

# The Microeconomics of Poverty Traps in Mexico

Jean-Paul Chavas  
University of Wisconsin at Madison

Hector J. Villarreal\*  
ITESM Campus Monterrey  
Escuela de Graduados en Administración Pública y Políticas Públicas (EGAP)

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## Abstract

Macroeconomists, development scholars, and policy makers have long recognized the importance of poverty traps as a mayor cause of persistent inequality and a serious limitation to growth. A poverty trap may be defined as a threshold level below which individuals or households will not increase their well-being despite the conditions of the economy. While the importance of poverty traps is widely accepted, their microfoundations (the rationality) behind them are not very well understood. Under the Mexican setting, this paper contributes in two ways. First, we assume that income depends on the capital (both physical and human) that a household posses. Hence, if a household is poor and it is not able to accumulate capital it will remain poor (unless there is a sudden increase to the returns of its existing capital). Thus a poverty trap will be generated. Following Chavas (2004, 2005) we explicitly model the preferences, consumption, and the physical and human capital accumulation of Mexican households. We argue that the typical dynamic model with additive utilities and constant discount rates will not be able to capture poverty traps. The reason is that survival motives are involved (endogenous discounting is needed). Second, employing the same model, we test the impact of the Mexican government most important social policy program (Progresas-Oportunidades), in alleviating poverty traps. In the case of households with youngsters, this program can provide funds conditioned on kids attending school. This will somehow, force the participants to increase their human capital. A comparison between households in the programs versus non participants should shed some light in the effectiveness of the program and the sensitivity of persistent poverty to cash transfers.

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\* [hjvp@itesm.mx](mailto:hjvp@itesm.mx)

## **I. Introduction**

This paper examines the linkages between poverty and the incentives to invest and accumulate capital. To the extent that accumulations of physical and human capital are a crucial part of the process of economic growth, its absence can generate poverty traps. The analysis presented below is at the household level, both consumption and investment decisions are explicitly modeled. Investment in physical capital and human capital is separated, given that they may follow independent paths. Instead of considering the standard model of additive intertemporal utilities with exogenous discounting, this study employs a more general specification where the discounting is endogenous to the model. The latter would help to explain why investment decisions between rich and poor are different, and not only dependent upon credit rationing (Berti 2001).

Another contribution of the paper is that the effects of two different social programs on household capital accumulation will be evaluated. Both consist of cash transfers, however one is conditional on certain household behaviors, and the other is almost unconditional.

The paper is organized in the following way. In Section II the model is presented. The limitations of additive intertemporal household preferences with exogenous discounting are exposed, and a more general approach motivated. An econometrically tractable reduced form specification is derived from the model. Section III describes the data, and how the variables were constructed. In Section IV the characteristics of the two Mexican social programs relevant for this study are discussed. Section V presents the econometric results, for the pure model and the model with the effects of the social

programs included. A brief analysis of the results and its implications is included in this part. Finally, Section VI concludes.

## II. The Model

This paper employs a model developed in (Chavas 2004, 2005).

The standard economic model specifying intertemporal household preferences as the present value of future utilities is:

$$U = u_0(x_0) + \beta u_1(x_1) + \beta^2 u_2(x_2) + \dots = \sum_{t \geq 0} \beta^t u_t(x_t), \quad (1)$$

where  $x_t$  denotes the consumption bundle at time  $t$ ,  $u_t(x_t)$  is the utility obtained at time  $t$ , and  $\beta$  is a discount factor satisfying  $0 < \beta < 1$ ,  $t=1,2,\dots$ . Two important assumptions stem from (1): first, the utility function embedded in (1) is additive over time, and second, the discounting of the future is done at a exogenous rate  $\beta$ .

Despite its convenience, the additive utility function (1) is not capable of capturing the essence of extreme poverty issues. Notice it implies  $\partial[\partial U / \partial x_t] / \partial x_{t'} = 0$  for all  $t \neq t'$ . Thus the marginal utility of consumption is independent of consumption at other periods. Given that survival issues are involved in extreme poverty, current consumption<sup>1</sup> must affect the marginal utility of future consumption.

A recursive specification of household preferences can be set as:

$$U = V(x_t, x_{t+1}, \dots) = U(x_t, V(x_{t+1}, \dots)), \quad (2)$$

where  $U(x_t, V(x_{t+1}, \dots))$  is non-satiated in  $x_t$ , and  $0 \leq \partial U / \partial V < 1$ . Specification (2) is a generalization of (1). Since (2) allows  $\partial U / \partial x_{t'}$  to depend on  $x_t$  for  $t' > t$ , it allows current consumption to affect the marginal utility of future consumption, thus permitting to capture survival issues. The discount factor  $\partial U / \partial V$  will vary with economic conditions.

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<sup>1</sup> At least for food, but other necessities may very well be considered (e.g. medicines).

For example if the consumption of food and other necessities is very low and threatens survival, it will affect how the household views the future and a very low discount factor can be anticipated, i.e.  $\partial U / \partial V \approx 0$ . The intuition is that concerns for survival make poor household focus attention on short term decisions sacrificing longer term payoffs.

Given recursive preferences, the decisions of the household in terms of both consumption and investment can be solved via backward induction. Let  $k_t$  be the vector of physical and human capital of the household, it evolves over time according the state equation:

$$k_{t+1} = f_t(k_t, \cdot) + z_t, \quad (3)$$

where  $[f_t(k_t, \cdot) - k_t] / k_t$  is the natural growth rate of capital (depreciation rate if negative), and  $z_t$  is the amount of household investments (disinvestment if negative) made at time  $t$ .<sup>2</sup>

At time  $t$  both physical and human capital generate a gross return denoted by  $g_t(k_t, \cdot)$ .

The market price vector of consumer goods  $x_t$  is  $p_t > 0$ , and  $q_t \geq 0$  the unit price vector of investments  $z_t$ . Consequently the household budget constraint at time  $t$  is:

$$p_t x_t \leq g_t(k_t, \cdot) - q_t z_t, \quad (4)$$

Using backward induction, optimal behavior is given by the functional equation (see Streufert 1990, 1992; Becker and Boyd 1997):

$$\begin{aligned} W_t(k_t) &= \text{Max}_{x_t, z_t} \{U(x_t, W_{t+1}(f_t(k_t, \cdot) + z_t))\} \\ &\text{s.t. (4),} \\ &\text{and} \\ (x_t, z_t) &= \text{feasible,} \end{aligned} \quad (5)$$

where  $W_t(k_t)$  is the value function at time  $t$ .

The optimal decisions rules in (5) can be denoted by:

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<sup>2</sup> A negative  $k_t$  can represent asset liquidation or borrowing in the capital markets.

$$x_t^* = x_t^*(p_t, q_t, k_t), \quad (6)$$

for consumption, and by

$$z_t^* = z_t^*(p_t, q_t, k_t), \quad (7)$$

for investment; completing the characterization of the household behavior.

### *Poverty and Household Investment*

In this section how poverty may have a negative influence on investment<sup>3</sup> is explored.

Under differentiability and assuming an interior solution, the first order conditions necessary to solve (5) are:

$$\partial U / \partial x_t + (\partial U / \partial V_{t+1})(\partial W_{t+1} / \partial k_{t+1})(\partial f / \partial x_t) = \lambda_t [p_t - \partial g_t / \partial x_t], \quad (8)$$

$$(\partial U / \partial V_{t+1})(\partial W_{t+1} / \partial k_{t+1}) = \lambda_t q_t, \quad (9)$$

where  $\lambda_t > 0$  is the marginal utility of income. Applying the envelope theorem to (5), the marginal of utility of capital is:

$$\partial W / \partial k_t = (\partial U / \partial V_{t+1})(\partial W_{t+1} / \partial k_{t+1})(\partial f / \partial k_t) + \lambda_t (\partial g_t / \partial k_t), \quad (10)$$

The marginal utility of capital can be decomposed in two parts: the discounted marginal utility of capital growth  $(\partial U / \partial V_{t+1})(\partial W_{t+1} / \partial k_{t+1})(\partial f / \partial k_t)$ , and the marginal utility of income generated by capital  $\lambda_t (\partial g_t / \partial k_t)$ .

For the moment, assuming  $x_t$  does not affect gross income  $g_t$ , household income at time  $t$  can be defined as:  $I_t = g_t(k_t) - q_t z_t$ . Thus from the household decision problem

(5), the consumption decision (6) conditional on income becomes:

$$x_t^* = x_t^+(p_t, I_t^*, k_t), \quad (11)$$

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<sup>3</sup> Chavas (2005) derives two applications of his model: first he explores how malnutrition may affect productivity, second he analyzes the effect of malnutrition on investment. In this study we stick to the latter, keeping the former idea for future research.

$$= x_t^+(p_t, g_t(k_t) - q_t z_t^*, k_t) = x_t^*(p_t, q_t, k_t), \quad (12)$$

where  $I_t^* = g_t(k_t) - q_t z_t^*(p_t, q_t, k_t)$ . Chavas (2005) distinguishes between the two representations (11) and (12). While (12) is a reduced form, (11) is a more structural form that isolates the effects of household income.

In order to understand the generation of a poverty trap, consider the case of very poor households. Given their low income they face poverty and survival problems, this implies limited incentives to invest. Without investment, the household stands small chances of accumulating capital. If there are not accumulations of physical or human capital, their income streams will not grow over time. Thus a vicious circle is generated, due in part by endogenous discounting.

### **III. The Empirical Environment**

The main source of data for this paper comes from INEGI (Instituto Nacional de Estadística Geografía e Informática), who collects a household income-expenditure survey called ENIGH (Encuesta Nacional de Ingreso y Gasto de los Hogares). These surveys include a set of disaggregated consumption data, and other variables such as income and socio-demographic characteristics. All the information was collected using a combination of the “booklet method” and daily interviews. ENIGH 2002 was employed, obtaining a sample of 17,168 households.

In order to keep the demand system tractable, the vector  $x^*$  was divided in two: food items and non-food items. Aggregation was dealt via the employment of a Törquist price index. The left hand side variables (quantities) were obtained by dividing total expenditures in the category by the price index. The variable capital was divided into physical and human capital. Physical capital was inferred utilizing imputed rents and the

returns to financial assets of the household.<sup>4</sup> Human capital was defined as the amount of school years studied by the members of the household. The vector  $z^*$  was defined by the current investment in physical capital (e.g. financial assets) while investment in human capital was defined as how many people in the household were currently attending school. The price of acquiring human capital can be obtained by dividing the total expenditures of the household in education by quantity. The price of physical capital is one (i.e. like depositing one dollar). While this is correct from an economic point of view, econometrically the price effect of physical capital would not be identifiable; it cannot be separated from the intercept.

Notice that all the variables for (6-7) have been specified. Thus a four system equation can be estimated, two for consumption ( $x^*$ ) and two for investment ( $z^*$ ). A final issue to be considered in this section is that the distribution of investment in human capital is truncated at zero. While it is possible to disinvest physical capital, people cannot get de-educated. In order to deal with the truncated variable in a system of equation the CTS estimator proposed by Shonkwiler and Yen (1999) would be employed.

#### **IV. The effects of two social programs on household's capital accumulation**

Social programs pursue two highly interconnected objectives: on the one hand they may try to alleviate urgent needs. These may include food safety, health problems, emergency shelter, and related survival issues. The second objective, which usually aspires to longer term effects deals with the reduction of poverty and welfare improvements. Given the model presented in section II, a sensible question is to what extent social programs incentive the accumulation of capital among poor and extreme poor people. If they do contribute to investment, then they can be good instruments to solve poverty traps.

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<sup>4</sup> A return of ½% per month was assumed.

Within the Mexican setting we investigate to of the most important social programs of the Mexican government: Procampo and Progres/Oportunidades. Procampo is a program whose target group is rural producers. It was created with the purpose of controlling the effects of NAFTA on the production of some basic crops (corn, beans, wheat, rice, barley, soybeans, sorghum, cotton and cardamom).<sup>5</sup> The program defines “qualifying land” as those hectares that sometime between 1991 and 1993 where employed to plant any of the enumerated crops. The owner (or responsible in the case of “ejidos” (communal land)) of any hectare of qualifying land now employed to plant crops, raise livestock, forestry or associated to approved environmental programs, can receive a direct cash transfer. The transfer is of around 80 USD per hectare per cycle (there are two agricultural cycles per year). This program has been defines as “a hybrid [program] between compensation, welfare and adjustment, defined in the context of a political window of opportunity to compensate the losers of trade liberalization, but with a definite welfare twist toward the rural poor”, (Sadoulet et al. 2001).

Progres/Oportunidades is a program that targets directly the poorest families in the country. At the beginning it was limited to rural households, nowadays urban households are also included but in a smaller proportion.<sup>6</sup> The program consists of two basic elements: a health component and an education component. In the case of the health part of the program, conditional on regular check-ups the household receives some nutritional supplements and a cash transfer. In the case of households with children in

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<sup>5</sup> A detailed explanation of the program can be found at <http://www.procampo.gob.mx>.

<sup>6</sup> Under 2002 data approximately 40% of the rural population participates in the program, compared with around 5% of urban population.



school age, they received cash transfers that vary according to age and gender of the kids, conditional on school attendance.<sup>7</sup>

## V. Results

The first results concern the estimation of the reduced form system (6-7). The four equations: food consumption, non-food consumption, physical capital investment and human capital investment were regressed<sup>8</sup> on the stocks of physical and human capital, and the prices of food items, non-food items, and human capital (education). As explained in section III it is not possible to identify the prices of physical capital, so their effect is embedded with the intercept. Table 1 summarizes the results.

<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>
<i>Food</i> intercept	<b>35.517025</b>	2.142506
physical capital	0.000340	0.000346
human capital	<b>0.827944</b>	0.015875
food prices	<b>-0.152818</b>	0.003042
Non-food prices	<b>0.002204</b>	0.000746
human cap. Prices	<b>0.001751</b>	0.000074
<i>Non-food</i> intercept	<b>19.492776</b>	0.251655
physical capital	<b>0.000239</b>	0.000034
human capital	<b>0.134437</b>	0.003860
Food prices	<b>0.003845</b>	0.001575
Non-food prices	<b>-0.007292</b>	0.000085
human cap. Prices	<b>0.001222</b>	0.000017
<i>Inv. Physical Capital</i> inter.	-319.402982	1792.792700
physical capital	<b>-1.434243</b>	0.007112
human capital	<b>43.967791</b>	7.259170
Food prices	-2.695722	1.429914
Non-food prices	0.162986	0.631289
human cap. Prices	<b>-0.162709</b>	0.022250
<i>Inv. Human Capital</i> inter.	<b>2.691026</b>	0.065975
physical capital	<b>-0.000062</b>	0.000022
human capital	<b>0.002547</b>	0.000505

<sup>7</sup> Skoufias and Parker (2001) provide a good description of the program and comment on some of its effects, Schultz (2004) provides an evaluation of the program and linkages to development policy, Cho (2004) presents an evaluation and the effects of possible modifications to its current format.

<sup>8</sup> ML estimation using GAUSS/GAUSSX.

Food prices	<b>-0.000292</b>	0.000123
Non-food prices	0.000034	0.000024
human cap. Prices	<b>0.000010</b>	0.000005
Censoring correction	<b>-1.882893</b>	0.042460

Table 1. Bold characters are significant at the 95% level. Estimation with the full sample (n=17,183 households).

With respect to consumption physical capital appears to have a statistical significant effect over consumption of non-food items, but not on food. The stock of human capital on the other hand, is significant in explaining the consumption of both food and non-food items. The prices in both equations have the expect sign: a negative own-price effect, while the coefficients of the other prices are positive.

Some complex patterns appear in the investment decisions. First while human capital stock correlates positively with both physical and human capital investment, physical capital has a negative effect. The human capital effect may accentuate poverty traps. In the case of physical capital stock a possible explanation and venue for further research is a cohort effect. For example older people have a smaller probability of having children, thus are less prone to invest in human capital. Also, given their life cycle stage they may be consuming part of their assets, with disinvestment showing up. In the case of food prices, they appear to have a negative impact on both physical and human capital investments. The linkages with poverty traps are direct, since higher food prices may hinder the accumulation of resources. The prices of non-food items are not statistically significant in either equation. The price of education has a negative effect on physical capital investment, and a positive effect on human capital investment.<sup>9</sup>

### *Social Programs' Effects in Household Capital Accumulation*

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<sup>9</sup> As will be discussed later in the paper, once the sample is limited to households with children, the signs of these effects flip, becoming the expected ones.

A problem when dealing with social programs that make cash transfers in a reduced form specification is that endogeneity issues may arise, (in order how to solve them see for example Dhar et al. 2003). Ideally it would be desirable to perform GMM estimation, conditioned on having the proper instruments. With all its limitation the simplest approach will be followed in order to shed some light on the effects of the programs in the household's investment decisions. The procedure will consist in building two dummies: each will take the value of one (zero otherwise) if the household receives a transfer from either PROCAMPO or Progres/Oportunidades, respectively. Each of these dummies will be included in the investment equations (7).

The system (6-7) was estimated with the inclusion of the dummies that accounted participation in both social programs. Magnitudes and signs of the previously observed parameters remained close to the original regression.<sup>10</sup> The results were that neither program has a significant statistical effect in physical capital investment. On the other hand, PROCAMPO was not significant in the accumulation of human capital, but Progres/Oportunidades was both statistically and economically significant in explaining the investment in education.

In order to check the robustness of the specification, the model was estimated on two subsamples. The first subsample consisted of all households with at least one person "on school age", defined as below 23 years. The program's effect did not changed: PROCAMPO was not significant for either physical or human capital accumulation, while Progres/Oportunidades was significant for education investments, but not for physical capital.

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<sup>10</sup> In order to control for space they are not reported here, but they can be provided upon request.

The last subsample consisted on households with persons on school age (defined as above), but that were also below an arbitrary income line. The criterion was to set this line at 2 USD per day per household member. The intuition is similar to that of a poverty line, however it was an arbitrary cut-off point. For physical capital investments the results were not different qualitatively as from the previous regressions. In the case of human capital accumulation, Progresa/Oportunidades was significant and positive as in the previous runs, and PROCAMPO if any had a negative effect (the coefficient was -0.1025 with a standard error of 0.0554).

An important difference between the two programs and which may be the driving effect behind the results found, is that while PROCAMPO is in practical terms a program with unconditional transfers, Progresa/Oportunidades conditions its transfers to specific household behaviors. In the case of very poor households while unconditional cash transfers would have a welfare effect, they may not induce capital accumulation. As (Chavas 2005) points out, concerns for survival make poor households focus on short term issues, sacrificing longer term economic payoffs.

## **VI. Conclusions**

This paper argues that when poverty is present, the classic representation of intertemporal additive utilities with exogenous discounting may be incorrect. Endogenous discounting is needed to reflect survival/extreme poverty issues. Moreover a household may discount the future so heavily that below certain threshold level they would never accumulate capital, thus their income would stay very low and a poverty trap is generated.

Consumption and investment decisions at the household level were explicitly modeled and estimated via a reduced form specification. The results showed that

investment and consumption are linked through the prices of both goods and assets. For example, the price of food had a direct negative effect on investment on both physical and human capital, with poor households showing more vulnerable. *Ceteris paribus*, better endowed in terms of human capital households are investing more in physical capital and education, thus inequality and poverty could present high persistence.

Within the reduced form specification, the effects on capital accumulation of two social programs are tested. PROCAMPO a social program whose only restriction is that “qualifying” land be used for an agricultural activity does not seem to have any significant effect on the accumulation of physical or human capital. It may even affect negatively the human capital accumulation of very poor households. On the other hand, Progresa/Oportunidades whose cash transfers are conditional on school attendance and/or participating in health check-ups has a significant influence in human capital accumulation (but not on physical capital investment). These results suggest that unconditional cash transfers may improve welfare and alleviate poverty in the short run, but may be inadequate to incentive capital accumulation and as an aid in breaking poverty traps. With heavy future discounting and limited cash transfers, programs may need the participating restrictions in order to induce capital accumulation.

Two immediate objectives appear for future research. First as previously mentioned, this study is utilizing a reduced form specification. A more structural specification, where income is treated as an endogenous variable may shed more light on the household’s decision process. Second, measuring the effects of extreme poverty on productivity may contribute to a better design of complementary programs that may

alleviate urgent needs. This can create better incentives for poor households to focus on longer run opportunities.

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