** **(0)**	**0.00927** **(0.004)**	**0.00831** **(0)**
Stature (cm), 15 or More Years Schooling	**0.0069** **(0.073)**	0.0048 (0.106)	*0.007* *(0.066)*	*0.0048* *(0.099)*	*0.00662* *(0.081)*	0.00481 (0.1)
3 or More Years Schooling	**0.0723** **(0.004)**	**0.1509** **(0)**	**0.0889** **(0.001)**	**0.1483** **(0)**	*0.0528* *(0.032)*	**0.15005** **(0)**
6 or More Years Schooling	**0.0874** **(0.001)**	**0.1045** **(0)**	**0.0965** **(0)**	**0.1029** **(0)**	**0.08133** **(0.001)**	**0.10394** **(0)**
9 or More Years Schooling	**0.1228** **(0)**	**0.1043** **(0)**	**0.1155** **(0)**	**0.1035** **(0)**	**0.12712** **(0)**	**0.10418** **(0)**
12 or More Years Schooling	**0.23** **(0)**	**0.1625** **(0)**	**0.1517** **(0)**	**0.1633** **(0)**	**0.25025** **(0)**	**0.16276** **(0)**
15 or More Years Schooling	**0.3975** **(0)**	**0.4773** **(0)**	**0.2329** **(0)**	**0.4759** **(0)**	**0.411** **(0)**	**0.47737** **(0)**
Experience, 0-2 Years of Schooling	-0.0047 (0.33)	0.0043 (0.441)	-0.0053 (0.292)	0.0039 (0.481)	-0.00187 (0.688)	0.00442 (0.417)
Experience, 3-5 Years of Schooling	-0.0028 (0.641)	*-0.0086* *(0.091)*	-0.0081 (0.188)	*-0.0086* *(0.084)*	-0.00332 (0.573)	*-0.00853* *(0.088)*
Experience, 6-8 Years of Schooling	0.0028 (0.541)	**0.0148** **(0)**	-0.0042 (0.374)	**0.0145** **(0)**	-0.00084 (0.85)	**0.01485** **(0)**
Experience, 9-11 Years of Schooling	**0.0188** **(0)**	**0.0194** **(0)**	0.0067 (0.178)	**0.0188** **(0)**	**0.01223** **(0.007)**	**0.0193** **(0)**
Experience, 12-14 Years of Schooling	**0.0259** **(0)**	**0.0334** **(0)**	**0.014** **(0.007)**	**0.0325** **(0)**	**0.02113** **(0)**	**0.03324** **(0)**
Experience, 15 or More Years Schooling	**0.0535** **(0)**	**0.0446** **(0)**	**0.0437** **(0)**	**0.0439** **(0)**	**0.04683** **(0)**	**0.04454** **(0)**
Experience2, 0-2 Years of Schooling	0 (0.566)	**-0.0002** **(0.007)**	0 (0.878)	**-0.0002** **(0.009)**	-0.00002 (0.621)	**-0.00016** **(0.006)**
Experience2, 3-5 Years of Schooling	0 (0.744)	0 (0.665)	0 (0.576)	0 (0.638)	0.00002 (0.797)	0.00003 (0.656)
Experience2, 6-8 Years of Schooling	-0.0001 (0.132)	**-0.0003** **(0)**	0 (0.833)	**-0.0002** **(0)**	-0.00002 (0.797)	**-0.00025** **(0)**
Experience2, 9-11 Years of Schooling	**-0.0003** **(0)**	**-0.0003** **(0)**	*-0.0002* *(0.03)*	**-0.0003** **(0)**	*-0.00019* *(0.021)*	**-0.00029** **(0)**
Experience2, 12-14 Years of Schooling	**-0.0004** **(0)**	**-0.0005** **(0)**	*-0.0002* *(0.024)*	**-0.0005** **(0)**	**-0.00026** **(0.004)**	**-0.00048** **(0)**
Experience2, 15 or More Years Schooling	**-0.0009** **(0)**	**-0.0008** **(0)**	**-0.0008** **(0)**	**-0.0008** **(0)**	**-0.00077** **(0)**	**-0.00077** **(0)**
Journal Worker (Employed as Reference)	*0.145* *(0.011)*	**-0.166** **(0)**	*0.1072* *(0.055)*	**-0.166** **(0)**	*0.1122* *(0.044)*	**-0.16594** **(0)**
Entrepreneur	*0.2087* *(0.037)*	**0.2735** **(0)**	*0.2138* *(0.032)*	**0.2733** **(0)**	*0.21872* *(0.027)*	**0.2734** **(0)**
Self Employed	**-0.33** **(0)**	**-0.2152** **(0)**	**-0.3275** **(0)**	**-0.2152** **(0)**	**-0.32185** **(0)**	**-0.21523** **(0)**
Work Without Pay	**-0.6094** **(0)**	**-1.1358** **(0)**	**-0.6007** **(0)**	**-1.1359** **(0)**	**-0.59245** **(0)**	**-1.13608** **(0)**
Not Reported	**-0.4177** **(0)**	**-0.428** **(0)**	**-0.4291** **(0)**	**-0.4283** **(0)**	**-0.41582** **(0)**	**-0.42825** **(0)**

1% Confidence in Bold, 10% Confidence in Italics, pValues in Parenthesis

Table I. Adult Income Estimates (Continued)
(Municipal Fixed Effects)

	OLS		Heckman I		Heckman II	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Wooden Walls (Bricks as	**-0.0959**	-0.0173	**-0.107**	-0.018	**-0.10725**	-0.01802
Reference)	**(0.009)**	(0.618)	**(0.006)**	(0.597)	**(0.007)**	(0.598)
Adobe Walls	**-0.1103**	*-0.0743*	**-0.1146**	*-0.0734*	**-0.12199**	*-0.07292*
	(0.001)	*(0.017)*	**(0.001)**	*(0.017)*	**(0)**	*(0.017)*
Others or Not Reported	*-0.1194*	-0.0631	*-0.1298*	-0.0624	*-0.12791*	-0.06192
	(0.011)	(0.114)	*(0.01)*	(0.111)	*(0.011)*	(0.114)
Cardboard or Metal Sheet Roof	**-0.1525**	**-0.1203**	**-0.1485**	**-0.1209**	**-0.14623**	**-0.12058**
	(0)	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**
Asbestos Sheet Roof	**-0.1069**	**-0.0954**	**-0.103**	**-0.0958**	**-0.10155**	**-0.09559**
	(0)	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**
Wooden or Thatched Roof	**-0.1551**	**-0.1003**	**-0.1417**	**-0.1004**	**-0.14027**	**-0.10001**
	(0)	**(0.005)**	**(0)**	**(0.004)**	**(0)**	**(0.004)**
Tiled Roof (Concrete as	**-0.1678**	*-0.1071*	**-0.153**	**-0.1065**	**-0.15768**	*-0.10597*
Reference)	**(0)**	*(0.01)*	**(0.001)**	**(0.009)**	**(0.001)**	*(0.01)*
Others or Not Reported	-0.0405	0.1345	-0.0615	0.1347	-0.05723	0.1349
	(0.712)	(0.113)	(0.606)	(0.106)	(0.635)	(0.106)
Earthen Floor (Cement as	**-0.1428**	-0.0417	**-0.156**	-0.0412	**-0.15963**	-0.04095
Reference)	**(0)**	(0.167)	**(0)**	(0.166)	**(0)**	(0.169)
Wood, Tile or Other Finishings	**0.1396**	**0.1315**	**0.1338**	**0.1317**	**0.10824**	**0.13126**
	(0)	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**
Others or Not Reported	0.1976	-0.0271	0.123	-0.0255	0.12618	-0.02414
	(0.146)	(0.82)	(0.411)	(0.829)	(0.402)	(0.837)
Kitchen	-0.0143	0.0197	-0.015	0.0214	-0.02811	0.02162
	(0.659)	(0.472)	(0.66)	(0.427)	(0.415)	(0.422)
Number of Rooms	**0.0054**	0.0027	**0.0085**	0.003	**0.0074**	0.00303
	(0.009)	(0.541)	**(0.001)**	(0.501)	**(0.004)**	(0.495)
Piped Water Outside House	**-0.0703**	**-0.0519**	**-0.0779**	**-0.0522**	**-0.06288**	**-0.05197**
(Inside as Reference)	**(0.001)**	**(0.003)**	**(0)**	**(0.002)**	**(0.003)**	**(0.002)**
Others or Not Reported	**-0.1198**	**-0.0887**	**-0.1229**	**-0.0902**	**-0.10742**	**-0.0902**
	(0.001)	**(0.009)**	**(0.001)**	**(0.007)**	**(0.005)**	**(0.007)**
Bathroom	**0.1332**	0.0154	*0.0747*	0.0151	*0.07208*	0.015
	(0)	(0.612)	*(0.045)*	(0.612)	*(0.055)*	(0.615)
Drainage to Septic Tank (Public	**-0.0778**	**-0.0816**	**-0.0766**	**-0.0818**	*-0.06761*	**-0.08166**
Sewage as Reference)	**(0.003)**	**(0)**	**(0.005)**	**(0)**	*(0.015)*	**(0)**
No Drainage	**-0.173**	**-0.1552**	**-0.2148**	**-0.1548**	**-0.20936**	**-0.15451**
	(0)	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**
Others or Not Reported	-0.0215	*-0.0884*	-0.0235	*-0.0876*	-0.01348	*-0.08744*
	(0.685)	*(0.061)*	(0.671)	*(0.059)*	(0.809)	*(0.059)*
Electricity	*0.1043*	0.0484	*0.0985*	0.0484	*0.09824*	0.04791
	(0.044)	(0.341)	*(0.07)*	(0.333)	*(0.073)*	(0.338)
Telephone	**0.2554**	**0.1758**	**0.243**	**0.1771**	**0.20119**	**0.17711**
	(0)	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**
Indigenous Language Dummy	**-0.1322**	**-0.1625**	**-0.1371**	**-0.1626**	**-0.13606**	**-0.1625**
	(0.002)	**(0)**	**(0.001)**	**(0)**	**(0.001)**	**(0)**
Rho (standard deviation in			*-0.6642*	*-0.0415*	*-0.6854*	*-0.05225*
parenthesis)			*(0.025)*	*(0.023)*	*(0.025)*	*(0.031)*
Sigma (standard deviation in			*0.9542*	**0.6917**	*0.96983*	**0.69184**
parenthesis)			*(0.015)*	**(0.007)**	*(0.016)*	**(0.007)**
Lambda (standard deviation in			*-0.6338*	*-0.0287*	*-0.66472*	*-0.03615*
parenthesis)			*(0.033)*	*(0.016)*	*(0.034)*	*(0.022)*
Number of obs	12997	11447	29063	14674	29063	14674
R Squared	0.506	0.492				
Uncensored obs			12997	11447	12997	11447
Wald chi2			14672	10152	15327	10267
Log likelihood			-34316	-18926	-34612	-19108
Wald test for rho=0, chi2			321.01	3.24	326.51	2.8
Wald test for rho=0, Prob			0	0.0719	0	0.0943

1% Confidence in Bold, 10% Confidence in Italics, pValues in Parenthesis

Table II. Selection Equation in Heckman I Adult Income Estimates
(With Human Capital Variables in the Selection Model)
(Municipal Fixed Effects)

	Female	Male		Female (Ctd)	Male (Ctd)
Number of Dependent Children	**0.2349**	**0.2387**	**Adobe Walls**	0.0393	-0.0662
	(0)	**(0)**		(0.219)	(0.169)
Number of Dependent Adolescents	**0.2313**	-0.037	**Others or Not Reported**	0.0263	-0.0743
	(0)	(0.104)		(0.584)	(0.283)
3 or More Years Schooling	**-0.1045**	**0.1627**	**Cardboard or Metal Sheet Roof**	0.003	0.0604
	(0)	**(0)**		(0.932)	(0.292)
6 or More Years Schooling	*-0.0478*	**0.1173**	**Asbestos Sheet Roof**	-0.0034	0.0378
	(0.049)	**(0.003)**		(0.895)	(0.343)
9 or More Years Schooling	0.0293	*0.0737*	**Wooden or Thatched Roof**	-0.0213	0.0093
	(0.207)	*(0.051)*		(0.568)	(0.88)
12 or More Years Schooling	**0.2444**	-0.0508	**Tiled Roof (Concrete as**	-0.0234	-0.0424
	(0)	(0.273)	**Reference)**	(0.577)	(0.483)
15 or More Years Schooling	**0.4677**	*0.1261*	**Others or Not Reported**	0.0786	0.0151
	(0)	*(0.026)*		(0.525)	(0.937)
Experience, 0-2 Years of Schooling	**0.0135**	**0.0358**	**Earthen Floor (Cement as**	0.0013	-0.0609
	(0.003)	**(0)**	**Reference)**	(0.967)	(0.194)
Experience, 3-5 Years of Schooling	**0.0157**	**0.0081**	**Wood, Tile or Other Finishings**	0.0256	-0.0161
	(0.003)	**(0.335)**		(0.199)	(0.61)
Experience, 6-8 Years of Schooling	*0.0107*	**0.0274**	**Others or Not Reported**	0.2234	-0.1389
	(0.011)	**(0)**		(0.182)	(0.58)
Experience, 9-11 Years of Schooling	**0.012**	**0.0505**	**Kitchen**	0.0191	**-0.1775**
	(0.013)	**(0)**		(0.561)	**(0.001)**
Experience, 12-14 Years of Schooling	**0.0163**	**0.0712**	**Number of Rooms**	**-0.0063**	**-0.0143**
	(0.002)	**(0)**		**(0.01)**	**(0)**
Experience, 15 or More Years Schooling	**0.0118**	**0.0599**	**Piped Water Outside House**	-0.0018	0.0374
	(0.186)	**(0)**	**(Inside as Reference)**	(0.93)	(0.232)
Experience2, 0-2 Years of Schooling	**-0.0001**	**-0.0005**	**Others or Not Reported**	-0.0062	*0.1203*
	(0.086)	**(0)**		(0.858)	*(0.024)*
Experience2, 3-5 Years of Schooling	-0.0001	**-0.0002**	**Bathroom**	**0.1224**	0.0217
	(0.159)	**(0.095)**		**(0)**	(0.658)
Experience2, 6-8 Years of Schooling	0	**-0.0004**	**Drainage to Septic Tank (Public**	-0.0079	0.0139
	(0.733)	**(0)**	**Sewage as Reference)**	(0.757)	(0.731)
Experience2, 9-11 Years of Schooling	0	**-0.0008**	**No Drainage**	**0.0787**	-0.0429
	(0.58)	**(0)**		**(0.009)**	(0.357)
Experience2, 12-14 Years of Schooling	-0.0001	**-0.0013**	**Others or Not Reported**	-0.0017	-0.0697
	(0.577)	**(0)**		(0.973)	(0.354)
Experience2, 15 or More Years Schooling	0	**-0.0011**	**Electricity**	0.0115	0.002
	(0.86)	**(0)**		(0.822)	(0.978)
Wooden Walls (Bricks as Reference)	0.0204	0.0535	**Telephone**	**0.0771**	**-0.1023**
	(0.59)	(0.362)		**(0)**	**(0.001)**

1% Confidence in Bold, 10% Confidence in Italics, pValues in Parenthesis

Table III. Selection Equation in Heckman II Adult Income Estimates
(Without Human Capital Variables in the Selection Model)
(Municipal Fixed Effects)

	Female	Male		Female (Ctd)	Male (Ctd)
Number of Dependent Children	**0.1673**	**0.36**	**Wood, Tile or Other Finishings**	**0.0809**	0.0231
	(0)	**(0)**		**(0)**	(0.452)
Number of Dependent	**0.2238**	*0.0406*	**Others or Not Reported**	0.1987	-0.1837
Adolescents	**(0)**	*(0.065)*		(0.233)	(0.465)
Wooden Walls (Bricks as	0.02	0.0274	**Kitchen**	0.0498	**-0.1641**
Reference)	(0.594)	(0.638)		(0.126)	**(0.001)**
Adobe Walls	*0.0565*	-0.077	**Number of Rooms**	*-0.0041*	**-0.0138**
	(0.076)	(0.105)		*(0.066)*	**(0)**
Others or Not Reported	0.0213	-0.1011	**Piped Water Outside House**	*-0.0329*	0.0088
	(0.654)	(0.138)	**(Inside as Reference)**	*(0.096)*	(0.776)
Cardboard or Metal Sheet Roof	0.0019	0.0227	**Others or Not Reported**	-0.0414	0.0845
	(0.956)	(0.692)		(0.224)	(0.111)
Asbestos Sheet Roof	-0.0067	0.0136	**Bathroom**	**0.123**	0.0267
	(0.792)	(0.731)		**(0)**	(0.585)
Wooden or Thatched Roof	-0.0278	-0.019	**Drainage to Septic Tank (Public**	-0.0229	0.0008
	(0.456)	(0.751)	**Sewage as Reference)**	(0.367)	(0.984)
Tiled Roof (Concrete as	-0.0161	-0.0687	**No Drainage**	*0.0686*	-0.0604
Reference)	(0.7)	(0.248)		*(0.022)*	(0.19)
Others or Not Reported	0.0627	0.0151	**Others or Not Reported**	-0.0163	-0.0625
	(0.611)	(0.935)		(0.741)	(0.403)
Earthen Floor (Cement as	0.0084	-0.0743	**Electricity**	0.0074	0.0241
Reference)	(0.784)	(0.111)		(0.884)	(0.742)
			Telephone	**0.1604**	*-0.0651*
				(0)	*(0.031)*

1% Confidence in Bold, 10% Confidence in Italics, pValues in Parenthesis

Table IV.1 Mean Returns to Education

Study based on ENIGH 1984, 1989, 1992, 1994, 1996

	1984	1989	1992	1994	1996
Primary	12.1	9.95	10.62	11.01	8.75
Secondary	9.25	7.55	10.1	11.42	12
Tertiary	19.04	14.13	15.78	17.13	16.7
Higher	10.04	14.65	16.9	20.17	18.76

Source: Zamudio (1999)

Table IV.2 Mean Internal Rate of Return to Education

Study based on ENIGH 1992

	Average	Men	Women
Primary	5.97	7.03	6.61
Secondary	4.35	4.53	4.3
Tertiary	6.91	6.69	8.21
University	6.32	8.35	6.49
Postgraduate	12.95	11.67	18.13

Source: Rojas, Angulo y Velazquez (2000)

Table V. Probit Estimates for School Permanence by Gender
Adolescents Ages 17-19
Municipal Fixed Effects, Stature Instrumented

	Female				Male			
	Lower to Higher	**Primary to Secondary**	**Secondary to Tertiary**	**Tertiary to Higher**	**Lower to Higher**	**Primary to Secondary**	**Secondary to Tertiary**	**Tertiary to Higher**
Stature (cm)	0.123	*0.098*	**0.184**	-0.024	*0.127*	**0.108**	**0.098**	-0.074
	(0.214)	*(0.052)*	**(0)**	(0.818)	*(0.052)*	**(0.004)**	**(0.002)**	(0.162)
Dummy for Age 17	0.08	-0.023	-0.019	0.044	-0.024	0.089	**-0.347**	0.128
	(0.619)	(0.778)	(0.809)	(0.842)	(0.889)	(0.375)	**(0)**	(0.68)
Dummy for Age 19	0.159	-0.076	-0.038	**1.666**	*-0.299*	*-0.177*	*-0.173*	**2.241**
	(0.374)	(0.389)	(0.642)	**(0)**	*(0.097)*	*(0.089)*	*(0.057)*	**(0)**
Household Income	-0.004	**-0.139**	*-0.1*	0.058	0.084	-0.038	-0.053	-0.169
	(0.963)	**(0.005)**	*(0.03)*	(0.612)	(0.333)	(0.5)	(0.277)	(0.237)
Household Head Completed	**0.715**	*0.197*	0.122	-0.546	*0.336*	*0.313*	0.183	-0.376
Lower Primary	**(0.001)**	*(0.089)*	(0.344)	(0.147)	*(0.093)*	*(0.01)*	(0.16)	(0.474)
Household Head Completed	*0.599*	**0.382**	*0.246*	-0.024	0.056	0.101	0.101	0.357
Primary	*(0.01)*	**(0)**	*(0.015)*	(0.932)	(0.788)	(0.39)	(0.343)	(0.294)
Household Head Completed	*0.489*	*0.208*	0.011	0.131	0.086	**0.749**	0.095	-0.024
Secondary	*(0.041)*	*(0.063)*	(0.906)	(0.537)	(0.717)	**(0)**	(0.32)	(0.94)
Household Head Completed	0.454	0.236	**0.584**	-0.018	0.312	*0.541*	**0.594**	-0.002
Tertiary	(0.294)	(0.193)	**(0)**	(0.943)	(0.442)	*(0.056)*	**(0)**	(0.995)
Household Head Schooling 15	*1.82*	-0.115	0.177	*0.629*	-0.096		0.123	*1.015*
Years or More	*(0.026)*	(0.662)	(0.394)	*(0.09)*	(0.879)		(0.535)	*(0.01)*
Household Head Schooling above	**-0.26**	-0.021	-0.013	0.008	-0.001	-0.043	-0.009	0.051
Spouse	**(0)**	(0.336)	(0.514)	(0.872)	(0.984)	(0.129)	(0.643)	(0.262)
Spouse Schooling Above	*0.115*	**0.133**	**0.076**	0.004	*-0.074*	0.02	*0.038*	0.107
Household Head	*(0.029)*	**(0)**	**(0)**	(0.916)	*(0.069)*	(0.439)	*(0.077)*	(0.113)
Number of Children	*0.057*	**0.047**	0.022		0.035	0.004	-0.002	**0.258**
	(0.032)	**(0.001)**	(0.131)		(0.201)	(0.786)	(0.881)	**(0)**
Indigenous Language Dummy	0.287	-0.244	0.055	0.326	*0.831*	0.298	-0.084	*4.082*
	(0.453)	(0.236)	(0.826)	(0.66)	*(0.08)*	(0.324)	(0.772)	*(0.014)*
Number of obs	1166	2499	2258	772	1016	1903	2066	547
LR chi2	211.1	714.54	699.53	224.47	150.47	459.8	637.41	192.69
Prob > chi2	0	0	0	0	0.009	0	0	0
Log likelihood	-250	-977	-1154	-241	-252	-767	-1100	-145
Pseudo R2	0.297	0.268	0.233	0.318	0.23	0.231	0.225	0.399

1% Confidence in Bold, 10% Confidence in Italics, pValues in Parenthesis

Table V. Probit Estimates for School Permanence by Gender (Continued)

Coefficients of Wealth Variables

	Female				Male			
	Lower to Higher Primary	Primary to Secondary	Secondary to Tertiary	Tertiary to Higher	Lower to Higher Primary	Primary to Secondary	Secondary to Tertiary	Tertiary to Higher
Walls (Bricks as Reference) Others or Not Reported	0.059	-0.291	0.241		0.423	0.196	0.091	1.007
	(0.896)	(0.207)	(0.395)		(0.363)	(0.51)	(0.763)	(0.363)
Wooden Walls	-0.243	-0.151	-0.242	0.643	*-0.612*	*-0.356*	0.235	*-2.02*
	(0.47)	(0.372)	(0.228)	(0.211)	*(0.058)*	*(0.071)*	(0.259)	*(0.029)*
Adobe Walls	0.341	*-0.244*	-0.032	0.497	*-0.718*	-0.055	0.126	-0.24
	(0.282)	*(0.099)*	(0.849)	(0.334)	*(0.011)*	(0.745)	(0.469)	(0.695)
Roof (Concrete as Reference) Others or Not Reported	-1.382	0.64	-0.344				0.327	
	(0.115)	(0.331)	(0.592)				(0.653)	
Cardboard or Metal Sheet Roof	0.31	-0.16	0.007	1.008	-0.083	**-0.482**	-0.317	-0.249
	(0.339)	(0.33)	(0.97)	(0.123)	(0.795)	**(0.009)**	(0.135)	(0.718)
Asbestos Sheet Roof	0.173	*-0.193*	*-0.193*	0.222	-0.1	*-0.271*	*-0.199*	*-0.936*
	(0.452)	*(0.079)*	*(0.095)*	(0.531)	(0.687)	*(0.039)*	*(0.095)*	*(0.095)*
Wooden or Thatched Roof	*0.776*	0.134	0.27	-0.362	0.006	-0.313	*-0.391*	-1.075
	(0.046)	(0.473)	(0.136)	(0.397)	(0.987)	(0.137)	*(0.071)*	(0.179)
Tiled Roof	0.158	0.061	0.16	*0.894*	0.057	0.274	*0.452*	
	(0.637)	(0.748)	(0.449)	*(0.048)*	(0.862)	(0.201)	*(0.061)*	
Floors (Cement as Reference) Others or Not Reported			-1.085				*-1.629*	
			(0.113)				*(0.037)*	
Earthen Floor	-0.33	**-0.377**	-0.238	-0.39	-0.092	0.028	*0.484*	0.478
	(0.176)	**(0.006)**	(0.219)	(0.615)	(0.723)	(0.872)	*(0.011)*	(0.716)
Wood, Tile or Other Finishings	*-0.37*	*0.225*	0.109	0.08	0.117	**0.308**	**0.224**	-0.042
	(0.065)	*(0.026)*	(0.186)	(0.655)	(0.553)	**(0.005)**	**(0.009)**	(0.873)
Kitchen	0.143	**0.404**	*0.41*	*-1.349*	0.001	-0.237	-0.143	0.39
	(0.619)	**(0.004)**	*(0.027)*	*(0.018)*	(0.999)	(0.242)	(0.485)	(0.594)
Number of Rooms	*0.166*	*0.07*	**0.097**	0.013	-0.026	*0.068*	**0.076**	-0.037
	(0.015)	*(0.024)*	**(0)**	(0.843)	(0.684)	*(0.067)*	**(0.007)**	(0.64)
Toilet Water (Inside as Ref) Others or Not Reported	-5.375	6.008	6.75	-6.37	0.034	4.127	5.734	-6.002
	(0.996)	(0.422)	(0.253)	(0.695)	(0.924)	(0.473)	(0.281)	(0.504)
Toilet Water From Bucket	0.082	**-0.267**	**-0.258**	-0.216	-0.217	0.046	-0.158	0.577
	(0.691)	**(0.006)**	**(0.006)**	(0.362)	(0.307)	(0.683)	(0.11)	(0.128)
Toilet Water Unavailable	-0.295	-0.043	-0.101	-0.907	-0.091	0.287	-0.134	-0.092
	(0.393)	(0.788)	(0.57)	(0.224)	(0.797)	(0.119)	(0.515)	(0.907)
Bathroom	-5.188	6.12	7.184	-4.691		4.257	6.015	-8.026
	(0.996)	(0.417)	(0.228)	(0.771)		(0.465)	(0.266)	(0.379)
Drainage (Public Sewage as Ref) Others or Not Reported	-0.614	**-0.615**	0.302	0.459	-0.579	-0.319	0.181	-0.464
	(0.121)	**(0.006)**	(0.317)	(0.571)	(0.167)	(0.274)	(0.53)	(0.561)
Drainage to Septic Tank	0.154	*-0.216*	-0.117	-0.109	*0.447*	*-0.227*	-0.162	-0.696
	(0.546)	*(0.069)*	(0.293)	(0.736)	*(0.068)*	*(0.092)*	(0.184)	(0.146)
No Drainage	-0.125	*-0.309*	**-0.604**	-0.252	*-0.533*	-0.221	-0.167	*1.146*
	(0.666)	*(0.035)*	**(0)**	(0.659)	*(0.047)*	(0.182)	(0.331)	*(0.066)*
Electricity	-0.174	0.115	0.387	-0.671	0.218	0.251	*1.322*	
	(0.743)	(0.623)	(0.306)	(0.451)	(0.585)	(0.441)	*(0.016)*	
Telephone	0.002	*0.274*	0.117	0.276	0.091	0.034	**0.289**	0.399
	(0.992)	*(0.018)*	(0.211)	(0.275)	(0.694)	(0.78)	**(0.004)**	(0.137)

1% Confidence in Bold, 10% Confidence in Italics, pValues in Parenthesis

Table VI. Probit Estimates for School Permanence (Both Genders Together)

Adolescents Ages 17-19, Municipal Fixed Effects

	Lower to Higher	Primary to Secondary	Secondary to Tertiary	Tertiary to Professional		Lower to Higher	Primary to Secondary	Secondary to Tertiary	Tertiary to Professional
Stature (cm)	**0.206**	**0.134**	**0.207**	-0.029	**Cardboard or Metal Sheet**	0.09	**-0.314**	-0.09	0.152
	(0.001)	**(0)**	**(0)**	(0.651)	**Roof**	(0.632)	**(0.004)**	(0.469)	(0.671)
Dummy for Age 17	-0.107	0.029	**-0.226**	-0.024	**Asbestos Sheet Roof**	0.019	*-0.186*	*-0.171*	-0.137
	(0.293)	(0.628)	**(0)**	(0.864)		(0.89)	*(0.012)*	*(0.023)*	(0.529)
Dummy for Age 19	-0.089	*-0.107*	*-0.134*	**1.312**	**Wooden or Thatched Roof**	0.259	-0.029	-0.058	-0.315
	(0.397)	*(0.077)*	*(0.018)*	**(0)**		(0.255)	(0.815)	(0.634)	(0.274)
Gender	**-2.602**	**-1.426**	**-2.625**	0.253	**Tiled Roof**	0.117	0.074	0.132	-0.127
	(0)	**(0)**	**(0)**	(0.755)		(0.546)	(0.561)	(0.334)	(0.71)
Household Income	0.033	**-0.09**	*-0.078*	0.024	**Floors (Cement as Reference)**			-0.682	
	(0.547)	**(0.007)**	*(0.012)*	(0.747)	**Others or Not Reported**			(0.11)	
Household Head Completed	**0.407**	**0.222**	*0.144*	-0.122	**Earthen Floor**	-0.174	*-0.159*	0.017	-0.375
Lower Primary	**(0.001)**	**(0.002)**	*(0.081)*	(0.581)		(0.222)	*(0.082)*	(0.893)	(0.454)
Household Head Completed	0.123	**0.203**	0.087	-0.145	**Wood, Tile or Other**	-0.175	**0.224**	**0.147**	0.144
Primary	(0.344)	**(0.005)**	(0.209)	(0.393)	**Finishings**	(0.138)	**(0.001)**	**(0.007)**	(0.244)
Household Head Completed	*0.277*	**0.365**	0.039	0.086	**Kitchen**	-0.012	0.16	0.037	-0.503
Secondary	*(0.054)*	**(0)**	(0.532)	(0.561)		(0.947)	(0.118)	(0.764)	(0.192)
Household Head Completed	0.327	*0.268*	**0.518**	-0.083	**Number of Rooms**	0.054	**0.078**	**0.088**	-0.017
Tertiary	(0.208)	*(0.054)*	**(0)**	(0.633)		(0.161)	**(0)**	**(0)**	(0.659)
Household Head Schooling	0.344	0.064	0.008	*0.599*	**Toilet Water (Inside as Ref)**	-5.991	6.2	6.824	-7.05
15 Years or More	(0.403)	(0.769)	(0.953)	*(0.016)*	**Others or Not Reported**	(0.992)	(0.228)	(0.194)	(0.503)
Household Head Schooling	**-0.104**	-0.024	0.007	0.003	**Toilet Water From Bucket**	-0.003	*-0.122*	*-0.125*	0.037
above Spouse	**(0)**	(0.123)	(0.605)	(0.912)		(0.982)	*(0.07)*	*(0.043)*	(0.817)
Spouse Schooling Above	-0.016	**0.063**	*0.025*	0.017	**Toilet Water Unavailable**	-0.068	0.011	-0.147	0.049
Household Head	(0.557)	**(0)**	*(0.069)*	(0.552)		(0.73)	(0.916)	(0.228)	(0.897)
Number of Children	*0.037*	**0.026**	0.007	*0.045*	**Bathroom**	-6.055	6.348	7.099	-7.401
	(0.021)	**(0.008)**	(0.475)	*(0.072)*		(0.992)	(0.22)	(0.18)	(0.483)
Indigenous Language Dummy	*0.665*	0.1	0.034	*0.716*	**Drainage (Public Sewage as**	*-0.541*	**-0.43**	-0.016	0.278
	(0.012)	(0.538)	(0.843)	*(0.097)*	**Ref) Others or Not Reported**	*(0.018)*	**(0.005)**	(0.928)	(0.503)
Walls (Bricks as Reference)	0.136	-0.14	0.061	0.762	**Drainage to Septic Tank**	*0.271*	*-0.198*	*-0.137*	-0.24
Others or Not Reported	(0.597)	(0.343)	(0.733)	(0.172)		*(0.075)*	*(0.015)*	*(0.071)*	(0.228)
Wooden Walls	*-0.363*	*-0.204*	0.003	-0.135	**No Drainage**	-0.257	*-0.178*	**-0.339**	0.113
	(0.053)	*(0.074)*	(0.984)	(0.715)		(0.121)	*(0.075)*	**(0.001)**	(0.719)
Adobe Walls	-0.243	*-0.21*	-0.036	0.171	**Electricity**	0.118	0.224	*0.606*	-0.886
	(0.155)	*(0.034)*	(0.745)	(0.59)		(0.652)	(0.175)	*(0.013)*	(0.161)
Roof (Concrete as Reference)	0.176	*1.061*	-0.04		**Telephone**	-0.057	0.062	0.053	*0.301*
Others or Not Reported	(0.795)	*(0.067)*	(0.919)			(0.698)	(0.459)	(0.462)	*(0.079)*
Number of obs	3348	5221	4631	1793					
LR chi2	324.8	1215.75	1314.87	342.43					
Prob > chi2	0	0	0	0					
Log likelihood	-620	-1951	-2474	-514					
Pseudo R2	0.2077	0.2376	0.21	0.25					

1% Confidence in Bold, 10% Confidence in Italics, pValues in Parenthesis

Table VII. Mean Marginal Probabilities Associated with 1 cm Stature Increase in Probit Estimates for School Permanence

Estimate:	Lower to Higher Primary	Primary to Secondary	Secondary to Tertiary	Tertiary to Higher
Male	*0.042*	**0.042**	**0.039**	0
Female	0.039	*0.038*	**0.073**	0
Joint	**0.0001899**	**0.0548546**	**0.1204284**	0.0550147

(1% Confidence in Bold, 10% Confidence in Italics)

Note: In joint regression for deciding to go beyond 15 yrs of schooling, stature above 154.86 predicts decision perfectly.

Table VIII. Mean Marginal Probabilities Associated with 1 cm Stature Increase in Probit Estimates for School Permanence by Gender and Household Head Schooling

	Female			Male		
Household Head Schooling	**Lower to Higher Primary**	**Primary to Secondary**	**Secondary to Tertiary**	**Lower to Higher Primary**	**Primary to Secondary**	**Secondary to Tertiary**
1 - 3	0.026	0.029	0.056	0.032	0.035	0.026
4 - 6	0.025	0.028	0.055	0.030	0.033	0.031
7 - 9	0.017	0.023	0.057	0.020	0.027	0.032
10 - 12	0.011	0.019	0.055	0.013	0.013	0.030
> 12	0.004	0.010	0.031	0.005	0.008	0.016