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Schooling in Mexico: An Evaluation of Private Costs as a Determinant of Household Demand for Education, and the Benefits of a Free Textbook Program

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BY

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B.A., Economics and Languages, University of New Mexico, 2007

THESIS

Submitted in Partial Fulfillment of the
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ABSTRACT

While the literature discussing public funding of education and the associated costs is extensive, studies that examine household, or private, costs for education are scarce. I use data from the 2005 Mexican Family Life Survey first to examine the nature of these private costs for Mexican families and second to determine to what extent direct schooling costs incurred by households are significant factors in enrollment decisions for primary and secondary school students. I find that, while small, direct costs are consistently significant determinants of school enrollment. Students age 13 to 15 are more sensitive to these direct costs than are their younger peers. Other opportunity cost and household factors, such as child employment and parents' education level, are also statistically significant determinants of enrollment.

Given the significance of direct costs on enrollment decisions, I examine one of Mexico's public education programs, its National Free Textbook Commission (CONALITEG), in order to determine if it is a sound use of public funds. Using a cost-benefit analysis, I conclude that CONALITEG is in fact a good use of funds that targets a demonstrable obstacle to school enrollment.

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Introduction

This thesis seeks to explore the relationship between education and economic outcomes, specifically from the perspective of a developing nation, Mexico. Chapter 1 examines the microeconomic and macroeconomic relationships between education and growth in order to establish the motivation behind analyzing education structures and policies in Mexico. The evidence strongly indicates that investment in education leads to private as well as public increases in income. However, there is some controversy as to the mechanisms at work and much debate over the problem of measurement. Given the assumption that education is beneficial for growth on a national level, Chapter 2 examines survey data from Mexico in order to tally the costs, both direct and indirect, that households face in sending children to school, and to identify the determinants of school enrollment. Chapter 3 then presents a cost-benefit analysis of Mexico's free textbook program. Given the national and private importance of education, coupled with the obstacles that families face in enrolling their children, I examine whether or not the textbook program is an economically sound use of funds. Finally, Chapter 4 provides policy implications.

Chapter 1: Education, Development, and Growth

1.1 Education in Growth Theory

The link between education and development raises a central question: does education lead to growth, or does growth lead to more education? Despite the difficulty in determining causality, there is substantial research linking education positively with growth both on a private and national level. Research in this field is primarily either microeconomic or macroeconomic in focus with few studies examining both branches. The microeconomic research explores the individual gains to additional years of schooling, usually through changes in wages. While most authors extend the individual analysis to assume that the nation's aggregate change in earnings also increases with education, they do not empirically test for the aggregate outcome. On the other hand, the macroeconomic literature attempts to quantify an entire country's gains from a better educated population; these gains include increased wages but also encompass positive externalities whose benefits directly attributable to education are difficult to measure, such as a reduction in crime and fertility rates. While the macroeconomic literature more directly links education with a nation's development process, it is also more controversial in nature due to the difficulty of measuring non-market consequences of increased education. The fact that most research does not evaluate *both* the microeconomic and macroeconomic trends leads to some paradoxical results. The controversy surrounding these opposing conclusions is discussed briefly in the following sections.

1.2 Microeconomic Literature

The first substantial work done on the returns to investment in education was in the 1970's by George Psacharopoulos; today his works still provide a strong foundation for current investigations (both his own and those of other authors). Updates to his work in 1985 and 2004 indicate that many of the same trends present in the late 1970's are still evident today. Using a panel of between 40 and 62 countries in developing and developed regions, Psacharopoulos calculates the returns to investment in education (the increase in expected future earnings for each additional year of schooling) using two techniques. On an individual level, he uses a Mincerian wage equation to estimate the coefficient on the years of schooling. Using this method, he finds repeatedly that returns to investment in education are highest for men who complete primary schooling in countries with a low per capita income, while returns for women are highest in secondary school (1985, 2004). Psacharopoulos concludes that across several studies, the average (worldwide) rate of return is nine to ten percent, a finding supported by other studies. Angrist and Krueger (1991) use a natural experiment in the United States to conclude that individual returns to an additional year of schooling are 7.2 to 10.2 percent. Similarly, Duflo (2001), using data from Indonesia, finds a return of 6.8 to 10.6 percent based on calculations using differences in regional educational attainment and subsequent earnings.

On the surface, it is reassuring to find that such disparate samples (Angrist & Krueger 1991, Duflo 2001, and Psacharopoulos 1985, 2004) return similar results; however, Psacharopoulos is quick to note that comparisons of this sort across disparate data sets in cross-country analyses are not inherently reliable. Sample selection is a large concern in wage data, and many cross-country studies do not accurately account for this shortcoming. In one country, the sample of wage earners may only include government workers if earnings data is difficult to obtain from private sources; in another country, however, there may be substantial wage information for workers in both the formal and informal sectors, providing a much broader view of the country's earnings and education profile. If wages from these two countries were compared without accounting for the difference in sample selection, the results would not accurately represent the true differences in earnings between the countries. While Psacharopoulos attempts to control for the variation in sample selection among the panel of countries (by carefully examining the sampling strategy and only comparing data sets with similar samples), he notes that some inconsistency may still be present.

Despite the potential inconsistency in samples, reviewing regional data between 1985 and 2004 presents an interesting trend: average returns to schooling have declined over the twenty-year period. Table 1 presents estimates from studies by Psacharopoulos that illuminate this trend. In the developing world, Africa's average rate of return drops by 1.3 percentage points while Latin America experiences a 2-percentage point decline. Developed nations fare similarly with the "advanced" nations experiencing a decline of 1.5 percentage points.

Table 1: Mincerian coefficient estimates on years of schooling (%)

Region	1985 estimate	2004 estimate
Africa	13	11.7
Asia	11	9.9
Latin America	14	12.0
Advanced	9	7.5

Source: Psachaopoulos 1985, 2004

In order to interpret the mechanism behind this trend, it is important to note that the average years of schooling have increased over the sample period (Psacharopoulos 2004), indicating that diminishing marginal returns to education exist. This conclusion is supported in much of the literature (Psacharopoulous 2004, Pritchett 2001, Eckstein & Zilcha 1994, Bils & Klenow 2000). If technological progress in the coming years leads to an increase in the demand for highly educated workers, then the diminishing marginal returns to education may begin to disappear.

The previous estimates of returns to schooling have not included the social cost associated with obtaining the education, and thus only represent the private returns that an individual would receive from consuming additional years of education. In order to include a measure of the total (social) cost associated with investing in education, Psacharopoulos employs his second estimation technique. This differences, or internal returns, method uses the following formula:

$$\frac{\textit{difference in wage due to extra level of schooling}}{\textit{cost to obtain extra schooling}} = \textit{return} \tag{1}$$

Thus, Psacharopoulos constructs social returns to education that include both social costs and private benefits. Psacharopoulos employs this method in his 2004 aggregate research, as shown in Table 2. The primary difference in social versus private returns is in higher education. While post-secondary schooling provides private returns that average 2.5 percentage points more than returns to secondary education, the same difference is not present in social returns; in fact, in most cases the social returns to higher education are equal to or less than those to secondary schooling. The most direct explanation is that investment in higher education is relatively much more expensive than investment in primary and secondary levels, thus increasing social costs more than private benefits.

Table 2: Social versus Private returns to schooling (internal returns method)

	Social			Private		
Region	Primary	Secondary	Higher	Primary	Secondary	Higher
Asia	16.2	11.1	11.0	20.0	15.8	18.2
Africa	25.4	18.4	11.3	37.6	24.6	27.8
Latin America	17.4	12.9	12.3	26.6	17.0	19.5
Advanced/OECD	8.5	9.4	8.5	13.4	11.3	11.6

Source: Psacharopoulos, 2004

The result for a developing nation is that an efficient allocation of resources may not place investment in higher education, but rather in primary and secondary schooling. For all but the advanced nations, it seems that primary schooling provides the highest return for the investment.

Although several potential problems exist in estimating private returns to education (such as ability bias, endogeneity, and sample selection), in recent years a variety of estimation techniques have been used to overcome these estimation concerns. Ordinary least squares, instrumental variable, and natural experiment estimation methods all yield similar results (Psacharapoulos 2004, Krueger & Lindahl 2001) and have verified the human capital model's assertion that increased education leads to increased wages. The rate of return to individuals (as demonstrated through wages) from education is widely accepted as being positive and demonstrable across income and development levels.

1.3 Macroeconomic Literature

Although private returns to education are well established, the link between education and aggregate income is surprisingly much more controversial. Pritchett (2001) examines several empirical growth models in conjunction with education levels and concludes that investment in education can be negatively correlated with growth in output. This apparent paradox between the microeconomic positive returns to wages from education and the macroeconomic lack of positive returns to growth suggests that something more complex than a direct connection between education and productivity exists. Pritchett posits that workers with more schooling may not actually possess better skills and therefore are not more productive in the labor force than their less-educated counterparts. In this case, a worker may still receive a higher wage due to the signal from his years of schooling, but would not actually contribute more efficiently or effectively to national income. Both Pritchett (2001) and Sylwester (2003) also discuss the potential problems created by sector resource allocation decisions. An individual may experience high returns to education by choosing a career that, as Pritchett explains, is "rent seeking and directly unproductive" (382); thus, the macro level returns would not support the link between this individual's education and increased productivity or growth in the economy. On an aggregate level, production may even slow if workers are matched with "unproductive" tasks on a large scale. Sylwester provides insights along the same lines, concluding that schooling may redistribute resources away from lower-income households and nations that need immediate capital stock for other ventures. Thus, although individuals are receiving higher wages for their increased education, macroeconomic projects may be operating inefficiently and thus creating a negative relationship between increased education and national income.

These concerns surrounding allocative efficiency do not preclude a positive link between education and growth, however. As Krueger and Lindahl (2001) discuss, once levels of capital and educational stock are taken into consideration, there is a strong positive relationship between education and growth. Pritchett's (2001) work fails to account for the interaction between these two stock variables and therefore does not consider the fact that the relationship between schooling and growth changes based on the initial stock of education in the country. Benhabib and Spiegel (1994) similarly account for educational stocks and find that there is a positive relationship between human capital accumulation and growth, and suggest that the educational stock variable may capture some of the macroeconomic externalities produced by education.

Krueger and Lindahl also note that Pritchett's use of an instrumental variable (IV) model does not produce robust results, because his choice of average years of schooling as an instrument for schooling growth does not embody the growth's true variability and therefore yields large standard errors. In their own application of an IV model for schooling using a newer data set to construct schooling growth as an instrument for education, Krueger and Lindahl find a positive relationship between education and growth, although the standard errors are still large. The authors conclude that IV estimates are largely inconsistent and should not be used as the primary econometric model when estimating macroeconomic results that include capital stock measurements. Accordingly, Krueger and Lindahl also perform various OLS specifications (using different rates of return, non-linear relationships among variables, etc.) and consistently find a positive relationship between education and growth that serves to support their initial IV method results.

As mentioned previously, even given a positive relationship between schooling and growth, the direction of causality is difficult to determine empirically. While Krueger and Lindahl (2001) demonstrate that initial stocks of capital and education are important determinants of growth, they do not specifically test for the direction of causality between growth and schooling. Bils and Klenow (2000) address this concern by creating a theoretical model where human capital accumulation is a function of expected future growth, concluding that schooling decisions are dependent upon the growth trends in the macroeconomy. The intuition behind this finding is that workers expect a higher future wage if the economy is growing rapidly, and thus it is beneficial to invest in schooling now (and thus forgo current earnings) for higher wages in the future. Although Bils and Klenow find evidence that growth influences schooling decisions, they also reaffirm previous studies that indicate that human capital accumulation encourages growth. By calibrating the model to be consistent with microeconomic returns to education from previous studies,[1] the authors find that human capital accumulation spurs growth both directly (through the labor force) and indirectly (through its interaction with technological progress) and enters most significantly as a stock from the previous generation. Thus, the positive relationship between education and growth is verified but the direction of causality is still ambiguous, with evidence pointing to both channels.

A closely related issue to the relationship between education and growth is the effect that schooling has on income inequality through redistribution. Eckstein & Zilcha (1994), Keller (2006), Marin & Psacharopoulos (1976), and Benabou (2002) explore this facet of the macroeconomic relationship and conclude that increased schooling investment leads to decreased inequality. Keller (2006) uses panel data to regress lagged education level variables on GINI coefficients from both developed and developing

[1] Bils and Klenow use data and results from many previous studies, including Psacharopoulos 1985 and UNESCO data from 1977 and 1983.

nations and concludes that investment in secondary education serves to decrease the income gap among countries. Marin and Psacharopoulos (1976) assess the effect of a change in the level of schooling in a country on the variance in the log of earnings in order to capture inequality effects. They conclude that, given U.S. data, one extra year of schooling leads to a decrease in the variance of log earnings by 10 percent, effectively reducing income inequality. Although this estimate may vary when particular rates of return and school investment data are used for developing nations, Marin and Psacharopoulos suggest that the positive link would still exist. Benabou (2002) specifically examines two alternate policies aimed at redistributing income: educational investment and taxes and transfers. Benabou determines that education finance produces higher income growth than a tax or transfer program; if about two-thirds of the difference in household education expenditures resulting from income disparities is offset (the upper 30 percent of the population subsidizing the bottom 70 percent through education investment), there would be a 7.3 percent efficiency gain in the economy, with six percent coming from increased aggregate income. Benabou concludes that redistributional measures through education would thus effectively lead to income growth. The issue of inequality as it relates to education is especially salient in Latin America, thus more attention is given to this subject in the specific discussion of Mexico in section 1.4.

Other macroeconomic studies focus on benefits from additional education other than growth. Haveman and Wolfe (1984) construct willingness to pay estimates for several non-market aspects of returns to education, including “improved citizenship” and changed valuation of leisure time. The authors conclude that estimated values for non-market returns to schooling indicate an underreporting of total returns in most studies that focus solely on private, easily measured benefits. Glewwe (2002) provides an example of the correlation between education and desirable social outcomes, noting that a study in South Africa by Duncan Thomas finds a strongly negative relationship between years of schooling and a woman's number of children. Similarly, the Inter-American Development Bank (IDB) reports that basic education is socially desirable, because it provides a foundation for future benefits such as improved health, lower birth rates, and higher standards of living (ESPLA 1998). Thus, conventional returns likely underestimate the true value of additional schooling.

1.4 The Case of Mexico

As mentioned previously, inequality is particularly pertinent to discussions of growth and development in Latin America. GINI coefficients in Latin America range between 43.4 (Venezuela) and 58.5 (Colombia) with Mexico falling in the middle at 48.1.[2] While there are nations with higher levels of inequality (Comoros is highest at 64.3), Latin America is the only region where all countries report GINI coefficients above 40. This inequality has a strong correlation with many other development tools and outcomes. The link between inequality and education is especially strong, and thus the discussion of education as a tool for growth and development in Latin America becomes a discussion of inequality as well.

There has been some discussion of investment in education in Mexico over the last several decades. Carnoy (1967) demonstrated that primary school investment was the

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[2] The numbers reported here reflect the average from 1992-2007 as compiled by the UNDP in its Human Development Reports.

most important for economic growth in Mexico at that time. Psacharopoulos (1996) provides more recent results indicating that secondary schooling yields higher returns. The more recent result hinges strongly on the fact that in the last three decades of the 20th century, primary education in Mexico became virtually universal (Psacharopoulos 1996). Most recently, the IDB reported that returns to secondary education in Mexico were 11 percent, lower than the 14 percent return to primary school (ESPLA 1998). These varying results may be due in part to inequality. The IDB report notes that workers in rural areas can earn up to 44 percent less than their counterparts in urban locations, suggesting that returns to schooling may vary greatly between the two areas (ESPLA 1998). Rural workers may benefit more from primary school education while urban workers may need secondary schooling to increase their expected wages most significantly. Similarly, as secondary schooling became more widespread in the last decade, there may have been a crowding of workers with secondary education, thus reducing the returns to this additional schooling in sectors with large populations of well-educated workers.

Despite the promising nature of many regional studies that focus on Latin America, the same concerns discussed above apply to these countries; sample selection concerns are especially problematic in countries where a large percentage of adults work in the informal sector. Glewwe (2002) notes that of formal sector workers in developing nations, a large percentage has government jobs that often have inflated, or artificially determined, wages that fail to accurately reflect educational background and thus underestimate the true returns to education. On the other hand, studies that only use wage earners may overestimate earnings due to the lack of less-educated workers who work in the informal sector and do not report earnings. Thus, especially in countries like Mexico where a large percentage of the population is employed in the informal or government sectors, estimates of the true returns to education may lead to either over- or underestimated values. The results from these studies are consequently unreliable if such sample selection biases are not addressed.

In his discussion of Latin American education investment trends, Behrman (1985) discusses two other potential omitted variable biases that are more prevalent in this region than elsewhere. First, Behrman notes that a failure to control for exogenous variables such as ability and family connections that may be associated with *both* schooling and wages is a substantial obstacle in Latin America. Exogenous variables such as indigenous background may play a strong part in both school access and wages, more so in Latin America than in more equal regions; much of the inequality in the region mirrors ethnic distributions, indicating that skin color and family background are associated with access to opportunities for advancement, thus leading to a biased result. Second, the "failure to control for geographical aggregation biases" (30) is a larger problem in Latin America than in many other developing regions due to the extreme inequality in capital availability among regions; as noted by Krueger and Lindahl (2001), capital stocks must be taken into account. By failing to control for these differences in physical capital availability among regions, results from empirical studies can easily misrepresent true returns to investment; an average for physical capital accumulation in an entire country would fail to capture the extreme differences in resources between poor and rich states. Behrman finds that traditional estimates of returns to education are significantly upwardly biased when controls such as those mentioned above are not used. Aggregate results for Latin American countries can easily overestimate returns to education if controls for unequal access to other resources are not taken into account. However, once Behrman controls for these potential biases, he still finds an average return of about 11 percent in his study of Brazil. He notes that these returns are still considerable, and likely do not capture the full value of the positive externalities that education provides. Thus, the positive relationship is unambiguously present in Latin American studies, but the value of the return varies based on the extent to which inequality is controlled for in the studies.

1.5 Conclusions

A review of the literature linking education and growth indicates some strong evidence that individuals as well as society benefit from investment in schooling. Higher wages and reduced inequality are only two of the many potential benefits. Including positive externalities that spillover into other facets of society, such as mortality rates and crime, would further imply that investment in education is beneficial for a developing nation. Despite results from some authors that suggest that education and growth are not positively related on an aggregate level, the methods employed to reach these conclusions have been refuted by more recent studies. The only conclusion that remains ambiguous is the direction of causality between education and growth; there is evidence to support causation from both directions.

Given the fact that education certainly yields private and social benefits, investment in schooling should be desirable for both individuals and governments. Many students, however, do not ever enroll in school or drop out early. In Mexico, the secondary school enrollment rate for children age 13 to 15 is 82.5 percent, but the enrollment rate for all older children, 13 to 18, is only 68 percent. Thus, dropout rates are high, especially compared with the secondary school enrollment rate of 88 percent for a developed country such as the United States (World Bank Group 2010). There are many factors that may influence these enrollment decisions in Mexico, including the potential for employment in the United States and the associated educational requirements (or lack thereof) for such jobs. There may also be measurable components of school costs, both direct and indirect, that potentially outweigh the benefits and serve to deter enrollment for these individuals.

Chapter 2: The Cost of Education and its Relationship with Enrollment Decisions for Mexican Households

It is well established that individuals receive a positive return to investing in their own education; more schooling almost always translates into higher earning potential. However, there are costs associated with investing in human capital accumulation rather than working or enjoying leisure time. These costs vary widely among and within countries and have not been thoroughly examined for many developing nations, including Mexico. Beyond serving as an indication of the magnitude of schooling costs, however, these measures may also inform a parent's decision to enroll his/her child in school. With universal primary and secondary education as one of Mexico's goals, it is useful to determine what the relationship is between a parent's decision to enroll a child (increase human capital) and the related costs.

2.1 Schooling Cost Theory

Many authors have discussed cost and expenditure components and their relationship with quality and quantity of schooling. In all evaluations of costs, it is clear that both public and private entities share the burden, and the degree to which each party's share affects schooling outcomes and decisions is central to policy recommendations. While many authors make the distinction between public and private costs, however, the specific definition of "private" varies widely in the field.

A substantial body of research defines "private costs" as those incurred by the private sector, i.e. businesses and for-profit organizations (James 1994, Jimenez 1986, World Bank 1986). When the private costs are defined in such a way, household demand for education is taken as exogenous. An alternative definition of "private costs" is given by some as costs incurred by the household (Verry 1987, Ilon & Moock 1991, Jacoby 1994, McEwan 1998), thus endogenizing the family's schooling demand. There is strong evidence to support the necessity of examining the demand side of education through the costs it imposes on private families. A cursory review of empirical results presented by Tsang (1994) reveals that the ratio of private (family) to public expenditures on education is substantial and in some cases greater than one; for example, the ratios in Brazil and Colombia are 1.11 and 0.51, respectively. In addition, the private costs in some instances comprise a large percentage of household income; measurements for the poorest 20 percent of households in Thailand in 1987 indicate that direct schooling costs were 16.3 percent of household income. Given the fact that families clearly incur substantial costs in many cases, a comprehensive cost analysis of education would require examination of household private costs, not just the for-profit sector private costs. Despite this fact, most of the literature takes household demand for schooling as exogenous (Jimenez 1986, James 1994) or forgoes a comprehensive individual cost structure that includes opportunity cost (Verry 1987).

In the small subset of work that does focus on household costs in an effort to characterize demand for schooling, there is a clear distinction between direct school costs (fees, books, uniforms, etc.) and opportunity costs (lost labor in family business, babysitting, etc.). There is not, however, agreement on which cost component more directly impacts schooling demand. Jacoby (1994) focuses on opportunity costs, ignoring direct expenditures, in an effort to tie demand decisions to household borrowing constraints in Peru. Using lifetime discounted utility for the household, Jacoby models attendance decisions and their relationship with siblings and other household resources. He concludes that borrowing constraints lead to a full-time/part-time switching point, the specific location of which is determined by comparative advantage calculations for all children; human capital investment (attendance in school) is only worthwhile for children who do not contribute as much to the family income.

In contrast, Ilon and Moock (1991) model attendance decisions using direct costs, opportunity costs, and extensive vectors of household and school characteristics to establish the relationship between private costs and demand for education in Peru. Their findings indicate that of the opportunity cost components, only work on the family farm significantly affects schooling decisions, while all of the direct costs have a great impact. For instance, low-income households are up to 19 percent more likely to enroll their children in school at an early age (between six and eight years old) if school fees and other direct costs are equivalent to those in the 10^{th} percentile of the sample rather than at the actual average level. Similarly, girls from low-, middle-, and high-income households are 18, seven, and one percent more likely, respectively, to stay in school if fees and other direct costs are equal to those at the 50^{th} percentile, compared with the actual higher levels for these subgroups. Socioeconomic factors, such as mother's education, also exhibited significant effects on school attendance for children. For instance, compared with the mother's true level of education, her children are up to eight percent more likely to ever be enrolled in school if she completes one additional year of schooling.

The combination of the Ilon & Moock and Jacoby studies indicates that both opportunity costs and direct costs have the potential to influence schooling decisions. Unfortunately, there are few other studies, especially within the last ten years, which examine specific household demand for education models; thus, there is a lack of evidence to support or refute the findings from these authors. Furthermore, both of the studies mentioned above focus only on Peru, with the Ilon and Moock study even more restrictively focused on *rural* Peru.

2.2 Analytical Framework and Methodology

The goal of this analysis is to expand on the literature and determine what components (such as household characteristics, community factors, and costs) affect a parent's decision to enroll a child in school. This decision is modeled by a combination of a Mincerian human capital model (1974) and Becker's household production model (1981). Although the individual who accumulates the human capital and trades leisure time for schooling hours is the child, I assume that parents or adult guardians make enrollment decisions for their children, especially given that this sample defines children as those under 16 years of age. Because a key component of Becker's model is the interdependence of utility functions, this specification fits well into the analytical framework.

Mincer's human capital model explains the relationship between schooling and training and wages. The empirical model is as follows:

$$wage = f(HK) = \alpha HK \tag{2}$$

where ***wage*** is expressed as a function of ***human capital (HK)***, and ***alpha*** is the return to the human capital investment. A more specific model proposed by Mincer describes the functional form of this relationship:

$$\ln(hourlywage) = \alpha_0 + \alpha_1 \exp erience + \alpha_2 \exp erience^2 + \alpha_3 s + u \tag{3}$$

where the ***log hourly wage*** is a function of a person's ***experience*** on the job, ***experience squared***, and years of ***schooling (s)***. Both experience and years of schooling are expected to have a positive relationship with wage. Because years of education thus contribute to determining an individual's wage, this model suggests that accumulating human capital in the form of years of schooling leads to positive private returns. Because this thesis seeks to explore human capital investment for children, I use a slightly altered model. Children do not usually have work experience that would lead to higher wages, so I substitute age for experience based on the assumption that an older child is stronger, more mature, and thus more productive; age should be positively associated with wage, just as experience was in equation (3) above. Thus, the basic human capital model for children is as follows:

$$\ln(hourlywage) = \alpha_0 + \alpha_1 age + \alpha_2 age^2 + \alpha_3 s + u \tag{4}$$

The other component of the analytical framework is Becker's household production model, which establishes both the relationship between labor and other household activities and the household decision-making process that leads to collectively maximized utility. The theoretical model is as follows:

$$\begin{aligned} &\max U = U(current\,consumption, future\,consumption) \\ &s.t. \quad px + wl = I \end{aligned} \tag{5}$$

Households maximize collective utility in terms of ***current consumption*** and ***future consumption***, subject to a budget constraint where the value of market goods (***price (p)*** times ***quantity (x)*** of all goods) plus the value of lost labor (***wages (w)*** times ***leisure (l)*** hours) must equal household ***income (I)***. The ***current consumption*** consists of time (both for parents and children) and market goods, which can be combined in order to maximize utility, but due to the budget constraint are not unlimited. The ***future consumption*** is the discounted value of market goods and time in a future period, similarly combined to maximize utility within the constraints of a household's income. This future consumption itself is a function, in part, of the children's ability to provide income in the future:

$$future\,consumption = f(future\,income) = f(s) \tag{6}$$

where ***s*** is children's years of schooling. The link between years of schooling and future income comes from the human capital model established in equation (4). Thus, any maximization choices toward future consumption require, in part, that children receive schooling in the current time period. The extent to which each household prefers current consumption to future consumption (the household's discount rate) will in part determine how each household solves its maximization problem; households with lower discount rates will have a smaller current to future consumption ratio than those households with higher discount rates. Thus, low discount rate households may require that their children obtain more education.

In this household production model, the standard utility maximization rule applies, specifically that the ratio of marginal utility to price must be equalized across all goods, both current and future:

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y} = \ldots = \frac{MU_n}{P_n} \tag{7}$$

Thus, if the price of one good increases, the household will necessarily consume less of it. Consumption of market goods, leisure time, and schooling all conform to the decision models established in equations (2) through (7).

The specific component of the household production function that I will explore is the decision to enroll a child in school. Thus, I use an empirical model where the dependent variable of interest is a binary enrollment variable. Based on the other components in the household production model, and following Ilon and Moock (1991), there are four categories of independent variables that comprise the decision model: individual child and household characteristics, opportunity costs, school access, and direct school costs. All of these variables affect the values in the utility maximization problem as given in equation (5); for example, household income provides information for the budget constraint while access to schools affects the price of education.

Based on the nature of the empirical question, I chose a probit model for the analysis. Although other authors (such as Ilon & Moock) have used a logit framework, Hahn and Soyer (2005) indicate that the differences between the probit and logit outcomes in a univariate (dependent) analysis are minimal. Due to the prevalence of probit models in household production and labor-related empirical work, I use the following probit model:

$$p(enrolled) = \beta_0 + \beta_1 direct + \beta_2 transportation + \beta_3 X + \beta_4 Y + \beta_5 Z + u \qquad (8)$$

where ***p(enrolled)*** is the probability of enrollment, the betas are parameters, ***direct*** is the direct school costs, ***transportation*** is the transportation cost to attend school, ***X*** is a vector of opportunity cost measures, ***Y*** is a vector of child and household characteristics, and ***Z*** is a vector of school access variables. Based on the human capital and household production models, we can predict the sign of the relationship between the dependent and independent variables.

Direct costs relate to the price of schooling. Given the utility maximization rule in equation (7), we know that if the price of a commodity increases, the amount consumed will decrease. Thus, if direct costs increase, we expect consumption of schooling to decrease, thus decreasing the probability that a child will enroll in school. We therefore expect a negative relationship between direct costs and the probability of enrollment. Similarly for transportation costs, we expect a negative relationship to exist between these costs and the probability of enrollment; as transportation costs increase, the quantity of transportation to school that the household consumes should decrease, and thus the probability of enrollment should decrease as well.

The opportunity cost variables represent other market and non-market goods that a household can choose to consume instead of schooling. If a child works, he is less likely to be enrolled in school because he has chosen to "consume" time working in the current period rather than consuming education or material goods. Every hour spent working is one hour that a child cannot be in school. Thus, we expect a negative relationship between a child's employment and enrollment in school. Similar relationships should exist for the dummy variables that indicate if a household owns a farm or a business. Work in a family business or in the household caring for other family members uses time that could otherwise be used for school. The final measure of opportunity cost, child's wages, should also exhibit a negative relationship with the probability of enrollment in school. Wages are essentially the price of time spent not working (leisure, schooling, other household activities), as shown in equation (5); thus, the higher the wage, the less non-work time the household will consume. As a child's wage increases, we expect the probability of enrollment to decrease.

Child and household characteristics inform a household's preferences and thus ultimate decisions when maximizing utility. Household income is represented in the budget constraint in equation (5). As income increases, the household is able to consume more of everything, including schooling. Thus, we expect a positive relationship between household income and the probability of enrollment. In order to determine the relationship between a child's age and his/her probability of enrollment, we begin with equation (4). According to the model, an older child is more productive, and thus should earn higher wages, all else equal. Given that age is positively related to wages, we then refer to the explanation above concerning the association between a child's wage and his probability of enrollment. Using equation (5), we know that the wage is the price of non-work time (such as school), and thus as the wage increases, the quantity of schooling consumed must decrease according to the utility maximization rule. Thus, we expect a child's age and his probability of enrollment to be negatively related.

Mother's and father's education enter the model in a more indirect way. Higher levels of parental education might indicate a preference for schooling that would manifest in a higher level of marginal utility that the household derives from sending individuals to school. Thus, higher parental education would lead to more consumption of education for the children, leading to a greater probability of enrollment (a positive relationship). Parental education could also enter the model through the discount rate. Investment in human capital implies a willingness to defer current consumption in favor of higher future consumption. Thus, if parents have chosen to invest in their own education, they might have lower discount rates than parents who chose to discontinue their own schooling early on. A lower discount rate implies a greater ratio of future to current consumption; if this is true, households with lower discount rates would need to invest more in children's human capital investments in the current time period, as discussed in equation (6). Thus, parents with higher education may have lower discount rates, thus investing more in a child's education in the present. This link suggests a positive relationship between parents' education and a child's probability of enrollment. The relationship between a mother's age and her child's probability of enrollment follows a similar explanation. An older mother may be more concerned about her child's ability to support her in old age, and thus prefer to invest more in her child's human capital now in favor of future consumption. An older mother may also serve as a proxy for the presence of older siblings in the household. If more older siblings are present, then there are more people who are likely to complete household chores or earn wages. Thus, the child's opportunity cost of attending school decreases. Both of these relationships suggest that a mother's age is positively related to her child's probability of enrollment.

A child's gender and indigenous background are two variables that may be positively or negatively related to school enrollment. Since girls may earn lower wages than boys due to discrimination, we would expect girls to have a higher probability of being enrolled (given the relationship between wages and enrollment as discussed earlier), and thus a *positive* relationship between girls and enrollment. However, lower wages could also reduce future expected consumption (according to equation 6), reducing the benefits from investing in human capital in the present. Thus, we would see a *negative* relationship. Similarly ambiguous, indigenous populations could have either a positive or negative relationship with enrollment. Because indigenous populations were historically underserved in schooling access, they could be less likely to be enrolled; however, the modern attempts to improve schooling for these populations and actively increase school access may create a positive relationship between the two variables.

School access variables and a dummy variable for rural households are the final variables in the model. We expect that the presence of schools in a community will be positively related to a child's enrollment. The closer a school is to a child's home, the lower the costs of attending (transportation, time lost in transit); thus, as discussed earlier, if the price of schooling decreases, the household will choose to consumer more of it. Additionally, the presence of higher-level schools (above elementary level) may also suggest a community or household preference for schooling, since households may choose their location based on school availability. This preference would increase the marginal utility that a household receives from consuming education, and thus we expect the household to increase its consumption. Both of these explanations suggest a positive relationship between access to schooling and enrollment. Conversely, we would expect households in rural communities to experience higher costs of school attendance (farther from schools), and thus have a negative relationship with enrollment.

Table 3 provides a list of the variables included in the empirical model (equation 8) along with their expected signs.

Table 3: Model components

Model component	Variables included	Expected sign
direct	Direct costs	-
transportation	Transportation costs	-
X (opportunity cost)	Child works Wage Owns farm Owns business	- - - -
Y (child and household characteristics)	Age Female Indigenous language Household annual income Mother's education Father's education Mother's age Rural location	- ? ? + + + + -
Z (school access)	Distance school in area Jr high is highest school in area High school is highest in area University is highest in area	+ + + +

2.3 Description of the Data

In order to evaluate individual-level schooling decisions, I use the Mexican Family Life Survey from 2005. Constructed by the Mexican National Bureau of Statistics (INEGI) in conjunction with researchers from the University of California Los Angeles, the National Institute of Perinatology (INPER), the Center for Economic Investigation and Teaching (CIDE), and the Universidad Iberoamericana (UIA), this nationally representative survey contacted 8437 households in 295 communities. The collected information ranges from household expenditures to individual health characteristics. In addition, community data for infrastructure and price levels were also collected. The survey is probabilistic, multi-staged, stratified by geographic and socioeconomic characteristics, and clustered. INEGI's sampling design ensured that accurate representation at the national and regional level was possible, and thus researchers oversampled rural populations. Because of this oversampling, I use household weights in the characterization of direct costs in order to accurately represent the true population.[3]

The sample used in this analysis consists of households with children (defined here as ages five to 16)[4] that responded to the question "Is the child enrolled in school?" This qualification yielded 7007 usable child records in the 295 community areas defined in the survey. Of the 7007 child observations that had data for the enrollment question, 5395 also reported other household and child characteristics. Thus, the final sample used here has 5395 children in 3027 households. Table 4 provides summary statistics detailing the characteristics of the sample. The observations are distributed almost equally between

[3] Sample weights for the 2005 data are not yet available. However, because the re-contact rate from the 2002 to 2005 surveys was close to 90%, the weights from each year are expected to be very similar. I therefore use the 2002 household weights in this analysis.

[4] Although the official enrollment age for primary school in Mexico is six, 85 percent of the 486 five-year-olds report being enrolled; thus, they were included in the sample. Compulsory education in Mexico extends through the end of secondary school, roughly age 16 (ILAB 2010).

girls and boys (51 percent female) with the average age about 9.7 years old. Slightly more than one third of the sample lives in a rural area (35 percent), and the average household annual income is about 55,500 pesos (US $5,073).[5]

Table 4: Descriptive Statistics

Variable Name	Description	N	Mean	Std. Dev.	Min	Max
Enrolled	Binary, enrolled=1	5395	.951	.217	0	1
Indigenous language	Binary, speaks indigenous language at home=1	5395	.135	.341	0	1
School type	Public=1, Private=0	4458	.959	.197	0	1
Child works	Binary, child employed=1	5395	.040	.196	0	1
Household annual income	Household annual income, in pesos*	5395	55550	61393	27	1008000
Mother's education	Mother's highest level of education in years	5395	7.0	4.1	0	21
Father's education (reported values only)	Father's highest level of education in years	4310	7.2	4.4	0	19
Father reported education	Binary, father reported=1	5395	.688	.463	0	1
Age	Age of child	5395	9.7	2.9	5	15
Female	Binary, female=1	5395	.505	.500	0	1
Rural	Binary, town of less than 2500=1	5395	.350	.477	0	1
Direct costs	Direct school costs annually, averaged by community, in pesos*	5395	1410	2664	56	23287
Wage	Child's log hourly wage, averaged by community and gender, in pesos* (delogged values in parentheses)	5395	.703 (2.02)	1.057 (2.9)	-.875 (.417)	5.704 (300)
Transportation costs	Transportation costs per month, averaged by community, in pesos*	5395	210	359	0	3737
Mother's age	Mother's age, in years	5395	36.3	7.1	18	72
Owns farm	Binary, family owns a farm=1	5395	.158	.365	0	1
Owns business	Binary, family owns a business=1	5395	.114	.317	0	1

Source: Mexican Family Life Survey 2005 and author's calculations
*peso:dollar conversion rate for 2005 is 10.94:1

Direct Costs

The direct costs for schooling include money spent on fees, tuition, books, materials, and uniforms during one school year; the survey asked respondents to report the combined value of these costs for the previous school year. Of the 5395 children in the sample, 5311 report direct costs; of these, about 562 report that direct costs were zero even though the child was enrolled in school. Because the majority of children attend public school (78 percent), it is not unlikely that families incur minimal costs for fees,

[5] The peso to dollar conversion rate for 2005 was 10.94:1

tuition, and books. The maximum direct cost reported is 82,700 pesos for a student who attends private school, and about 52,000 for a student in secondary public school. These reported values should be taken as rough estimates, however, given the discrepancy between the reporting date and the time in which the money was actually spent. In his book discussing household surveys, Deaton (2000) warns that cost and expenditure estimates tend to decline as more time passes between the payment date and the survey date. While a longer timeframe more accurately represents an average expenditure and avoids capturing anomalous data points, respondent recall becomes weaker as the time period increases (25). Because the collection of direct cost information in this survey referred to the previous school year, recalled estimates are likely biased downward.

Table 5 more closely examines the distribution of reported direct costs (for households with children who are enrolled) among different household and community types.

Table 5: Direct Annual Costs per Child (in pesos) for Households with Enrolled Children (Standard deviations in parentheses)

	Household with Primary Age Students Only	Household with at least one Secondary Age Student
Mother's Schooling		
None	782	779
	(178)	(125)
Primary	1,007	1,581
	(120)	(412)
Secondary	1,833	3,191
	(214)	(774)
Post-Secondary	7,105	10,472
	(1,344)	(4,021)
Father's Schooling		
None	693	517
	(103)	(64)
Primary	1,077	1,190
	(157)	(185)
Secondary	1,719	1,856
	(234)	(452)
Post-Secondary	4,010	10,170
	(841)	(3,515)
Type of School		
Public	1,240	2,062
	(108)	(412)
Private	13,020	13,533
	(2,204)	(3,741)
Child is employed		
No	2,171	2,635
	(218)	(480)
Yes	3,747	2,530
	(2,678)	(1,298)
Area		
Large City (>100,000)	2,618	3,218
	(379)	(826)
Small City (15,000-100,000)	1,382	3,558
	(294)	(2,302)
Town (2,500-15,000)	2,717	4,663
	(849)	(1,888)
Rural (<2,500)	1,801	1,276
	(233)	(147)

Table 5 (cont'd)

	Household with Primary Age Students Only	Household with at least one Secondary Age Student
Household Annual Income		
Low	1,111	867
	(256)	(135)
Middle	1,718	1,626
	(297)	(428)
High	3,831	5,019
	(636)	(1,327)
Region		
Northern	2,474	2,138
	(453)	(409)
Central	1,857	2,331
	(257)	(559)
Southern	2,987	3,782
	(654)	(1,296)
Indigenous Language at Home		
No	2,307	2,585
	(245)	(492)
Yes	1,538	2,836
	(537)	(1,123)
Gender		
Female	2,442	2,282
	(361)	(531)
Male	1,975	2,996
	(258)	(741)
N (households)	1871	1102

Source: Author's calculations using MXFLS 2005 data, household sample weights used

There are several clear patterns in this data. Private schooling is more than ten times as expensive as public schooling, and there is no great difference between the cost of primary and secondary school of either type. Students in rural areas seem to pay at least 2000 pesos (about $200) less for secondary schooling than their peers in larger towns and cities. Given that the overall mean of these averaged direct costs is about 1700 pesos, this decrease in costs for the rural areas seems to be significant. As we would expect, higher income households (over 63,000 pesos a year)[6] spend more than three times as much on schooling as do low income households (those below the average of Mexico's four minimum wages of about 17,000 a year), while there is not much difference in schooling costs between low- and middle-income families. This jump in spending by higher income households may be due to a higher prevalence of private school attendance (seven percent of high income children attend private school compared with four percent in the general sample).

Interestingly, families pay more for primary school if their children also work. This fact may be due to the extra income that households have from children's wages, but we more often observe that households where children work are lower income and thus would not use "extra" wages to pay for schooling, rather for food, shelter, etc. In this sample, low-income households have the highest percentage of children who work (6.14 percent) compared to middle- and high-income families (with 3.37 and 4.12 percent of children working, respectively). Because children who work are not more likely than

[6] The average wage in Mexico for 2008 (the 2005 data was not available) was about 62,700 pesos. The average of Mexico's four minimum wages in 2008 was about 16,900 pesos (Mexico Facts). I therefore chose to divide the income categories roughly along these boundaries. In the given sample, 15.88 percent of households are "Low Income," 54.63 percent are "Middle Income," and 29.48 percent are "High Income."

average to attend private school (about four percent do, the same as the general sample), we cannot attribute these higher costs to private school fees and tuition.

The final categories of the direct cost analysis that are noteworthy are parents' education. There is a clear pattern that indicates that more educated parents spend more on their child's education. Much of this increase in costs stems from a dramatic jump in the number of students who attend private school (15 percent) if at least one parent has attended college; only two percent of students without at least one college-educated parent attend private school. These cost measures are one way to see the intergenerational transfer of educational standards; less than one percent of students who have at least one college-educated parent are not enrolled in school, and this high attendance rate is reflected in the higher costs that these families are willing to pay to send their children to school.

In general, these household direct schooling costs are small compared to public expenditure on education. In 2005, public expenditure per primary school student was 14 percent of GDP per capita, or about 11,405 pesos; public expenditure per secondary school student was a bit higher at 15 percent of per capita GDP, or about 12,220 pesos (World Bank Group 2010).[7] With the exception of parents who have a college education and private school students, none of the households spend more than about 38 percent of the public expenditure. Recalling work by Tsang (1994), a ratio of private (household) to public expenditure on students of 0.38 is not high compared with other Latin American countries; Brazil and Colombia have ratios of 1.11 and 0.51, respectively. The average (weighted) household income for this sample of students is 58,432 pesos while the

[7] According to the CIA World Factbook, GDP per capita for Mexico in 2005 was US $7,446.86. The 2005 peso:dollar exchange rate was 10.94:1, thus GDP per capita in pesos for 2005 was 81,468. 14 and 15 percent of this total is 11,405 and 12,220, respectively.

average (weighted) direct cost per student is 1,731 pesos. Thus, direct costs per student are, on average, three percent of household income, an estimate lower than most reported in other developing countries (Tsang 1994).

In order to use these direct costs as an independent variable in the model, we need to create a proxy for direct costs for those children who are not attending school in order to avoid a perfect correlation between not being enrolled and having zero direct costs. (Children who do not attend school do not have direct costs by definition.) The proxy direct costs variable should control for as many community characteristics as possible in order to accurately predict what the value would be if the child were enrolled. Thus, I created a variable that is the average of direct costs in the child's community (as defined by the community identifier in the survey). In this way, each community now has a direct cost per child measure that is an average of the reported values from member households. Because most households did report direct costs, the predicted values for the missing observations are expected to be good approximations. The average values also serve to temper outliers, as can be seen from Table 4 where the maximum value of the *average* direct costs has dropped to 23,000 from the 82,700 maximum reported.

Opportunity Cost

The primary activity choices for a child in Mexico are to attend school or to work, either at home or in a market setting; 216 children (four percent of the sample) report being employed in the last 12 months, and 182 of these also attend school.[8] Although a child's employment status may be a fair predictor of whether or not that child is enrolled in school, the variable itself does not act as a good measure of opportunity cost, because

[8] The legal employment age in Mexico is 14, with special provisions for workers under 16 (ILAB 2010). In this sample, however, 156 of the 216 working children are under the age of 14.

the two are highly correlated due to time constraints; because there are a limited number of hours in the day, a choice to work automatically decreases the number of hours available for school, and vice versa. Thus, using the simple binary child employment variable to fully embody the opportunity cost only captures this time allocation portion. In order to sufficiently capture the opportunity cost of enrolling in school, other variables are necessary.

The best measure of opportunity cost for adults attending college, for example, is the wage that could be earned outside of school. The obstacle to using wages for children is the fact that only four percent of these students are working; thus, 96 percent of the sample population does not have a reported wage. A common way to overcome missing data is to impute the missing values. In doing so, however, the results may be biased due to sample selection. The four percent of students who are working may choose to do so because their wages are high enough to offset the lost leisure time. Conversely, those children who work may be from liquidity constrained, poorer households and consequently may be less productive at work (due to poorer nutrition, perhaps) and receive lower than average wages. Thus, simply using the wages of the employed students as a guideline for every student's wage could over- or underestimate the true wages for the sample. The solution to this potential selection bias problem is to use the Heckman model (1979) to impute the missing values.

In constructing imputed wages for these students, a basic human capital model based on Mincer's 1974 model is used for the first-stage wage equation. As discussed earlier, the basic model is altered to substitute age for experience, given the fact that children likely do not have work-related training that affects wages. The resulting human capital model for children is based on equation (4), with the addition of two control variables for gender and rural location:

$$\ln(hourlywage) = \alpha_0 + \alpha_1 age + \alpha_2 age^2 + \alpha_3 s + \alpha_4 female + \alpha_5 rural + u \qquad (9)$$

where ***ln(hourly wage)*** is the log of the hourly wage reported by children who work, the alphas are parameters, ***s*** is years of schooling, and ***age, female,*** and ***rural*** are child characteristics as defined in Table 4.

The second-stage selection equation must include a variable that likely predicts whether or not a child is employed (in order to correct for the sample selection bias) but does not predict the child's wage. In a similar computation, Binder and Scrogin (1999) find that mother's employment status serves as a viable selection variable for imputing a child's wage. Because this variable is not readily available in the sample, mother's education was tested as a possible alternate choice for a selection variable. The result is that mother's education did predict whether her child was employed but did not have a statistically significant influence on her child's wage.[9] Thus, the second-stage selection equation included mother's education as the selection variable.

The resulting model is as follows:

$$predicted\,wage = \alpha_0 + \alpha_1 age + \alpha_2 age^2 + \alpha_3 s + \alpha_4 female + \alpha_5 rural + \lambda + u \qquad (10)$$

where ***predictedwage*** is the imputed wage, the alphas are parameters, ***s*** is years of schooling, ***age, female,*** and ***rural*** are child characteristics as reported in Table 4, and the ***lambda*** term is the calculated value from the Heckman equations.

[9] Mother's education was statistically significant and negatively correlated with her child's employment status (marginal effects coefficient estimate: -.002, standard error: .0007). On the other hand, mother's education was not statistically significant in her child's wage equation but the coefficient was still negative (coefficient estimate: -.041, SE: .030)

The results from running the Heckman two-stage procedure indicate that the model does not perform well. While the variables in the selection equation were significant, the resulting imputed wage model only produces one significant variable, gender. In other words, the created model will not accurately predict a child's wage. The most likely explanation for this outcome is that a child's wage may be highly variable and not depend on the standard components of a human capital model. Using the observations from children who do report a wage, I run the human capital model from equation (9) in order to determine if children's wages follow the same theoretical pattern that Mincer suggested. The result is presented in Table 6; only the dummy variable for rural community is significant and years of education and age have signs opposite those we would expect. This result strongly suggests that children's wages in our sample do not closely follow the standard human capital model and thus cannot be imputed using such a framework.

Table 6: OLS estimates for Children's Wages
(Standard errors in parentheses)

Variable	Coefficient
Years of education	-.0302 (.0579)
Age	-.3508 (.4964)
Age^2	.0284 (.0216)
Rural community	.5721** (.1921)
Female	.3267 (.2090)

Note: Sample is based on those children who directly report wages; n=139
** p<0.05, * p<0.1

In order to establish some kind of wage measure, we can use the community information for each child rather than an imputed wage. Because wages are likely to vary among communities based on local factors, we can create an average children's wage for each community. In addition, we separately find the mean wage for girls and boys in each community. Thus, the wage variable used in the final models is an average of community wages by gender. Using this wage allows us to model what we expect to be a significant opportunity cost for attending school while also acknowledging the extreme variability of children's wages in the sample.

Due to the uncertainty surrounding wage measurements, it is important to include other variables that capture opportunity cost as well. Although only four percent of the children in the sample report being employed, there may be many more children who work at home for their relatives on a family farm or in a family business. These children likely wouldn't report employment, much less report a wage; however, working for a relative may directly influence a family's decision to send a child to school. In order to capture this potential opportunity cost, we can use information about family ownership of a farm or business. Thus, I include two dummy variables (for ***owning a farm*** and ***owning a business***) as additional measures of opportunity cost.

Another opportunity cost measure that is supported in the literature (Jacoby 1994, Ilon & Moock 1991) is the number of siblings and birth order. Unfortunately, the available data did not include this information for much of the sample. Instead, ***mother's age*** is used as a related measure to birth order and number of siblings. An older mother is used as a proxy for there being older children in the household, a situation that might reduce the opportunity cost for the observed child. ***Mother's age*** was constructed by first matching each child with his/her mother and then including the woman's age information from the adult files.

Transportation Costs

Survey respondents reported the cost of transportation one-way to school for the previous month. Just as with the direct costs, a community average is used in the empirical analysis in order to account for the lack of transportation costs for those children not enrolled.

Child and Household Characteristics

The data for ***age*** and ***female*** come directly from household roster questions asked by the interviewer and are given for each child in the household under 16 years of age. ***Rural*** location was created using the size of the household's town or city; rural locations are classified by the survey developers as those with fewer than 2500 inhabitants. Respondents were also asked to indicate whether or not the child spoke an indigenous language at home, providing data for the ***indigenous language*** variable. ***Household annual income*** was created by summing the reported annual income for all adults in the household; the reported incomes include wages earned from market-based employment and from self-employment. ***Mother's education*** and ***father's education*** were created by first matching each child with his/her mother and father in the data set and then including the survey respondent's answer to the question "what is the highest level of schooling that this (adult) individual has achieved?" While ***mother's education*** comes directly from these reported values, the father's variable required more manipulation. Because the response rate for father's education was low (only 4310 out of the 5395), I created two variables in order to keep the integrity of the entire sample. ***Father's response*** is a dummy variable that indicates whether or not the father's education is reported, and

father's education is an interaction variable equal to the binary response variable times the reported education. This way, ***father's education*** has observations for the entire sample of 5395, but we are still able to distinguish between those fathers who truly reported zero years of education and those who simply did not answer the question.

School Access Variables

All five school access variables come from the community files in the survey. For each of the 295 communities, an administrator or other official responded to questions regarding local infrastructure and prices. The five school access variables indicate responses to the question, "Is there a (elementary/jr.high/high/university/distance school) in the area?" Because 95 percent of communities have an elementary school,[10] I created a dummy variable indicating the highest-level school in the area; thus, ***jrhigh***, ***high***, and ***university*** take the value of "1" if the community does not have any higher-level schools. Therefore, elementary schools are taken as the base category in the dummy variable analysis. Distance schools are left as a unique variable.

2.4 Empirical Results

I ran three specifications of the model presented above in equation (8), with standard errors calculated for clustering by household. Table 7 presents the marginal effects results. All three models include direct and transportation costs, while Models 2 and 3 add subsequently more detailed information about child characteristics and community variables indicating access to schooling.

[10] The distribution of elementary schools is not correlated with a child's enrollment; 95.05 percent of children who are enrolled have an elementary school in their area, while 94.97 percent of those who are not enrolled have an elementary school presence.

Table 7: Probit Estimates, Marginal Effects
(Robust standard errors in parentheses)

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
Direct costs/1000	-.0016**	-.0016**	-.0021**
	(.0009)	(.0008)	(.0008)
Transportation costs/1000	-.0083	-.0083	-.0086
	(.0096)	(.0088)	(.0087)
Child works	-.0712**	-.0670**	-.0665**
	(.0203)	(.0194)	(.0191)
Female	.0110**	.0116**	.0119**
	(.0042)	(.0040)	(.0040)
Age	.0698**	.0655**	.0649**
	(.0058)	(.0056)	(.0055)
Age squared	-.0036**	-.0034**	-.0033**
	(.0003)	(.0003)	(.0003)
Rural	.0051	.0050	.0052
	(.0047)	(.0044)	(.0043)
Mother's education	.0050**	.0039**	.0038**
	(.0007)	(.0008)	(.0008)
Wage	.0028	.0026	.0023
	(.0021)	(.0020)	(.0019)
Father reported schooling		-.0121**	-.0115*
		(.0062)	(.0061)
Father's education		.0033**	.0031**
		(.0008)	(.0008)
Mother's age		.0004	.0004
		(.0003)	(.0003)
Owns farm		-.0016	-.0023
		(.0056)	(.0057)
Owns business		.0077	.0082
		(.0057)	(.0055)
Indigenous language		.0068	.0079
		(.0056)	(.0054)
Household annual income/1000		-.0001	-.0001
		(.0005)	(.0005)
Distance school in area			.0029
			(.0047)
Jr. high is highest school in area			.0080
			(.0060)
High school is highest school			.0097*
			(.0053)
University is highest school			.0110*
			(.0057)
Observations	5395	5395	5395

** p<0.05, * p<0.1
(Standard errors calculated for clustering by household)

In all three models, direct costs are highly significant. Economically speaking, if direct costs increase by about $100 (1094 pesos), then the probability of a child being enrolled declines by between 0.16 and 0.20 percentage points; if direct costs increase by one standard deviation (2664 pesos, or about $243), the probability of enrollment decreases by about 0.48 percentage points. While not a large effect, direct costs are systematically related to schooling choices.

Of the individual child characteristics, gender, age, and parents' education are the most significant. Consistent with the examination of direct costs made earlier, for every extra year of education a parent has, the probability of his/her child being enrolled in school increases by about 0.4 percentage points. A mother with additional education equivalent to one standard deviation (about four years) has an increased probability that her child is enrolled of about 1.3 percentage points. Interestingly, age has a sign opposite what we expect, indicating that older children are more likely to be enrolled. However, the highly significant age squared variable indicates an inverted-U shaped relationship between age and enrollment. In this sample, enrollment increases up to age 9.74 and then begins to decline; the positive portion of the relationship must be stronger than the negative to drive the coefficient on the age variable. The dummy variable for female has a statistically significant and positive coefficient, indicating that girls are about one percentage point more likely to be enrolled than boys. As discussed in section 2.2, the relationship between gender and enrollment was theoretically ambiguous; the empirical results reveal that in this sample, the positive relationship is stronger, although girls do not receive statistically significantly lower wages than boys, as postulated earlier.

Of the opportunity cost measures, only the dummy variable indicating whether or not the child was employed is significant; if a child works, his/her probability of enrollment decreases by about seven percentage points. This result is economically large and to be expected, since the choice between working and going to school is a time allocation decision; a child who works automatically has less time to attend school. Furthermore, this result may also help to explain why secondary school enrollment is lower than primary school enrollment (86 and 95 percent, respectively). Of children who are secondary-school age (13-15), 9.67 percent work; only 2.49 percent of younger children are employed.

Although not directly an opportunity cost variable, whether or not the father reported years of schooling is also significant and may serve as an opportunity cost measure. If a father reported schooling, his child is about one percentage point less likely to be enrolled than a child whose father did not report schooling. A possible explanation for this relationship is that a lack of father response indicates the father's absence during the interview, possibly due to employment. On the other hand, a father who did respond to the schooling question may have been home during the interview rather than at work. If a father does not work, then the children may have to work instead to contribute to the family income. Because the correlation coefficient between the father's response and the child's employment is -0.034, it does not seem to be the case that children work in the market in place of their fathers. However, children may stay home with younger siblings while their mothers work in the father's stead, thus leading to lower enrollment probabilities for these children.

Finally, access to higher levels of education in the community is statistically significant at the five percent level. Compared with children who only have elementary schools in their communities, children with high schools are 0.97 percentage points more likely to be enrolled in school, while children with universities in their communities are 1.1 percentage points more likely to enroll.

I also ran four subgroup specifications in order to examine segments of the sample that may behave differently. For instance, because 95 percent of all children are enrolled, examining the entire sample may not yield meaningful information in regards to enrollment deterrents. Rather, examining only secondary school students (86 percent of which are enrolled) could lead to clearer results. In addition, subgroups using just public school children and just girls could provide a different perspective. Table 8 reports the results from these subgroup specifications.

Table 8: Subgroup Probit Estimates, Marginal Effects
(Robust standard errors in parentheses)

VARIABLES	(1) Secondary	(2) Public	(3) Girls	(4) Secondary Girls
Direct costs/1000	-.0059**	-.0022**	-.0018**	-.0055**
	(.0018)	(.0008)	(.0007)	(.0018)
Transportation costs/1000	.0098	-.0092	-.0052	-.0044
	(.0178)	(.0093)	(.0075)	(.0148)
Child works	-.0932**	-.0710**	-.0348	-.0316
	(.0275)	(.0203)	(.0237)	(.0325)
Female	.0188**	.0127**		
	(.0094)	(.0042)		
Age	-.1340	.0681**	.0537**	-.4810**
	(.1800)	(.0057)	(.0070)	(.2450)
Age squared	.0041	-.0035**	-.0028**	.0174*
	(.0069)	(.0003)	(.0004)	(.0093)
Rural	.0126	.0053	.0025	.0031
	(.0100)	(.0046)	(.0047)	(.0124)
Mother’s education	.0054**	.0039**	.0022**	.0019
	(.0016)	(.0008)	(.0008)	(.0019)
Wage	.0036	.0025	.0013	.0059
	(.0041)	(.0020)	(.0021)	(.0053)
Father reported schooling	-.0184	-.0122*	-.0149**	-.0168
	(.0135)	(.0064)	(.0058)	(.0158)
Father’s education	.0044**	.0033**	.0039**	.0049**
	(.0017)	(.0008)	(.0009)	(.0021)
Mother’s age	.0007	.0004	.0006	.0016
	(.0008)	(.0003)	(.0003)	(.0010)
Owns farm	-.0181	-.0024	-.0020	-.0278
	(.0151)	(.0060)	(.0071)	(.0215)
Owns business	.0093	.0086	.0070	.0017
	(.0140)	(.0059)	(.0065)	(.0196)
Indigenous language	.0140	.0084	.0110**	.0155
	(.0110)	(.0058)	(.0046)	(.0120)
Household annual income/1000	.0000	-.0002	-.0002	-.0013
	(.0011)	(.0006)	(.0005)	(.0008)
Distance school in area	.0213*	.0031	.0029	.0099
	(.0110)	(.0050)	(.0051)	(.0137)
Jr. high is highest school in area	.0280**	.0087	.0064	.0285**
	(.0109)	(.0062)	(.0060)	(.0110)
High school is highest school	.0239**	.0105*	.0152**	.0318**
	(.0106)	(.0056)	(.0046)	(.0096)
University is highest school	.0332**	.0114*	.0121**	.0475**
	(.0116)	(.0056)	(.0056)	(.0136)
Observations	1754	5214	2727	871

** p<0.05, * p<0.1
(Standard errors calculated for clustering by household)

Regardless of the model restrictions, direct costs are statistically significant. In smaller samples, an increase in direct costs of one standard deviation leads to a decrease in the chance of enrollment by more than for the entire sample. The model restricted to secondary-age students reports that an increase in direct costs of one standard deviation leads to a decrease in the probability of enrollment of 1.57 percentage points; compared with a decrease of 0.53 percentage points in the full sample, the restricted model effect is much larger. Thus, secondary-age students are more sensitive to direct costs when making enrollment decisions. In general, we see that the same child, household, and community variables are significant. The child employment variable, however, is no longer significant for the subgroup of girls. This result is consistent with the characteristics of working children; 2.97 percent of girls work compared with 5.06 percent of boys. Two variables of note in the subgroup estimates are mother's education and age. Given secondary-age girls, father's education is still statistically significant, but mother's education loses its statistical significance. Age, on the other hand, is still statistically significant, but now has a negative sign. This result indicates that older students start exhibiting the behavior that we expect, with younger children being more likely to enroll. This result confirms that the turning point in the inverted-U relationship, previously calculated at 9.74 years, is somewhere before age 13.

2.5 Conclusions

Based on a household production model that maximizes collective utility by combining current and future consumption, I suggest that a child's probability of being enrolled in school is dependent on several components, including socioeconomic and individual characteristics, the direct costs of schooling, and opportunity costs. Because direct schooling costs, such as materials and fees, are most easily altered by the community or government, the first goal of this thesis was to examine the distribution and characteristics of current direct costs in Mexico since no comparable examination currently exists.

The direct cost analysis suggests that Mexican households do not pay a large percentage of their income on school fees, uniforms, etc. At about three percent of the average annual household income, Mexican families pay less than many other developing nations. Similarly, the ratio of household to public schooling expenditures in relatively low, at about 0.38. Other Latin American countries, such as Brazil, have ratios greater than one. While these families in general do not spend great amounts on direct schooling costs, there are some subgroups that tend to have much higher costs. Private school students and those with college-educated parents spend up to ten times more on direct costs than their counterparts. While these categories do overlap some, the results indicate that households are willing to pay for higher levels of high quality education. Lastly, it appears that the direct costs for secondary education are not systematically larger than those for primary; this result is important for policies that aim to increase secondary school enrollment.

Although the direct cost analysis indicates that Mexican households do not spend more than other Latin American countries on schooling, these costs may still be a deterrent to enrollment. In order to determine which components were most likely to influence an enrollment decision, I created a probit model that included measures of opportunity cost, household characteristics, and direct costs. The results of the probit regressions indicate that while small, direct costs play a role in determining whether or not a child is enrolled in school; this result is consistent with previous studies such as Ilon and Moock (1991). Given the relatively small size of these direct costs, it is somewhat surprising that such a consistent relationship exists. It is clear that households include direct cost measures in their household production functions and make enrollment decisions with such costs in mind, but it is unfortunately beyond the scope of this data set to determine what specific components of direct costs (materials, books, fees, uniforms, etc.) have the most impact. Despite this fact, policies that aim to decrease any kind of direct costs will have a small, but consistent, impact on school enrollment decisions.

Several other variables were also statistically and economically significant. The positive relationship between parents' education and their children's enrollment is consistent with previous findings and the theoretical prediction based on the household production function. This finding also supports the macroeconomic literature that suggests that schooling has intergenerational effects. On average, an extra year of parents' schooling increases that probability that their child will be enrolled by about 0.4 percentage points. While both father's and mother's education are statistically significant for the entire sample, only father's schooling retains its significance for girls age 13 to 15. This subgroup of girls also exhibits a negative relationship between age and enrollment and a lack of significance for the employment dummy variable. There may be other measures of opportunity cost not included in this analysis that influence enrollment decisions for the subgroup of older girls.

In this analysis, quantitative measures of opportunity cost do not provide statistically significant information in regards to enrollment decisions. As mentioned earlier, there are several additional measures of opportunity cost that should be included in future analyses should the data become available, such as birth order. This analysis did find, however, that children who are employed are much less likely to be enrolled in school. Although this result is to be expected, the magnitude of the enrollment difference (about seven percent) is great enough to warrant policy consideration. If universal primary and secondary enrollment is a policy goal, then these results suggest that limiting child employment would aid in attaining that goal.

Finally, the presence of schools in the household's community has a statistically significant impact on enrollment decisions. Children with universities in their communities are one percent more likely to enroll in school than children with only an elementary school. While this result isn't as economically significant as the child employment variable, it does suggest that public investment in education (as demonstrated by the construction of and support for higher-level schools) has a positive impact on a household's schooling choices. In other words, the supply of and demand for education appear to affect one another. While this connection is most likely due to decreased transportation and attendance costs for the household, some of the relationship may be due to a stronger community preference for education.

Based on the results of this analysis, it appears that parental education, child employment, direct costs, and school access are the most consistently important components of a household's decision to enroll a child in school. Thus, future policies should focus on lowering direct costs and increasing community support for education in order to reach the goal of universal primary and secondary education for Mexican children.

Chapter 3: Mexico's Free Textbook Program

In this chapter, I evaluate Mexico's National Commission for Free Textbooks (CONALITEG) program. CONALITEG produces and distributes textbooks for primary, secondary, vocational, and post-secondary school students. It is clear that the CONALITEG program aims to increase human capital accumulation through an indirect route: alleviating costs to students. Rather than subsidizing enrollment itself (as the Progresa program does, for example), CONALITEG removes one component of direct costs that households would otherwise pay: textbook costs. Because direct costs proved to be a significant factor in household enrollment decisions for children, this approach may serve to increase enrollment. If enrollment increases and investment in human capital expands, then there is strong evidence that Mexico will experience economic growth, a reduction in inequality, or any number of positive externalities such as were described earlier in the literature. Given this context, it seems that the Mexican government has chosen a prudent channel for its investment in education. A common economic tool used to systematically evaluate a program's effects is a cost-benefit analysis (CBA). Based on the evidence provided thus far, we expect the CONALITEG program to pass this analysis, indicating that the effort is a good (in this case meaning strictly that it provides more economic benefits than costs) use of government funds.

3.1 The Program

CONALITEG was started in Mexico in 1959 by the Mexican federal government in order to serve primary and secondary students in all 31 states and the Federal District, Mexico City. The program distributes textbooks to regional warehouses, which then distribute the materials to individual schools. The CONALITEG program serves as the only textbook distributor in Mexico that is officially sanctioned by the Secretary of Education. While the program produces a small number of books in two warehouses, the majority of textbooks are purchased from independent and well-established publishers, cutting down on the costs that CONALITEG would incur by producing large quantities of books in-house; CONALITEG has deals with over 20 publishers, all but one with offices in Mexico.

Because CONALITEG is a federally funded program, it is subject to reviews by the Secretary of Education. Its last official review in 2009 resulted in stellar ratings in categories ranging from "completion of goals" to "organizational structure." However, the external reviews of CONALITEG do not view the program from an economic cost-benefit analysis perspective. Rather, the reviews are more normative in nature. In order to determine whether or not the program is a good use of federal money, I will examine its associated costs and benefits from a purely economic perspective. It is important to note, however, that non-economic considerations clearly hold weight in the Mexican government's analysis of the program, so any conclusions reached in this discussion may not reflect the government's opinion of CONALITEG's benefits.

3.2 Theoretical Overview

Before beginning the analysis of costs and benefits associated with the CONALITEG program, it is necessary to discuss whether there is any support for the theory that there are benefits directly attributable to the program. The driving force behind the CONALITEG project is the belief that providing textbooks to students will enhance their education. Many components of a student's educational experience are tied to materials and infrastructure; however, it is often hard to quantify the exact impact that materials have on educational outcomes. Therefore, a cost-benefit analysis of the CONALITEG program makes a strong assumption that textbooks are actually tied to improved educational outcomes and future earnings. There is empirical evidence for and against this assumed connection between textbooks and student outcomes.

In his work on student attendance in Peru, Jacoby (1994) used textbook provision as one of the determinants of school progress. While other components of school costs seem to have a larger impact on attendance decisions, textbooks are still statistically significant. Jacoby finds that students who have textbooks provided by the school and/or government are 20 percent more likely to progress to the next grade. If we consider that school progression is an integral part of school success, the results of Jacoby's study suggest that textbooks help students finish school. If they are more likely to finish school, then their expected future earnings are higher than they would be without the textbooks. However, not all studies agree with Jacoby's findings.

In the study by Ilon and Moock (1991) using data from rural Peru, "school quality" variables, such as the provision of textbooks, were not significant factors in students' school attendance decisions. Other elements of household costs, such as the opportunity cost of students who would have otherwise worked in the family home or business, were the significant determinants of school attendance. While this conclusion contradicts that of Jacoby's study, the difference in sample characteristics might account for some of the disparity. Because Ilon and Moock only used rural households, the importance of transportation, materials, and opportunity costs may vary greatly from the combined urban and rural sample used by Jacoby.

To further complicate the discussion of the link between textbook provision and student success, a study in Honduras by Bedi and Marshall (1999) indicates that textbooks may have a negative effect on student test scores, contradicting the findings by Lockheed, Vail, and Fuller (1986) that conclude textbooks in Thailand increase test scores as much as an additional 1.6 months of schooling would. The difference in results may be due to variations in textbook use. Lockheed et. al find that one use of textbooks is as a substitute for teacher education; thus, if a classroom has textbooks in order to compensate for low teacher education, then a negative relationship may exist between books and student achievement that captures the lack of teacher training. The study in Thailand thoroughly interviewed teachers and their backgrounds as well as use of the books, while the Honduras study did not; thus, the Thailand findings may better separate the effect of the textbooks from those of teacher education. In a related study, Heyneman, Jamison, and Montenegro (1984) use an intervention analysis of the government textbook program in the Philippines in 1977 to find that textbooks are most efficient in improving academic performance for students from more impoverished backgrounds relative to their peers. These results are all based on standardized test scores rather than attendance, however, so a direct comparison between this study and those previously discussed may be invalid. It is clear from these studies that the link between textbook provision and student outcomes may depend on the context.

One possible reason for the varied effects is that provision of textbooks does not necessarily lead to proper use of the materials. Most of the studies mentioned thus far, as well as the CONALITEG literature itself, only examine whether the presence of textbooks has an effect on outcomes. It is clear, however, that textbooks sitting on a shelf in the classroom might not have a measurable impact on student success. Therefore, some of the studies that find no effect on outcomes due to textbooks may be capturing the lack of proper textbook use in the classroom. On the other hand, studies that show a positive impact from textbooks (Lockheed et.al. 1986, for example) may have captured the full potential of a teacher's effective use of the materials. It is impossible to know whether or not teachers are properly using the textbooks in studies without teacher surveys, but future data collection and reviews would benefit from including such information.

In order to acknowledge the different conclusions regarding textbook effectiveness, the benefits calculation will include two different probability increases for progress to the next school year, 20 percent and one percent, which will serve as upper and lower bounds for the true benefits. The 20 percent probability increase comes from the results in Jacoby's 1994 study in Peru; he concluded that the provision of textbooks decreased the chance that a student would drop out or repeat a grade by 20 percent. If a student did *not* enroll in a higher grade the following year, it would be because he/she dropped out or repeated the lower grade. Thus, by reducing the chance that a student does either one of these two things, textbooks are in effect increasing the chance that a student will progress to a higher grade the following year.

3.3 Decision Criteria

Because CONALITEG has been in operation for so long, examining the costs and benefits of a "with the program" and "without the program" world is not feasible.

However, there are several options for comparing the costs and benefits. First, because the program sets yearly goals of production and distribution quantities, it could be possible to compare the current costs and benefits with the projected costs and benefits to expand the program to reach future goals (for example, comparing 2008 costs/benefits with projected 2012 costs/benefits). The potential problem with this approach is that projecting future costs would be almost entirely hypothetical, since the program has not steadily expanded in any consecutive years; determining incremental expansion costs may be too difficult.

The second possible approach is to use available data from past years; in this case, the "without" analysis may be the costs and benefits associated with continuing the production and distribution at the exact same costs for a base year (2000 for example) and the "with" analysis of expanding the way the program actually did in the following years (from 2001-2008). In analyzing costs and benefits this way, though, we would have to assume that the program costs would have remained completely unchanged for the "without" analysis, an assumption that very clearly contradicts the actual trends of the program.

The third possibility is that instead of setting an arbitrary "without" base year and assuming that program costs would continue at that level indefinitely, it would be possible to simply choose a timeframe (2000-2008) and analyze the costs and benefits present during that time in order to determine if the program is worthwhile. In this case it would be hard to identify a "without" case; rather, the decision criteria would simply be whether the present value (PV) of costs is less than or equal to the present value of benefits for the time period. Given the available data on both costs and benefits, the final approach is used in this analysis. The timeframe in question, as determined again by the availability of a full set of cost and benefit data, is the 2008-2009 school year.

3.4 Costs

The costs associated with the CONALITEG program can be broken into two broad categories: direct program costs and opportunity costs. Each category is described in more detail below.

Program administration costs (broken down by CONALITEG into four categories)

- Wages/employment: This would only include wages paid to employees who work directly for the CONALITEG program. Employees in the book publishing firms, for example, are paid by their own companies and not counted as a cost for CONALITEG.
- Materials and provisions: Payments to book publishers for acquisitions and transportation costs to deliver the books.
- General services
- Property: This category includes the maintenance for the plant that CONALITEG owns and operates to produce a small fraction of the necessary books itself.

Opportunity costs

- To publishers: The government buys the textbooks at a wholesale 40 percent discount; thus, if publishers sold in a competitive market they would receive a higher price. The difference between the government wholesale price and the market price is the opportunity cost for publishers. If we assume that *all* books would be sold in the private market, this is an upper bound for the publishers' opportunity cost.

- CONALITEG production plant: The plant used to produce books could be used for another purpose. To impute the opportunity cost of this space, we use land rental values in the Querétaro region.

Calculation of these costs gives the following values (in pesos):[11]

- Direct program costs[12]

Wages/employment	92,753,782.37
Materials and provisions	1,838,703,581.94
General services	132,847,055.19
Property maintenance	+ 5,105,145.74
Total direct cost:	2,069,409,565.24 pesos

- Opportunity costs
  - To publishers:

Market value of books:	864,028,225
Payments received from CONALITEG:[13]	- 518,416,935
Subtotal opp. cost:	345,611,290 pesos

  - Production plant:
    (Plant square meters)x(rent per square meter) = land value

	34,844
	x 1930
Subtotal opp. cost:	67,248,920 pesos

Thus, the total upper bound present value of costs is 2,482,269,775 pesos, or US $222,625,029.

[11] The peso: dollar conversion rate for 2008 is 11.15:1
[12] "Ejercicio Presupuestal por Capitulo de Gasto," May 2009. *Comision Nacional de Libros de Texto Gratuitos*. http://www.conaliteg.gob.mx/index.php/finanzas.
[13] "Programa Federal de Secundaria," July 2009. *Comision Nacional de Libros de Texto Gratuitos*. http://www.conaliteg.gob.mx/index.php/finanzas.

3.5 Benefits

The most apparent benefits from the CONALITEG program accrue to the students who receive the books and to their families while indirect benefits accrue to the communities in which the recipients are located. There are several potential complications with calculating all of the combined benefits, however. Throughout the analysis we only consider benefits accrued to the students or communities due to books received in the 2008-2009 school year; some of these benefits will transfer into the future while others are received immediately.

There is some evidence, as discussed previously, that receiving textbooks and other classroom materials encourages more school attendance. Recalling work by Jacoby (1994) that found that the provision of textbooks in schools has a positive effect on school progress, and the findings from some authors (Lockheed et.al. 1986, Heyneman et.al. 1984) that academic achievement improves with the presence of textbooks, we conclude that simply having more textbooks could increase the chance that students attend or successfully progress through school. The extra schooling that these students receive has the potential to lead to increased earnings in the future.

Many studies have examined the relationship between years of schooling and earnings, as discussed in Chapter 1. Expected earnings increase dramatically with high school graduation and even more with college education. An extra year of secondary education increases expected earnings by approximately 12 percent in Mexico according to Schultz (2004) in his study of Mexico's Progresa program. If we expect that the provision of textbooks will increase the education that students receive, then we can expect some increase in future earnings for these students. First, we must determine whether to count students in primary school, secondary school, or both. Given the fact that in 2005, 58 percent of workers in the labor force had a primary school education, while only 19 percent had completed secondary school, we would expect to see a much higher return to secondary schooling than to primary, given the relative scarcity of the former group (World Bank Group 2010). However, according to the Inter-American Development Bank (IDB) in its 1998 report, the average return to primary schooling in Mexico is 14 percent,[14] higher than the calculations of secondary returns from Schultz (2004) and the IDB, at 12 and 11 percent respectively (ESPLA 1998). Unfortunately, because the CONALITEG information regarding payments to publishers is only for secondary school books, we must restrict the benefit calculation to secondary students as well. The implications of this restriction will be addressed in the conclusion. Given the sample of secondary students, we must determine how to calculate the value of the extra schooling.

If, as Jacoby estimates, the provision of textbooks (either by the family or the school) makes a student 20 percent less likely to repeat a grade/fall behind in school/drop out, then we can calculate the increased expected value of wages for students who receive textbooks. Unfortunately, we do not have information on how *many* extra years of schooling textbooks induce. Thus, we can conservatively estimate that receiving a textbook in one year only impacts a student's likelihood to attend the following year. In reality, the effect from a textbook in year t may reach beyond year $t+1$, but because this effect will vary from student to student and thus is hard to quantify, we assume here that lasting effects do not exist. Ultimately, this assumption will serve to potentially bias our benefits estimate downward. Using this information, the extra benefit for each secondary

[14] This average obscures a large gap between rural and urban returns to primary schooling, however; rural returns are about 8 percent while urban returns are close to 17.

student per additional year of school is 0.2*(0.12)*(wage without extra school)=0.024*(wage without extra school). As a lower bound, we use one percent increased attendance probability and thus consider 0.01*(0.12)*(wage without extra school)=0.0012*(wage without) as our worst-case scenario regarding individual benefits. These benefits are expressed per student per extra year of school. The total benefit to students, then, is simply this lifetime discounted value times the number of students affected by the program.

According to the Mexican National Institute of Geography, Statistics, and Information, the total number of 13-15 year olds in 2005[15] was 6,537,062. Of these, 82.5 percent were enrolled in school, giving us 5,393,076 students of secondary school age. Unfortunately, this estimate does not account for students who are between 13 and 15 years of age but attend primary school or for older secondary school students still enrolled in school. The roughly 5.3 million students, then, could under- or overestimate the true number of students enrolled in secondary school. I assume for this analysis that the two competing effects cancel out, and that the 5.3 million students is a close estimate.

The final pieces of information necessary to calculate the present value of the individual student benefits are the wage and discount rate. In order to continue our analysis of upper and lower bounds, two different wages are used. The lowest official minimum wage in Mexico is 53 pesos a day, while the average wage is 209 pesos a day, according to the Mexican Social Security Institute (Mexico Facts). If we assume that the average laborer works six days a week for 50 weeks during the year, then the two yearly salaries are 15,900 pesos (minimum wage) and 62,700 pesos (average wage).

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[15] The most recent data regarding school enrollment is from 2005, thus it is used to proxy the 2008 numbers.

Because the benefits connected to increased earnings are discounted over a student's lifetime, we must choose a discount rate and time span over which to discount. A 30-year time horizon is reasonable in this case in order to capture the majority of a student's adult working years. The Mexican rate for 30-year government bonds is 6.75 percent, so we will use this as a lower bound. A discount rate of three percent is typical in studies associated with the macroeconomy because it mirrors the growth rate. Although this study focuses on individual student benefits, the result is an aggregation of all benefits and costs on a macro level; thus, the three percent discount rate serves as an upper bound.

By combining all of the information thus far, we can calculate various levels of benefits accrued to students from the CONALITEG program. Appendix A details the iterations of benefits using various combinations of the discount rate, wage, student population, and increased attendance probability. The upper bound for the present value of student benefits from these calculations amounts to 163,839 million pesos ($14,694 million); the lower bound, or worst-case scenario, amounts to 1,398 million pesos ($125 million). By examining the net present value calculation in Appendix A, we see that all but the two worst-case scenarios result in a positive NPV for the program, despite only having considered student benefits thus far.

Community benefits from increased education are difficult to measure, as discussed in Chapter 1. Most societal benefits stemming from education come through the individual student. For instance, improved health and reduced propensity for criminal activity are two personal benefits that could create positive externalities for the community. In her review of the literature linking education with social benefits, Stacey

(1998) comments that in general, “rates of poverty, out-of-wedlock childbearing, early family formation, and child abuse and neglect are all substantially lower among high-school graduates than among dropouts” (57). Similarly, the IDB reports that basic education is socially desirable, because it provides a foundation for future benefits such as improved health, lower birth rates, and higher standards of living (ESPLA 1998). If we expect CONALITEG to increase school progress and attendance and/or learning outcomes, then it is reasonable to expect that some, if not all, of these social elements are affected as well. Crime rates and health outcomes are also commonly cited areas of social benefit from increased education.

Unfortunately, when it comes to actually valuing these social improvements there is very little data. Hedonic pricing models would give us the clearest way to measure society’s willingness to pay (WTP) for lower crime rates, decreased teenage pregnancy, etc. In the context of CONALITEG, we would need to measure pricing in various communities in Mexico in order to create the imputed benefit from social improvements. Once we had a measure for WTP for decreased crime, for example, we would still need to measure how *much* crime decreases for each extra year of schooling that a child in the community receives. Data for the relationship between years of schooling and specific social outcomes is more prevalent for the United States than for Mexico, however, and is difficult to find.

Despite the fact that we cannot independently calculate a WTP for improved community benefits from the CONALITEG program, we can clearly identify a threshold value that would allow all net present value calculations, even in the worst-case scenario, to be positive. Because the lower bound of student benefits is 1,398 million pesos and the costs are 2,482 million pesos, the NPV is -1,084 million pesos. Using this information, we can conclude that if community benefits from the program total at least 1,084 million pesos, then the program will pass our decision criteria requirements.

3.6 Conclusions

Despite the fact that the benefits associated with the CONALITEG program were difficult to identify and quantify, we can reach a firm conclusion regarding the program during the 2008-2009 school year. First, we must recall the decision criteria set forth earlier, namely that the net present value of $\left(\sum benfits - \sum costs\right)$ be greater than or equal to zero. We will examine the final values of this equation at an upper bound and a lower bound (the extremes being derived from the various benefits calculations earlier that iterated combinations of discount rates, attendance probabilities, and wages).

At an upper bound,[16] the present value of benefits totaled 163,839 million pesos while the costs totaled 2,482 million pesos. Thus, the decision criteria calculation is (163,839,418,665 -2,482,269,775) = 161,357,148,890 pesos ($1,4471,493,200), a value far greater than zero. In the upper bound case, then, the program passes the CBA.

At the lower bound,[17] the present value of benefits totaled 1,398 million pesos while the costs were constant at 2,482 million pesos. Our NPV is (1,398,022,401-2,482,269,775) = -1,084,247,374 pesos (-$97,241,917). At the lower bound, then, the program does not pass. However, as mentioned earlier in the benefits discussion, the total benefits used here only encompass individual student benefits and leave out positive

[16] Benefits using a 3 percent discount rate, an average wage of 219 pesos/day, and a 20 percent increase in the probability that students will attend the next grade.
[17] Benefits using a 6.75 percent discount rate, a minimum wage of 53 pesos/day, and a 1 percent increase in the probability that students will attend the next grade.

externalities. The justification for this omission hinges on the fact that there is not any willingness to pay data that would indicate an approximate value for the positive externalities. In order for the program to pass at this lower bound, however, we know that the WTP for positive externalities associated with the program would need to collectively total 1,084 million pesos. Because the Mexican population is about 107 million people (Mexico Facts), this WTP works out to approximately 10 pesos per person per year. If the true WTP is at least 10 pesos (which is a small amount given that minimum wage workers earn 15,900 pesos per year), then the project passes even at a lower bound.

Overall, from a cost-benefit analysis perspective the CONALITEG program is a good use of public funds because the NPV$\left(\sum benfits - \sum \cos ts\right)$ is positive in almost all cases. Furthermore, even in the extreme cases that yield a negative value, the positive externality valuation almost certainly makes up the difference. Thus, CONALITEG should continue to function.

There are several components of this analysis that relied heavily on assumptions, however, and any changes to those assumptions could change the conclusions presented herein. First, the analysis only evaluated students at the secondary level. Given the evidence from the IDB that indicates returns to primary education may be higher than those for secondary schooling (ESPLA 1998), it would be important to include primary school students in future evaluations. Although we do not have specific data, we can make several assumptions given our secondary school results. We know that the benefits for primary school students will be larger given the higher rate of return coupled with the larger primary student population. Similarly, we know that costs will be higher for two reasons; first, more students means more books, which cost more to procure. Second, more books require more employees and higher costs for transportation. However, there may also be some components of costs that will overlap with the secondary school costs; for example, administrative and management costs are most likely shared among all students, and adding primary school books would not increase these costs by a proportional amount. Thus, evaluating primary school students as well would most likely increase benefits more than costs, and would therefore provide further support for the CONALITEG program.

The primary concern with this analysis, however, lies with the assumption of benefits tied directly to the CONALITEG program. If more research is done regarding the impact of textbooks on school progress or future earnings, then the benefits to individual students might change dramatically. Likewise, values for the improved community aspects as a result of better schooling are not well researched. This analysis proposes a minimum level that would make the program worthwhile, but data that imputes a true WTP would lead to more accurate analyses in the future. Despite these shortcomings, however, the CONALITEG program appears to incur benefits that far outweigh the costs, thus justifying its continued presence in the Mexican education system.

Chapter 4: Policy Implications

There is substantial evidence to support investment in education from an economic standpoint. Private returns to schooling in both developed and developing nations are consistently positive and reflect the value of extra schooling in an individual's wage; estimates from the IDB suggest that primary education increases expected future earnings by 14 percent in Mexico, an increase that amounts to roughly US$215 more per year for a minimum wage worker (ESPLA 1998).[18] Such an increase on an individual level translates to a positive return on a national scale as well. Despite some authors who suggest that the link between education and macro-level growth is tenuous, the majority of studies provide strong evidence to support a positive link. Given current levels of educational and physical capital stocks, authors such as Krueger and Lindahl (2001) show that increased education leads to an increase in GDP. If this is the case, then both private and social returns to investment in schooling suggest that countries would benefit from encouraging the expansion of access to education as well as high levels of enrollment. The pragmatic issue is *how* governments should encourage this expansion of enrollment.

There are macro-level policies that, given the evidence presented here, would serve to increase access to education as well as enrollment levels. Based on the results of the regression analysis, children who live in a community with a high school or university are about one percent more likely to enroll in school than are their counterparts who only have an elementary school present. Public construction of higher education

[18] The minimum wage used here is 16,900 pesos, 14 percent of which is 2,366 pesos. The 2005 peso to dollar conversion rate is 10.94.

facilities, therefore, would not only directly increase access to these schools but would also serve to increase the probability of school enrollment at all lower levels as well. Similarly, children whose parents have completed secondary school are about two percent more likely to enroll than children whose parents only completed primary school. Thus, if education is encouraged on a large scale during the parents' generation, then the effects will carry into the subsequent generation. Public expenditures on schooling are not a one-time-period investment.

Another macro level policy concern is whether children should be discouraged from joining the workforce. Given the results of the analysis presented here, children who work during their secondary school years are 9.3 percentage points less likely to enroll in school than are their counterparts who do not work. Not only is this result both economically and statistically significant, but it is also the largest single determinant of a child's enrollment decision in the model. If increased enrollment is the government's primary goal, then discouraging children's participation in the workforce is a well-targeted policy. However, there are other consequences to consider when evaluating such a policy. As discussed previously, low-income households have the highest percentage of children who work, indicating that the extra income generated by the child is necessary for household expenses. If children were not permitted to work, they would not necessarily enter school instead; rather, they might find alternate methods of supporting household production, such as caring for younger siblings while the parents take on extra employment. The relationship between child employment and school enrollment is therefore not clearly defined, and more information is necessary before policies should be enacted. Further studies that collect data regarding reasons for child employment are important next steps.

In addition to macro level policies that would increase both access to education and actual attendance, there are micro level components that appear to be important as well. An examination of the private direct costs of schooling yields several interesting results. The fact that direct costs for primary and secondary schooling are not systematically different implies that programs aimed at alleviating these costs should target the entire school system, not just one level. Contrary to the belief that secondary schooling is both more expensive and more valuable (a belief that is contradicted by the IDB study discussed above) than primary education, the evidence here suggests that Mexican households would benefit equally from subsidies aimed at tempering the costs of both primary and secondary schooling. However, despite the fact that households would receive the same degree of financial relief from subsidies aimed at primary and secondary schooling, the non-financial consequences of such government assistance differ noticeably between primary- and secondary-student households.

The results of the econometric analysis presented in this thesis argue that direct costs are statistically significant determinants of a child's enrollment in school, more so for secondary students than for the entire sample. If direct costs were to decrease by one standard deviation (2664 pesos), then the probability of a secondary school student enrolling would increase by 1.57 percentage points (compared with a 0.53 percentage point increase for all students combined). This result suggests that changing private direct costs has a larger impact on secondary enrollment than on primary. In this case, subsidies that aim to increase enrollment should focus on alleviating direct costs to secondary school students.

Given this evidence, Mexico's programs that attempt to alleviate direct costs, such as the CONALITEG textbook program, appear to address the appropriate obstacles. Not only does CONALITEG target a statistically significant deterrent to enrollment (direct costs), but it is also economically efficient from a cost-benefit analysis standpoint, producing more aggregate benefits than costs. The analysis here was restricted to secondary school students, which suggests that CONALITEG, in reality, produces even more benefits than are measured in this study. Future government policies aimed at improving enrollment and access to education should follow a similar model and target other aspects of direct costs, such as tuition, fees, and other materials. Further studies should focus on separating the components of direct costs in order to determine the effect of each individual cost on enrollment decisions; with this more specific information, public policies aimed at increasing enrollment can specifically target the direct cost component that most strongly impacts a child's enrollment choice. It is clear from this analysis that future policies should focus on alleviating direct costs and increasing community support for education in order to reach the goal of universal primary and secondary education in Mexico.

Appendices

Appendix A: Net present value calculations for CONALITEG

Table A-1: 1% increase in enrollment probability, 12% increased in expected future earnings (in pesos)

	Minimum wage		Average wage	
Year	3%	6.75%	3%	6.75%
1	19.0800	19.0800	75.2400	75.2400
2	18.5243	17.8735	73.0485	70.4824
3	17.9847	16.7434	70.9209	66.0257
4	17.4609	15.6846	68.8553	61.8508
5	16.9523	14.6929	66.8498	57.9398
6	16.4586	13.7638	64.9027	54.2762
7	15.9792	12.8935	63.0123	50.8442
8	15.5138	12.0782	61.1770	47.6292
9	15.0619	11.3145	59.3952	44.6175
10	14.6232	10.5991	57.6652	41.7963
11	14.1973	9.9289	55.9856	39.1534
12	13.7838	9.3010	54.3550	36.6777
13	13.3823	8.7129	52.7718	34.3585
14	12.9926	8.1620	51.2348	32.1859
15	12.6141	7.6459	49.7425	30.1508
16	12.2467	7.1624	48.2937	28.2443
17	11.8900	6.7095	46.8871	26.4583
18	11.5437	6.2853	45.5214	24.7853
19	11.2075	5.8878	44.1956	23.2181
20	10.8811	5.5155	42.9083	21.7500
21	10.5641	5.1668	41.6586	20.3747
22	10.2564	4.8401	40.4452	19.0864
23	9.9577	4.5340	39.2672	17.8795
24	9.6677	4.2473	38.1235	16.7489
25	9.3861	3.9788	37.0131	15.6899
26	9.1127	3.7272	35.9350	14.6978
27	8.8473	3.4915	34.8884	13.7684
28	8.5896	3.2707	33.8722	12.8978
29	8.3394	3.0639	32.8857	12.0823
30	8.0965	2.8702	31.9278	11.3183
PV ben/student	385	259	1519	1022
PV ben total	2077389758	1398022401	8191970933	5512956261
PV costs total	2482269775	2482269775	2482269775	2482269775
NPV	-404880017	-1084247374	5709701158	3030686486
NPV in $US	-36312109	-97241917	512080821	271810447

Table A-2: 20% increase in enrollment probability, 12% increase in expected future earnings (in pesos)

	Minimum wage		Average wage	
Year	3%	6.75%	3%	6.75%
1	381.6000	381.6000	1504.8000	1504.8000
2	370.4854	357.4707	1460.9709	1409.6487
3	359.6946	334.8672	1418.4183	1320.5140
4	349.2181	313.6929	1377.1052	1237.0155
5	339.0467	293.8575	1336.9953	1158.7967
6	329.1715	275.2764	1298.0537	1085.5238
7	319.5840	257.8701	1260.2463	1016.8842
8	310.2757	241.5645	1223.5401	952.5847
9	301.2386	226.2900	1187.9030	892.3510
10	292.4646	211.9812	1153.3039	835.9260
11	283.9462	198.5773	1119.7125	783.0688
12	275.6760	186.0209	1087.0995	733.5540
13	267.6466	174.2584	1055.4364	687.1700
14	259.8510	163.2397	1024.6956	643.7190
15	252.2826	152.9178	994.8501	603.0154
16	244.9345	143.2485	965.8739	564.8856
17	237.8005	134.1906	937.7416	529.1669
18	230.8743	125.7055	910.4287	495.7067
19	224.1498	117.7569	883.9114	464.3622
20	217.6211	110.3109	858.1664	434.9997
21	211.2827	103.3358	833.1713	407.4939
22	205.1288	96.8017	808.9042	381.7273
23	199.1542	90.6807	785.3438	357.5900
24	193.3536	84.9468	762.4697	334.9789
25	187.7219	79.5755	740.2619	313.7976
26	182.2543	74.5438	718.7009	293.9556
27	176.9459	69.8302	697.7678	275.3682
28	171.7921	65.4147	677.4445	257.9562
29	166.7885	61.2784	657.7131	241.6451
30	161.9306	57.4037	638.5564	226.3655
PV ben/student	7704	5185	30380	20445
PV ben total	41547795164	27960448021	163839418665	110259125214
PV costs total	2482269775	2482269775	2482269775	2482269775
NPV	39065525389	25478178246	161357148890	107776855439
NPV in $US	3503634560	2285038410	14471493200	9666085690

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