School Participation and Labor Supply in Urban Mexico: Evaluating Alternative CCT Policies Using Structural Estimation

WORKING PAPER

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Abstract

I develop and estimate a dynamic household choice model that incorporates a broad set of determinants of children's labor supply and school attendance, to perform *ex-ante* evaluations of alternative versions of the urban implementation of the Mexican conditional cash transfer program Oportunidades. Previous research suggests that re-calibrating the targeting and parameters of the educational component of the program could potentially improve its effectiveness with respect to two key objectives: (i) increasing average schooling levels and (ii) eliminating the educational gender gap. The estimation of this behavioral model complements previous *ex-post* evaluations by providing a forecasting tool that can replicate how the households solve the optimization problem as the program's structure changes. I focus on evaluating cost-equivalent policy schemes that improve the program's efficacy in the first dimension. I find that, by eliminating grants at primary and lower secondary levels (where attendance is close to universal) and proportionally expanding transfers at upper secondary, attendance rates could increase by 14.8% for youth 15-17.

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1 Introduction

Conditional Cash Transfer (CCT) programs are now internationally recognized as a leading social assistance mechanism to break intergenerational transmission of poverty. Attaching conditions to cash transfers, such as regular school attendance, health check-ups, nutritional supplementation or prenatal care, has proven to be an effective means to engage poor households in behaviors that promote children's human capital accumulation.[1] Mexico's Oportunidades (formerly called PROGRESA) has become a paramount example of CCT programs given its large scale, relative early start and the collection of rigorous experimental data during the initial stages of implementation. Based on the randomized social experiment carried out in rural areas between 1997 and 2000, impact evaluations show that the program effectively increased school enrollment and educational attainment, improved health outcomes and reduced child labor.[2]

However, an evaluation by Behrman et al. (2010) suggests that the urban implementation of Oportunidades was not as successful in promoting human capital formation among low-income youth in the short-run (after 2 years). In particular, they suggest that reforms to this CCT program could potentially improve its effectiveness with respect to two key objectives: (i) increasing average schooling levels and (ii) eliminating the educational gender gap. Using a difference-in-difference matching methodology and non-experimental data gathered after the urban expansion of Oportunidades between 2002 and 2004, they study the program's impact on schooling attainment, school enrollment and child labor supply. Their research shows that, because pre-program enrollment rates where already over 90% for children 14 years old or younger (i.e., in compulsory basic education: grades 1-9), there is little scope for an effective intervention for this age group. More importantly, they document that, after two years of intervention, the program had no statistically significant impact on enrollment rates of children 12 to 18.[3] Precisely because the average drop-out rate is high

[1]The conditions and scale of CCT programs vary significantly across countries. Fiszbein et al. (2009) present a survey of the different motivations and types of implementations of CCT programs in over 30 low and middle income countries around the world.

[2]Impact evaluation of Oportunidades on school enrollment and educational attainment can be found in Schultz (2000). The effects on drop-out rates, grade progression and repetition and re-entry rates are studied by Behrman, Sengupta and Todd (2000). Skoufias and Parker (2001) evaluate the impact of the program on salaried and non-salaried activities. Gertler (2000) documents positive effects on child health and growth. Hoddinott, Skoufias, and Washburn (2000) show that Oportunidades increased overall household consumption.

[3]Behrman et al. do find a small but statistically significant positive effect on school attainment (years of schooling) for youth 12-18 after two years of implementation of the program. More importantly, their results suggest that after one year the program had an effect on enrollment rates of children 15-18. Yet, this effect disappears when the 2-year impact is measured. The conclusion of

for this group (around 40%), they suggest the program should be re-calibrated in order to promote school attendance after compulsory education. In addition, Behrman et al. (2010) find that, even though the program offers higher educational grants to girls, their labor supply is not significantly affected by the program and there are no proportionally greater impacts on female schooling outcomes. This result is particularly important since the subsidy scheme with differentiated transfers across genders was motivated by the fact that Mexico was one of the few Latin American countries that had not yet achieved gender parity in terms of average years of education by year 2000 (see Duryea et al. 2007). These results highlight the need to answer further questions that require adjusting the original setup of the urban implementation of the program in order to improve its efficacy.

In this paper I tackle this issue by developing and estimating a dynamic model of the household that incorporates key determinants of children's labor supply and school attendance, such as: income shocks, credit constraints, family structure and comparative advantages in household and market production activities.[4] A structural estimation approach lets me perform ex-ante evaluations of alternative policy designs, including changing the program's targeting (i.e., extrapolating the treatment to different groups) and parameters (e.g., varying the amount and timing of monetary transfers).

To my knowledge, there have been two previous endeavors to perform ex-ante policy evaluations of Mexico's CCT program using structural estimation methods. Both use experimental data from the initial implementation of the program in rural villages. Todd and Wolpin (2006) (TW, henceforth) estimate a parental fertility and school attendance choice model using only pre-treatment data. This approach lets them test the robustness of the estimated model with an out-of-sample validation exercise, that is, comparing actual post-program outcomes with simulation results. Among the series of alternative program scheme evaluations they analyze, the elimination of subsidies at lower grade levels and the proportional expansion at higher levels is particularly interesting because it shows how this methodology contributes to policy fine-tuning. Simulations show that under this setup average schooling attainment is around 25% larger than the gain under the original design.

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their analysis is that the program encouraged children to attain their "targeted" education at earlier ages. For instance, if a girl's objective was to reach nine years of education and normally it would of taken her 11 years, the incentives introduced by Oportunidades could of motivated her to complete ten years of education in 10 years.

[4]I group all paid or unpaid work outside the household as market production activities. Home production activities include: Cooking, washing clothes, cleaning the house, taking care of elder people and other children, helping any home member to study, collecting firewood or water and helping with the household agricultural activities (weeding hoe, cleaning, sowing, ungraining corn, extirpating herbs or taking care of animals).

Attanasio, Meghir and Santiago (2001) (AMS, henceforth) develop and estimate a model of educational choices using both pre- and post-treatment data, thus using the variation induced by the randomized experiment in the estimation of the specified structure. In contrast, TW use the variation in wages —i.e., the opportunity cost of schooling— across villages, and not the experimental variation. The alternative strategy of AMS has advantages and disadvantages. On the one hand, using the variability induced by Oportunidades lets them estimate a more flexible structural model without imposing income pooling within the household: the effect of the program transfers are not assumed to be equivalent to a reduction in child wages. This specification lets them incorporate general equilibrium effects that the program might have on the wages of children. On the other hand, they cannot perform an out-of-sample validation exercise.

This paper builds on the seminal work of TW and extends it in several ways. First, I model explicitly the parental choice problem of household consumption, own labor supply and sibling's school attendance and labor supply. An innovative feature is that labor supply is chosen both on the extensive and intensive margins, separately for market and home production. This specification intends to capture how comparative advantage in these activities determines the time allocation of school-aged children. Second, to estimate the structural model I use non-experimental data collected in the 2002 wave of the Mexican Family Life Survey (MxFLS) that was carried out before the expansion of the Oportunidades program to non-rural areas of Mexico. Third, instead of using a likelihood maximization procedure to estimate the structural model, I use an indirect inference method. As a first approach, in this paper I focus only on estimating a dynamic model of time allocation choices of the parents and their first-born child. Evidence shows that, after controlling for age, gender and household characteristics, birth order is strongly correlated with a child's labor supply and school attendance. This approach reduces the problem's complexity and makes the estimation more tractable. In the spirit of TW, I evaluate the elimination educational grants at primary and lower secondary levels (where attendance is close to universal) and the proportional expansion of transfers at upper secondary. I estimate that, by reallocating the resources, the average cash transfer could be almost doubled at upper secondary and consequently increase attendance rates by 14.8% for youth 15-17.

The paper is organized as follows. Section 2 presents a description of the urban expansion the Oportunidades program and a brief overview of the Mexican education system. In section 3, I introduce the data and discuss the general stylized facts that motivate the specification of the structural model presented in section 4. Section 5 describes the estimation of the model. The estimation results and model fit assessment are presented in section 6. The motivation and results of the policy counter-factual experiments are described in section 7. Lastly, section 8 concludes.

2 Institutional and Policy Intervention Overview

2.1 The Mexican Education System

The Mexican education system is organized in four major components: pre-school, compulsory basic education, upper secondary education and higher (or tertiary) education. Preschool caters early education to children aged three to five. One year of preschool became mandatory after 2004. The nine grades of compulsory basic education are divided into primary and lower secondary. Primary education consists of grades 1-6 and serves only children between 6 and 14 years of age. The last three grades of basic education (7-9) make up lower secondary education, and serve children 12-16 years old.[5] By law, basic education in Mexico is publicly provided and free (not including transportation, uniforms and other costs).[6] Upper secondary (also know as high school) includes grades 10-12, it is not mandatory and serves students that are normally between the ages of 15 and 17. Two types of education are offered at this level: technical or vocational training, and the usual academic track required to advance to tertiary education.

2.2 The Oportunidades Program

In 1997 the Oportunidades program was first introduced to rural areas of Mexico, and by 2002 a swift expansion started toward urban areas of the country. The program is targeted at families classified as eligible using a marginality index that summarizes household characteristics such as assets and education. The main components of the program's treatment are a health and nutrition subsidy and a schooling subsidy. The condition attached to the first subsidy is attending to regular check-ups and informational health talks at clinics. To get the schooling subsidy, children in participating households and enrolled to one of the eligible grade levels, have to attend school for at least 85% of school days. Education grants are given to a child at most two times for the same grade and when aggregated at the household level they cannot surpass a ceiling.

The design of the program varied significantly between the rural and urban implementation stages, particularly in two dimensions: the application and enrollment procedure, and the inclusion of schooling transfers for upper secondary students. In the rural program, a census was done at the targeted villages and the households that

[5]Kids older than 14 that do not complete primary education and kids older than 16 that do not complete lower secondary education, can only enroll in an adult schooling system that works in parallel.

[6]According to the Mexican Education Ministry, private schools account for around 12% of total enrollments.

met certain requisites where informed of their eligibility. In contrast, for budgetary reasons a census was infeasible in the urban implementation, so potential beneficiaries had to self-select into the program by visiting local sign-up offices that were open for a limited time. This process meant that beneficiaries had to know about the existence of the program, visit the office to learn their eligibility status, and apply if their incentives were compatible with the program's. The result of the procedural differences in terms of the observed take-up rates is not surprising. While program participation rates of eligible households was above 90% in rural areas, in the urban implementation phase it was only about 60%.

In general terms, the education grant structure in rural and urban areas is almost identical. The only difference is that in the urban implementation the benefits were extended to students enrolled in grades 10-12. In 2003 average monthly benefits ranged between 10 and 63.5 USD and were offered throughout the ten month academic period. As shown in Table 1, subsidy amounts increase with grade level and are higher for girls. The rationale behind this design is to compensate older children's higher opportunity costs of going to school, and reduce the gender gap in post-primary enrollment rates.

3 Stylized Facts

As mentioned before, to estimate the model I use data from the first wave of the MxFLS, which was collected in 2002, before the expansion of Oportunidades to urban areas of Mexico. Using this dataset has several advantages. There most relevant is that the survey collected detailed information of all of the household member's time allocation in market and home production activities. Edmonds (2009) estimates that when studying child labor supply in developing countries, ignoring domestic work would understate average total hours worked by a child by a factor greater than two. According to the 1973 "Minimum Age Convention" of the ILO, the difference between *light work* and *child labour* is that the former is: (i) "not likely to be harmful to their health or development" and (ii) "not such as to prejudice their attendance at school, their participation in vocational orientation or training programs approved by the competent authority or their capacity to benefit from the instruction received" (Article 7, Section 1, Convention 138, ILO). Therefore, it is clear that both theoretical and empirical definitions of child labour should include work outside (paid or unpaid market production) and inside the household (home production) given that they impede a child to allocate enough time to welfare enhancing activities, such as schooling. Second, this survey has rich information about siblings that do not reside at the household, a feature that lets me use an additional subsample of first-born children in the model estimation.

An initial analysis of the data highlights several important characteristics of children's time allocation. The first one is that working and going to school are not necessarily mutually exclusive activities: 77% of the children 10-17 years old report to be working, yet approximately nine out of ten say that they are going to school. However, as shown in figure 1, when the amount of working hours reaches the 36 hours per week threshold, school attendance rates drops bellow 50%.[7]

Secondly, there is a distinct specialization in domestic and market production across genders. Girls specialize in home production activities: while 85% of the girls work in home production activities, only 9% of them participate in market activities (see fig.2). In contrast, the labor participation of boys concentrates in market activities; only 24% of the boys work more than one hour per day in home production, but approximately 14% work more than 21 hours per week in home market activities (see figure 3). This is particularly relevant because home production appears to be less rival with school attendance. As shown in figures 4 and 5, the gradient of school attendance rates to the number of hours worked per week is significantly larger with respect to market production activities.

As mentioned before, I focus on the labour supply of first-born children. As a starting point, it is interesting to study the mechanisms behind the eldest child's labour supply because this sub-sample has particular characteristics, such as greater number of younger siblings and being the first in the birth order ranking, that are strongly correlated with both the extensive and intensive margins of labour supply. A simple visual comparison between the distribution of total hours per week worked of first-born children and non-first-born children (see figure 6) suggests that the latter are less prone to participate in any activity and, if they do, in average they have a lower workload. This could be explained by the fact that both birth order (figure 7) and age (figure 8) are strongly associated with labour supply: in general younger and higher birth order children work less (work hours distribution is skewed to the left).

Exploiting the panel structure of the 2002 and 2005 waves of the MxFLS, I examine how labor supply is statistically associated with the child's gender, age, birth order and sibling structure, controlling for household-specific unobserved heterogeneity (household level fixed effects). The reduced form analysis indicates that, after accounting for gender and age effects, birth order is significantly correlated with labor supply in both the extensive and intensive margins. I estimate the linear probability model represented by equation 1, where the probability of labor participation of child i from household j ($I(H_{ij} > 0)$) is explained by birth rank (a vector of dummies for kids ranked second, third, fourth or more that is equal to one for child i's birth rank,

[7]Edmonds (2009) finds a similar discontinuity in drop-out rates when children work between 35 and 38 hours per week in Albania, Burundi, Cote d'Ivoire, DR Congo, Guyana, Madagascar, Nepal and Swaziland.

$\sum_{k=2}^{5} I(BR_{ij}=k)$), gender (a dummy equal to one if child i is female, $I(Girl_{ij})$), age (a vector of dummies for each child aged 11-17 years that is equal to one for child i's age, $\sum_{k=11}^{17} I(Age_{ij}=k)$), household fixed effects (FE_j) and logistically distributed errors (e_{ij}).[8] By including interactions of the gender dummy variable with other right hand variables I allow for differentiated effects by gender.

$$\begin{aligned} I(H_{ij}>0) &= \sum_{k=2}^{5}\beta_{1,k}I(BR_{ij}=k)+\sum_{k=2}^{5}\beta_{2,k}I(BR_{ij}=k)*I(Girl_{ij}) \\ &+ \beta_3 I(Girl_{ij})+\sum_{k=11}^{17}\beta_{4,k}I(Age_{ij}=k) \\ &+ \sum_{k=11}^{17}\beta_{5,k}I(Age_{ij}=k)*I(Girl_{ij})+FE_j+e_{ij} \end{aligned} \quad (1)$$

The estimates presented in table 2 indicate that increasing the birth ranking (from older to younger) is associated with a lower probability of working (both in home or market production, see columns 2 and 3, respectively). In particular, when this equation is estimated only for girls (tab.3) the results suggest the correlation is stronger within female children. Additionally, it is worth mentioning the fact that age is always positively correlated only with a kid's probability of participating in market activities. In contrast, the association between age and home production participation is weaker and non-linear: it becomes negative for kids that are 14 or more years old.

I also analyze the intensive margin of labor supply by estimating a simple linear model of the conditional mean of total weekly hours worked (that is, $E[H_{ij}|H_{ij}>0]$). In this linear fixed effects (FE) model I include the above mentioned right hand variables (except here e_{ij} is only assumed to be *iid* and have mean zero, see equation 2) and include only children that participate in any labor activities ($H_{ij}>0$). The FE coefficients indicate a strong correlation of working children's labor supply with birth order (see column 1 in table 5).[9] For instance, controlling for household and age heterogeneity, a first-born boy works approximately 10 hours per week more than a boy that is fourth in the birth ranking. The magnitude of this association is significantly greater when the analysis is made for the conditional mean of home production hours (column 2), rather than for market production hours (column 3). In particular, the FE estimates show that age is highly correlated with the amount

[8] Throughout the paper $I(\cdot)$ represents indicator functions.

[9] The FE estimates are not corrected for sample selection biases. The high complexity of estimating a model with both fixed effects and sample selection bias corrections exceeds the motivational purpose of this exercise. Instead, first I estimate a model of the extensive margin of labor supply (selection into work) and second a model of the intensive margin of labor supply conditional on participation.

of market production hours. Holding everything else constant and conditional on participating, a 17 year old kid works in average almost 17.5 more hours per week than a 10 year old. Particularly, age has a stronger and positive association with the intensive margin of labor supply in market production activities.

$$
\begin{aligned}
E[H_{ij}|H_{ij}>0] &= \sum_{k=2}^{5} \beta_{1,k} I(BR_{ij}=k) + \sum_{k=2}^{5} \beta_{2,k} I(BR_{ij}=k) * I(Girl_{ij}) \\
&+ \beta_3 I(Girl_{ij}) + \sum_{k=11}^{17} \beta_{4,k} I(Age_{ij}=k) \\
&+ \sum_{k=11}^{17} \beta_{5,k} I(Age_{ij}=k) * I(Girl_{ij}) + FE_j + e_{ij} \qquad (2)
\end{aligned}
$$

Furthermore, when the extensive margin of labor supply is analyzed separately by gender —i.e., when the reduced form model is estimated for girls and boys separately— the association with birth order is more significant for girls (tab.6): the conditional mean of both home and market production hours decreases with the birth rank. In contrast, for boys this relationship sustains only with respect to home production hours (see table 7).

Similar results are found when focusing on the number and gender composition of siblings. As shown in table 8, for all children participation in any kind of activity increases with the number of younger siblings. In particular, the probability of working rises faster with the number of younger sisters than with the number of younger brothers (tab.9). However, when comparing within gender (again, estimating the Logit models for each gender separately), the results are mixed. On the one hand, for boys the number of younger sisters is not associated with participation in home production activities. On the other hand, girls' participation in market activities is not correlated with the number younger brothers.

When studying the intensive margin of labor supply the story changes partially: given that kids are working, the number of younger siblings is mostly associated with the average amount of hours per week invested in home production activities. As shown in the second panel of table 10, only when comparing within girls the conditional mean of market production hours increases with the number of siblings. For instance, the results indicate that after controlling for age and household effects, compared to a girl with no siblings a girl with more than 3 siblings works on average 10 more hours per week in home production and 8 more in market production (for a total of 18 extra hours per week). On the contrary, when comparing a boy with no siblings with one with more than 3 —and holding everything else constant—, the latter works on average an additional 8 hours in home production but no extra hours in market production.

Additionally, it is interesting how the number of male and female siblings is associated with the conditional mean of work hours per week of kids. As shown by the estimates presented in the second and third panels of table 11, while the number of younger brothers and sisters is highly correlated with a girl's total amount of workload in both market and home production, among boys only the number of younger sisters is associated with additional hours of market work.

The results presented in this section give an idea of some of the features a theoretical model of child labor supply should have. As shown above, child labor supply is simultaneously associated with gender, age, birth order and sibling structure. Hence, these variables should be included in the model as factors behind the time allocation choices made by within households. Moreover, given the observed sector specialization of girls and boys, it is important to differentiate between labor supply in home and market production activities and to incorporate mechanisms that promote it, such as differences in home and market productivity across genders. Finally, the idea of reducing the complexity of the problem by analyzing only the eldest child's time allocation decisions comes from the empirical observation that birth rank is strongly correlated with both the extensive and intensive margins of a child's labor supply .

4 The Model

4.1 General structure of the household's problem

The proposed model addresses the sequential decision-making process of the parents about their labor supply in market and home production activities (m_{pt}, h_{pt}), the household's aggregate consumption (C_t) and savings (s_t), and, if present, the eldest child's leisure (l_{ct}), labor supply in market and home production activities (m_{ct}, h_{ct}) and school attendance (e_{ct}). These choices are made every period conditional on a vector of state variables: the amount of savings from the previous period (s_{t-1}), the age and educational attainment of the first-born child (A_{ct}, E_{ct}), the household size (i.e., the number of siblings, N_t), the market wage offers to the parents and the eldest child (w_{pt}, w_{ct}), the price of consumption goods (P_t^C), the price of education (P_t^e) and the interest rate (R_t). The structure of the household's problem varies across these three stages: (i) when there are no productive children in the household, (ii) when the first-born child is school-aged and productive and (iii) when the parents no longer decide for the first-born child. Figure 9 presents the timing and sequentiality of the three stages.

I assume that all children under six are not productive in any home or market production activities, therefore, in the first stage (when $t \in S_1$) the first-born's time allocation is not part of the problem (i.e., $m_{ct} = h_{ct} = e_{ct} = 0$). Similarly, in the third stage ($t \in S_3$) the eldest child is assumed to reach his or her independence, meaning that the parents no longer choose for the child. At these two stages, given state vector z_t and price vector P_t, parents choose vector x_{1t} to solve:

$$\begin{aligned}
\max_{\{x_{1t}\}} & \quad \left\{ \mathbf{E}_0 \sum_{t \in S1 \cup S3} \delta^t U\left(C_t, H_t, l_{ct}, E_{ct} | z_t, P_t\right) \right\} \\
x_{1t} &= \{s_t, h_{pt}, m_{pt}\} \\
z_t &= \{s_{t-1}, w_{pt}, w_{ct}, N_t, A_{ct}, E_{ct}\} \\
P_t &= \{P_t^C, P_t^e, R_t\}
\end{aligned}$$

subject to:

$$P_t^C C_t + s_t = w_{pt} m_{pt} + R_t s_{t-1} \tag{3}$$

$$2 = m_{pt} + h_{pt} \tag{4}$$

$$1 = l_{ct} + m_{ct} + h_{ct} + e_{ct} \tag{5}$$

$$H_t = H(h_{pt}, h_{ct}, A_{ct}, S_c, N_t | \alpha) \tag{6}$$

$$s_{MIN} \leq s_t \tag{7}$$

$$N_{t+1} = N(Edu_p, A_{ct}, N_t, \xi) \tag{8}$$

At these two stages parents have preferences toward C_t, total home production (H_t) and the educational attainment and leisure of the first-born (E_{ct}, l_{ct}). In addition, their choices are constrained by an intertemporal budget constraint (eq.3), the time constraints (eq.4 and 5), a given home production technology (eq.6), and an exogenous fertility process (eq.8) that depends on the parent's educational attainment (Edu_p), A_{ct}, N_t and iid shock ξ. Additionally, households face a maximum credit limit, that is, a lower bound in negative savings (s_{MIN}). Both the wage offer processes and the fertility processes are explained in detail in section 4.2. I assume home production technology uses the family member's time spent in home production activities as inputs and varies by household size (N_t). The idea behind this structure is that home production technology should reflect the fact that the number of siblings affects the level of H_t that a household can and needs to produce. Also, in order to capture the fact that access to credit depends on the households wealth or ability to provide a collateral, in the model the maximum credit limit depends on the educational level of the parents.

Following Behrman et al. (1982), I assume the welfare function parents maximize depends indirectly on their children's expected adult full income, in this case only on the eldest child's expected adult full income: Y_{ct}. It is commonly denominated as "full" income because it is a linear combination of the child's income and her/his spouse's income. Hence, during their parenting lifetime, mother and father consider both future labor market returns and future marriage market returns when deciding the time allocation in schooling, leisure and labor supply of the first-born child. In other words, parents not only take into account how well a kid is going to do in the labor market thanks to her or his accumulated human capital, but also consider that human capital is a determinant of the "quality" of the child's match in the marriage market.

By imposing this structure I am assuming that parents don't actually receive a fraction of their children's future human capital returns in the form of a direct monetary transfer. I do not have information about the transfers made by adult offspring to their parents. As an alternative, I include Y_{ct} as a public good in the parent's utility function. Even if I cannot directly observe Y_{ct} in the data, I impose a structure where the eldest child's expected adult full income in t is a function of observed past and present variables that capture her or his human capital accumulation process. In particular, I assume the child's own adult income depends only on school attainment, hence E_{ct} is included in the household's welfare function as an indirect measure of Y_{ct}.

The second stage of the problem starts when the eldest child reaches the schooling age ($A_{ct} = 6$) and finishes when she/he reaches the age of majority ($A_{ct} = 18$). During this stage, the first-born can participate in home production activities and have a job outside home. In addition to C_t, s_t, m_{pt} and h_{pt}, parents will choose every period the labor supply (m_{ct},h_{ct}), leisure (l_{ct}) and school attendance (e_{ct}) of the eldest child. Again, H_t is produced with the given technology.

Parent's and first-born's allocation across market labor supply, home production, leisure and schooling is bounded by a time constraint (equations 4 and 5, respectively). Schooling is the only activity that cannot be adjusted in the intensive margin: either the child goes to school for a fixed number of hours or she/he doesn't. Similarly as before, for the household wage offers (w_{ct}, w_{ct}), the fertility process, prices and credit limit are given. The household's problem in the second stage is:

$$\begin{aligned} \max_{\{x_{2t}\}} & \quad \left\{ \mathbf{E}_0 \sum_{t \in S2} \delta^t U\left(C_t, H_t, l_{ct}, E_{ct} | z_t, \mu_t, P_t\right) \right\} \\ x_{2t} &= \{s_t, m_{pt}, h_{pt}, m_{ct}, h_{ct}, e_{ct}\} \\ z_t &= \{A_{ct}, E_{ct}, N_t, s_{t-1}\} \end{aligned}$$

subject to equations 4, 5, 6, 7, 8 and:

$$P_t^C C_t + s_t + P_t^e e_{ct} = w_{pt} m_{pt} + w_{ct} m_{ct} + R_t s_{t-1} \tag{9}$$

4.2 Exogenous sources of uncertainty

In order to replicate the observed specialization of adults, boys and girls, I assume differentiated wage processes. For the parent's, the process is determined by their education (edu_p) and experience (exp_{pt}). For the children, age and gender (S_c) enter in the wage profile as a determinant of their productivity. Additionally, I assume that wages are also determined by a skill shock that is identically and independently normally distributed: $\mu_{pt} \sim N(0, \sigma_p^2)$ and $\mu_{ct} \sim N(0, \sigma_c^2)$. Therefore, w_{pt} and w_{ct} have different first and second moments. Given this assumed structure, the wage profiles are given by:

$$w_{pt} = \nu_1 + \nu_2 edu_p + \nu_3 exp_p + \mu_{pt} \quad (10)$$

$$w_{ct} = \rho_1 + \rho_2 S_c + \rho_3 A_{ct} + \mu_{ct} \quad (11)$$

The fertility process is assumed to be determined exogenously, i.e. parents don't choose the timing or number of children. Following Brien, Lillard and Stern (2006) I introduce a statistical process for N_t that tries to match the data. In particular, I assume that the stochastic process of having a child ($n_t = \{1, 0\}$) is represented by a Probit model where the explanatory variables are the parent's education, the number of children, the age of the first-born and the square of these variables (to capture non-linear effects):

$$n_t = \begin{cases} 1 & \text{if } \chi_0 + \chi_1 edu_p + \chi_2 A_{ct} + \chi_3 A_{ct}^2 + \chi_4 N_t + \chi_5 N_t^2 - \xi > 0 \\ 0 & \text{if } \chi_0 + \chi_1 edu_p + \chi_2 A_{ct} + \chi_3 A_{ct}^2 + \chi_4 N_t + \chi_5 N_t^2 - \xi \leq 0 \end{cases}$$

Therefore, given $\xi \sim N(0, \sigma_\xi)$ we have that:

$$Pr(n_t = 1) = \Phi\left(\frac{\chi_0 + \chi_1 edu_p + \chi_2 A_{ct} + \chi_3 A_{ct}^2 + \chi_4 N_t + \chi_5 N_t^2}{\sigma_\xi}\right) \quad (12)$$

I addition, I assume that there is no uncertainty on educational investment, that is, school attendance always increases the educational stock of the children.

4.3 Model solution: household's Dynamic Programming Problem

The recursive problem faced by every household at every period t can be written in the following form:

$$V(z_t, P_t, \mu_t, \xi_t) = \begin{cases} \max_{x_{1t}} \{U(t|\Theta) + \delta \mathbf{E}_t V(z_{t+1}, P_{t+1}, \mu_{t+1}, \xi_{t+1})\} & , t \in S_1 \\ \max_{x_{2t}} \{U(t|\Theta) + \delta \mathbf{E}_t V(z_{t+1}, P_{t+1}, \mu_{t+1}, \xi_{t+1})\} & , t \in S_2 \\ \max_{x_{1t}} \{U(t|\Theta) + \delta \mathbf{E}_t V(z_{t+1}, P_{t+1}, \mu_{t+1}, \xi_{t+1})\} & , t \in S_3 \end{cases}$$

Every period, after observing the vector of state variables (z_t) and using the known distributions of the stochastic shocks ($\mu_t = \{\mu_{pt}, \mu_{ct}\}$ and ξ_t), each household computes the value functions (i.e., the present period utility plus the discounted expected value function in $t+1$) associated to all of the feasible choices. Hence, the parents can choose optimally knowing that this will affect the state variables and feasible choice set in period $t+1$. Given that the problem has a finite horizon, it can be solved by backwards recursion. In the final period, when $t = T$, the continuation value is assumed to be zero, thus the value function equals the present utility at T. Following Keane and Wolpin (1994), this problem can be simplified and solved by indirectly recovering the expected value functions —also known as Emax functions—. The first step is to discretize the state, shock and choice spaces. Then, for every t, the Emax functions are calculated for the finite number of points in the resulting space generated by combining the above mentioned discrete spaces. The Emax functions can be approximated with a parametric function of the state variables in the current period. These approximations are used then to generate the optimal decision rules (or policy functions) that let us simulate the behavior of the households. The details of the discretization and approximation procedure are addressed in section 5.

4.4 Introducing functional forms

4.4.1 Utility function

The advantage of choosing the functional form presented in equation 13 as the representation of the parent's preferences is that the parameters can be easily interpreted. The intertemporal elasticity of substitution for consumption is described by $\frac{-1}{\theta_1}$. The relative importance of home production and the leisure and educational attainment of the eldest child are captured by θ_3, θ_2 and θ_4, respectively.

$$U_t = \frac{(C_t)^{1-\theta_1}}{(1-\theta_1)} + \theta_2 \ln l_{ct} + \theta_3 \ln E_{ct} + \theta_4 \ln H_t \tag{13}$$

4.4.2 Home production technology

The functional form presented in equation 14 captures some important features of the observed time allocation to home production activities. The parameters $\hat{\alpha}_1$ and $\hat{\alpha}_2$ measure the elasticity of H_t with respect to the domestic labor of the parents and the first-born child. Also, $\hat{\alpha}_3$ and $\hat{\alpha}_4$ capture the additional effect of the parent and eldest child's allocation of time in home production when N_t siblings are present in the household. Additionally, $\hat{\alpha}_5$ captures the productivity impact of the eldest child's age (A_{ct}) and $\hat{\alpha}_6$ the differential productivity across girls and boys in home production

($S_c = 1$ if the first-born is a girl).

$$H_t = h_{pt}^{(\hat{\alpha}_1 + \hat{\alpha}_3 N_t)} h_{ct}^{(\hat{\alpha}_2 + \hat{\alpha}_4 N_t + \hat{\alpha}_5 A_{ct} + \hat{\alpha}_6 S_c)} \tag{14}$$

Given this structure, it is impossible to separately identify the parameters in the home production technology. If we substitute equation 14 into the fourth term of the utility function presented in eq.13 we have that:

$$\theta_4 \ln H_t = (\alpha_1 + \alpha_3 N_t) \ln h_{pt} + (\alpha_2 + \alpha_4 N_t + \alpha_5 A_{ct} + \alpha_6 S_c) \ln h_{ct} \tag{15}$$

where: $\alpha_1 = \theta_4 \hat{\alpha}_1$, $\alpha_2 = \theta_4 \hat{\alpha}_2$, $\alpha_3 = \theta_4 \hat{\alpha}_3$, $\alpha_4 = \theta_4 \hat{\alpha}_4$, $\alpha_5 = \theta_4 \hat{\alpha}_5$ and $\alpha_6 = \theta_4 \hat{\alpha}_6$. Again, only α_1, α_2, α_3, α_4, α_5 and α_6 can be separately identified. As a starting point, in this paper I use a very simple structure for the home production technology that captures only the coarse effect of the total time allocated in home production activities by the parents and eldest child:

$$\theta_4 \ln H_t = \alpha_1 \ln h_{pt} + \alpha_2 \ln h_{ct} \tag{16}$$

5 Estimation Methodology

5.1 Indirect Inference Algorithm

The vector of parameters in the model (Θ) is estimated using the method of indirect inference proposed by Gourieroux and Monfort (1996). Given a sample of n households and S simulations of each household, the solution of the problem proposed by this approximation is represented by:

$$\Theta^* = \arg\min_{\Theta} \left[\Lambda_n - \frac{1}{S} \sum_{s=1}^{S} \lambda_n^s(\Theta) \right]' \Omega_n \left[\Lambda_n - \frac{1}{S} \sum_{s=1}^{S} \lambda_n^s(\Theta) \right] \tag{17}$$

The goal is to estimate the unknown vector of parameters by minimizing the distance between a vector of simulated statistics (λ_n^s) —also known as auxiliary parameters—, to the corresponding vector of actual data statistics (Λ_n). I use an iterative search procedure, were, for an initial guess Θ_o I follow these steps: (i) solve the model recursively, (ii) simulate model, (iii) build λ_n^s (for n households and S simulations), (iv) compare λ_n^s with Λ_n and estimate a distance measure. If the matching between the simulated and data statitstics is not good enough (i.e., the distance measure is too large), (i)-(iv) are repeated with a new guess ($\Theta_o + \epsilon$). This procedure is repeated until the distance is minimized, thus Θ^* has been found. The list of auxiliary parameters to be matched in the indirect inference procedure is presented in tables 12 and 13. Ω_n is a positive definite weighting matrix given by the inverse of the covariance matrix of the data statistics (estimated using a standard bootstrap method with 1000 bootstraps).

5.2 Estimated Parameters

As a first approach, I estimate a reduced version of the full scale model presented before. First, to narrow the dimensions in the search procedure, only four structural parameters are estimated endogenously: θ_1, θ_3, α_1 and α_2. As explained in appendix 1, to pin down the scale of the estimated parameter vector, θ_2 is given the *ad hoc* value of 0.006529. The parameters estimated outside the model are the ones in the wage processes (ν_1, ν_2, ν_3, σ_ν, ρ_1, ρ_2, ρ_3 and σ_ρ), the marginal cost or price of education (P_t^e) and the credit limit (s_{MIN}). The interest rate (R_t) is set to be 40%.[10]

Second, I aggregate children in 12 age groups, and assume that at each period t the parents choose if their first-born attends and completes the age corresponding three-year educational level: lower primary (grades 1-3), upper primary (grades 4-6), lower secondary (grades 7-9) or upper secondary (grades 10-12). As shown in figure 9, the problem is limited to a horizon of 12 periods where each age group is indexed to a period.[11] For instance, a household in the in the fifth period ($t = 5$) starts with a 15 year old child with E_{c5} years of education, and chooses to pay or not the price P_5^e to get three additional years of education. Given that the household can only invest in the child's educational stock during the second stage of the model (while $t \in S_2 = \{2, 3, 4, 5\}$), the maximum attainable educational stock is 12 years. Third, the fertility process is excluded, hence the number of siblings is constant and always known for a household. Therefore, χ_0, χ_1, χ_2, χ_3, χ_4 and χ_5 are not estimated.

5.3 Discretization of state, shock and choice spaces

As mentioned before, the solution and estimation of the model requires the discretization of the state, shock and choice spaces. The variables that I re-classify into discrete grids (i.e., discretize) are: household's net savings, father's education, father's experience, number of siblings, labor supply in market and home production activities of the parents and the eldest child, and the eldest child's leisure. Net savings are discretized into a 10 point grid that corresponds to the 5^{th}, 10^{th} , 20^{th}, ... , 80^{th} and 95^{th} percentiles of the empirical net savings distribution. Father's education and experience are discretized in two-point grids ($edu_p = \{\text{Low,High}\}$ and $exp_p = \{\text{Low,High}\}$). Households where the father has less than nine years of education are grouped in the first point of the father's education grid, and the ones with more than 9 years in the second. Experience is approximated by the father's age at the time his eldest child was born. If the father was less than 23 years old when his eldest child was born,

[10]According to the Mexican National Financial Institution User Protection and Defense Committee (CONDUSEF) the average APR offered by banks was 40%.

[11]A_{c1} includes ages 0-5, A_{c2} ages 6-8, A_{c3} ages 9-11, A_{c5} ages 12-14, A_{c5} ages 15-17, A_{c6} ages 18-21 and so on, upto A_{c12} that includes first-borns 38 or more.

then the household is classified into the first grid point (otherwise, into the second).[12] The number of siblings was discretized into a four point grid: $N_t = 1$ if the first-born child has no siblings, $N_t = 2$ if the first-born child has one sibling, $N_t = 3$ if the first-born child has two siblings or $N_t = 4$ if the first-born child has three or more siblings. Time allocation variables (labor supply in market and home production activities and leisure) are discretized into three point grids: {None, Half-time, Full-time}. School attendance of the eldest child is the only time allocation choice that is restricted to a two point grid: {None, Full-time}. For the stochastic shocks (μ_p, μ_c) I use a five point grid that corresponds to the 5^{th}, 25^{th}, 50^{th}, 75^{th} and 95^{th} percentiles of the empirical distribution of the residuals from the estimated wage equations.

5.4 Function approximation

To approximate the Emax and policy functions along a continuous support, I use an extended version of the *B-spline* interpolation routine presented by De Boor (2001). The basic idea of this methodology is to estimate a sequence of polynomial approximations —one for each segment of the grid— that are connected end to end. This method guarantees a continuous approximation that passes through the estimated values at each point of the discrete grid. I extend this routine by including a safeguard that substitutes all non-monotonically-increasing polynomial splines with linear splines.

6 Results

6.1 Sample Selection

The estimation sample includes only households that meet the following criteria: located in non-rural areas (cities with population greater than 2,500), both parents reside in the household, either are reported as the household head, the father is less than 65 years old, they have at least one sibling (not necessarily living with them), and they have complete information on educational attainment, time allocation and financial history. After dropping the households with incomplete financial information the sample size falls from 2,347 to 1,912 (an 18.5% decrease). Tables 14 and 15 present descriptive statistics of the sample before (panel A) and after (panel B) this restriction. The most relevant effect of this sample selection is that I drop disproportionately more households with more educated fathers that are on the upper tail of

[12] I chose this threshold for two reasons. First, because a 23 year old a person has had the chance to complete at least some tertiary education. Second, because it guarantees I have a large number of households in each group.

the labor income distribution.[13]

6.2 Parameter Estimates

Table 17 reports the OLS estimates of the adult labor income process.[14] The dependent variable is the aggregate three year labor earnings of working parents. Considering that in 2002 the official minimum daily wage in Mexico was $42.15 Pesos (approximately $39,452 Pesos in a 3 year period with 26 working days per month), my predicted average labor earnings for a low education and low experience adult of $50,480 ($\nu_1$) seems relatively high. As expected, the results suggest both education and experience have a positive and significant effect on adult earnings. On average, having more than 9 years of education increases expected labor income by a factor greater than three. In contrast, parents in the high experience level group have on average only a 60% earnings premium. The parameters in the youth labor income equation are estimated using a two-stage sample selection bias correction procedure (see table 17). The estimates indicate that boys have a wage premium —ρ_2 is significant and negative— and that wage offers increase with age —ρ_3 is significant and positive—.

As mentioned before, the cost of education is taken directly from the observed distribution of reported household expenditures in education.[15]. As shown in table 18, the average cost of upper secondary is approximately 70% higher than in lower secondary, three times larger than in lower and upper primary and represents 38% of the 2002 official minimum wage.

Similarly, the credit limit used in the model estimation and simulation is derived from the distribution of current debt reported by the households in the MxFLS. Table 19 presents the average credit for the households in my sample, conditional on the educational level. Two facts are worth highlighting. First, that the average credit amount for households where the father has 9 or more years of education is 72.5% higher. Second, that credit access is very limited: the debt to income ratio for a low education and low experience household is approximately 2.4%.[16]

[13]Since the relevant educational policies for this paper are the ones targeted at low income households, loosing information of the wealthiest households does not seem critical.

[14]For two reasons I decide to ignore selection biases in the estimates by using an OLS approach. First, because I observe that in almost 90% of the households in my sample at least one parent is working full-time. Second, because I would have to include an additional state variable in the model that serves as a valid exclusion restriction for the first stage of the selection model. This is not very tractable considering the high dimensionality the problem already has.

[15]Including school fees (enrollment, fellowship, exams, special courses, school maintenance and others), school material (books, educational material, uniforms and sports fear), school festivities an celebrations, transportation and spending money.

[16]According to OECD data, in 2008 consumer debt to income ratio was above 60% in Western

The estimates of the parameters endogenous to the indirect inference procedure are presented in table 20. All of the parameters are statistically different from zero at a 95% confidence level. The intertemporal rate of substitution (θ_1) is 2.37 and is in the range of values found in the empirical literature: $\{2, 5\}$. The relative importance of the educational stock of the first-born to parents (θ_3) is 0.142. The home production technology parameters, α_1 and α_2, are 0.189 and 0.068. The interpretation of the last three parameters is not very transparent since they coarsely capture the relative importance of the child's educational stock, the time in home production of the parents and the child, with respect to the child's leisure.

6.3 Model Fit

The auxiliary parameters estimated using the MxFLS data and the simulated data are presented in table 21 and 22. The model does a very good job fitting the average school attendance rate of first-born children by age group (statistics 1-4). In particular, the simulated data closely replicates the observed drop of more than 30% in school attendance for youth 15 to 17 years old. Additionally, the simulation broadly reproduces the pattern observed on school attendance rates across household size (statistics 5-8): as the number of siblings increases, the probability that the eldest child attends school diminishes.

However, the fit for the rest of the auxiliary statistics is not completely satisfactory: even if they are generally in the ballpark —the average relative distance for statistics 9-28 is 12.1%—, they don't replicate important patterns observed in the data. For instance, the model is not able to reproduce the fact that on average attendance rate is higher for girls (statistics 9-10) and children in households with more educated and older fathers (statistics 11-14). Also, the model is not able to match the positive correlation between the first-born's time allocation in home production and the number of siblings in the household (statistics 10-22), and the negative correlation between the parent's time allocation in home production and the age of the first-born (statistics 24-28).

7 Policy experiments

The main purpose of estimating the underlying structural parameters of a dynamic model is to perform *ex-ante* evaluations of alternative policy designs were the program's targeting and/or parameters are modified. Given the estimated parameters, my behavioral model can be used to predict the impact of different conditional cash

developed countries and 120% in the US.

transfer schedules on school attendance in urban areas of Mexico. This effort complements previous *ex-post* evaluations of the urban implementation of Oportunidades —based on the straightforward impact measurement between treatment and control groups— by providing a forecasting tool that can replicate how the households solve the optimization problem as the program's structure changes. In the simulated counter-factual scenarios I present, educational grants enter the household's budget constraint when subtracted from the educational-level-specific costs (P_t^e). Therefore, at some point the subsidy amount can surpass education costs and compensate (partially or completely) the forgone earnings when attending school.

7.1 Policy Exercise 1: Original Oportunidades Scheme

The first policy exercise presented serves as an external validation exercise: an *ex-ante* evaluation of the original scheme of educational grants offered in the 2003 urban implementation of Oportunidades. An optimal external validation exercise would require the use of experimental data to test if a model estimated using only pre-program data is able to replicate the impact found with observational methods (i.e., any reduced form *ex-post* impact measurement). Since I'm using the MxFLS data, I do not have experimental data to create an impact baseline to do this kind of external validation exercise. However, I can use the results from Behrman et al. as a point of reference to evaluate the validity of the model's structure.

In this exercise the subsidy is offered to all households, not only to households with a low income generating capacity (or poor). The schedule of transfers is presented in table 23, where the amount is given for each 3-year long education level. To have an idea of the generosity of the transfers, in the third and fourth columns I report their relative size with respect to the official minimum wage in Mexico. As you can see, the subsidies are quite significant: for a girl in upper secondary, being a recipient of the subsidy would represent a 55% supplement to the labor income of a household with a single minimum wage earner. Schultz (2000) finds that in rural areas the highest transfers of the program represented 44% of the minimum wage. Furthermore, the subsidy is larger than the average school expenses at the last three educational levels (see columns 5 and 6), meaning that the subsidy is generous enough to cover the direct costs of attending school and compensate at least partially forgone labor earnings.

Overall, the model does a good job reproducing the results by Berhman et al.: the simulated data predicts that this policy scheme would not have a substantial effect on the school attendance rates of all children. As shown in figure 10, the largest impact would be on the attendance rate of children in upper secondary, yet this effect would be merely 1.2%. This roughly matches the results from the matching difference-in-difference estimation: after 2 years of implementation, the program has no statistically significant impact on enrollment rates of youth 12-18. Nevertheless, the *ex-post* evaluation reports that the impacts for the 8-11 age group were approximately 2-3%, yet in the simulation the impact is closer to zero (0.14% for children 9-11).

7.2 Policy Exercise 2: Focusing on Upper Secondary

As mentioned before, the subsidy offered to students in grades 3-9 was identical in urban and rural areas. Yet, in urban areas an additional and substantially larger grant was offered at grades 10-12. The main motivation for this new transfer schedule was to compensate youth's higher earnings potential in urban areas and provide enough incentives to promote enrollment beyond compulsory school and hopefully increase overall school attainment. However, the results previously discussed suggest that this effort was insufficient.

In the second policy exercise I evaluate an alternative subsidy schedule were the transfer at primary and lower secondary is eliminated, and the grant at upper secondary (to children 15-17) is increased. This kind policy adjustment has been suggested before in the literature supported by the fact that, at compulsory school, pre-program enrollment is already close to universal, while at upper high school attendance rates are below 65%.[17] In other words, the grants offered at grades 3-9 are closer to a direct transfer: since most of the children were planning to go to school, the subsidy is not changing their behavior and only increasing the household's resources. Hence, it seems reasonable to reallocate the program's resources toward the grades in which they.

Since my model does not do a good job replicating gender differences in school attendance, I evaluate a transfer scheme that is homogeneous for boy and girls. In figure 11 I present the simulated impact —i.e., the change in the attendance rate with respect to the original level of 63.2%— as the conditional cash transfer per month is increased. Given the highly discretized structure of the model, graphical representations of the simulated data result in step functions with presumably interesting thresholds. Since the number and location of the thresholds depend on the *ad hoc* grids imposed on the choice and state variables, my analysis focuses on a smooth approximation of the simulations (thus undermining the relevance of the thresholds).

I focus on the ex-ante evaluation of a cost-equivalent policy scheme were the increment of the transfer at upper secondary is fully funded by the cuts in primary and lower secondary. According to official administrative data[18] the distribution of the urban beneficiaries across the four educational levels was: 19.7% in lower primary, 42.3% in upper primary, 21.9% in lower secondary and 16.1% in upper secondary.

[17]Todd and Wolpin (2006) and Attanasio et al. (2011) evaluate this kind of policy fine-tunning for the rural implementation of the program.

[18]Details about the ENCELURB survey can be found at www.oportunidades.gov.mx.

Using this distribution, a back-of-the-envelope calculation indicates that the freed resources would be enough to increase the average cash transfer offered to youth 15-17 by a factor of 1.91 (to \$1,075 Pesos per month). As shown in figure 11, the model predicts this amount would be enough to take the attendance up to 72.5%, which represents an impact of 14.8%. To be able to reach an attendance rate of 80%, the model predicts the subsidy would have to be 3 times larger than the original.

The implementation of this policy should consider one important caveat: modifying the targeting of the program could have the unintended consequence of generating an intra-household reallocation of work. For instance, for a family that has multiple children with ages such that they should be attending different educational levels, the new subsidy scheme increases the incentives for the parents to send the eldest children to school, but also to shift the home production and/or income generating responsibilities partially or completely to the younger siblings. [19] To evaluate this second order effect we need a more sophisticated model that maps the time allocation choice of all of the household members. I leave this endeavor to future research.

8 Conclusions

In this paper I develop and estimate a dynamic structural model to preform an ex-ante evaluation of alternative versions of a CCT program in urban areas of Mexico (Oportunidades). By estimating the underlying structure of the incentives behind time allocation choices of adults and children in a household, I create a tool to compare counter-factual scenarios and measure the effectiveness of different subsidy schedules in promoting school attendance. Ample empirical research has shown that in rural areas this CCT program was successful in increasing educational attainment and reducing child labor. However, an impact evaluation of the urban version of these educational grants policy finds that, after two years of implementation, the financial incentives offered had no statistically significant impact on the enrollment of youth 15 to 18 years old. This finding is particularly important since the risk of dropping out form school is substantially higher for this age group: while enrollment rates are above 90% for children 6-14, less than 65% of youth 15 or older report to be attending school. The purpose of my analysis is to provide some insight on the future fine-tunning of this program.

To estimate the structural model I use non-experimental data collected in the 2002 wave of the Mexican Family Life Survey (MxFLS) that was carried out before the expansion of the Oportunidades program to urban areas of Mexico, and I focus only on the time allocation choices of the parents and their first-born child. Following

[19] Barrera-Osorio et al. (2011) find strong evidence of this kind of intra-household work reallocation in their evaluation education-based conditional cash transfers in Colombia.

the suggestions proposed in the literature, I evaluate a cost-equivalent policy that eliminates educational grants at primary and lower secondary levels (where attendance is close to universal) and proportionally expands the transfer amount at upper secondary. In this policy simulation I estimate that the reallocated resources would multiply the average cash transfer to youth 15-17 by a factor of 1.91 and attendance rates at upper secondary could increase by 14.8% (to 72.5%). The model's predictions suggest that focalizing the program's resources on upper secondary would not be enough to reach enrollment rates similar to the ones at compulsory school levels.

9 Figures

Figure 1: Distribution across school attendance rates and working hours per week

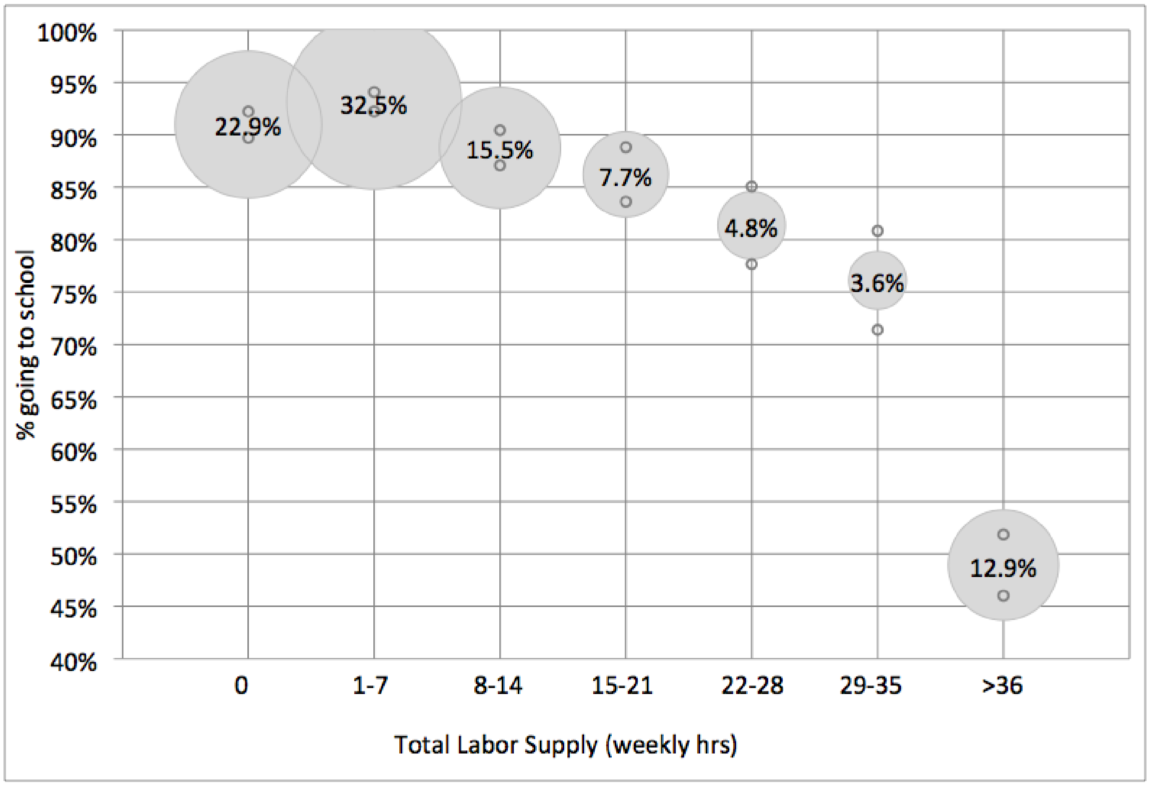


Figure 2: Joint distribution of working hours in Home Production and Market Production

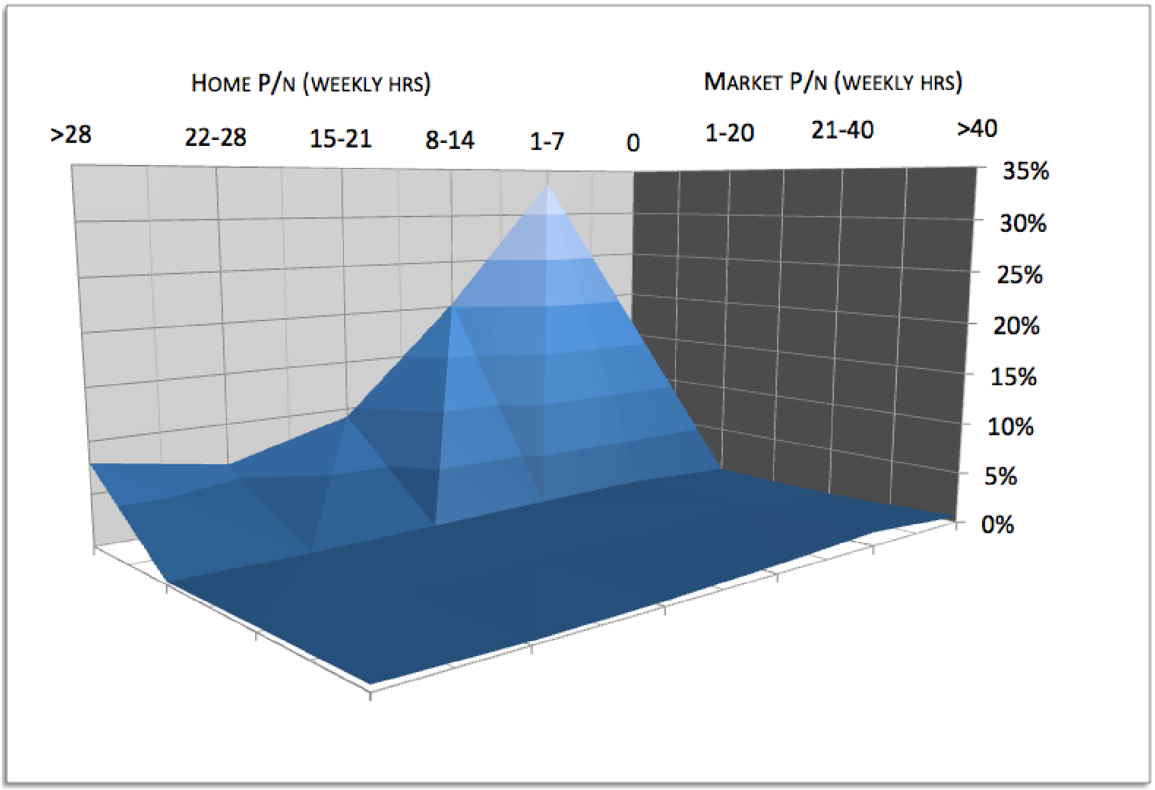


Figure 3: Joint distribution of working hours in Home Production and Market Production

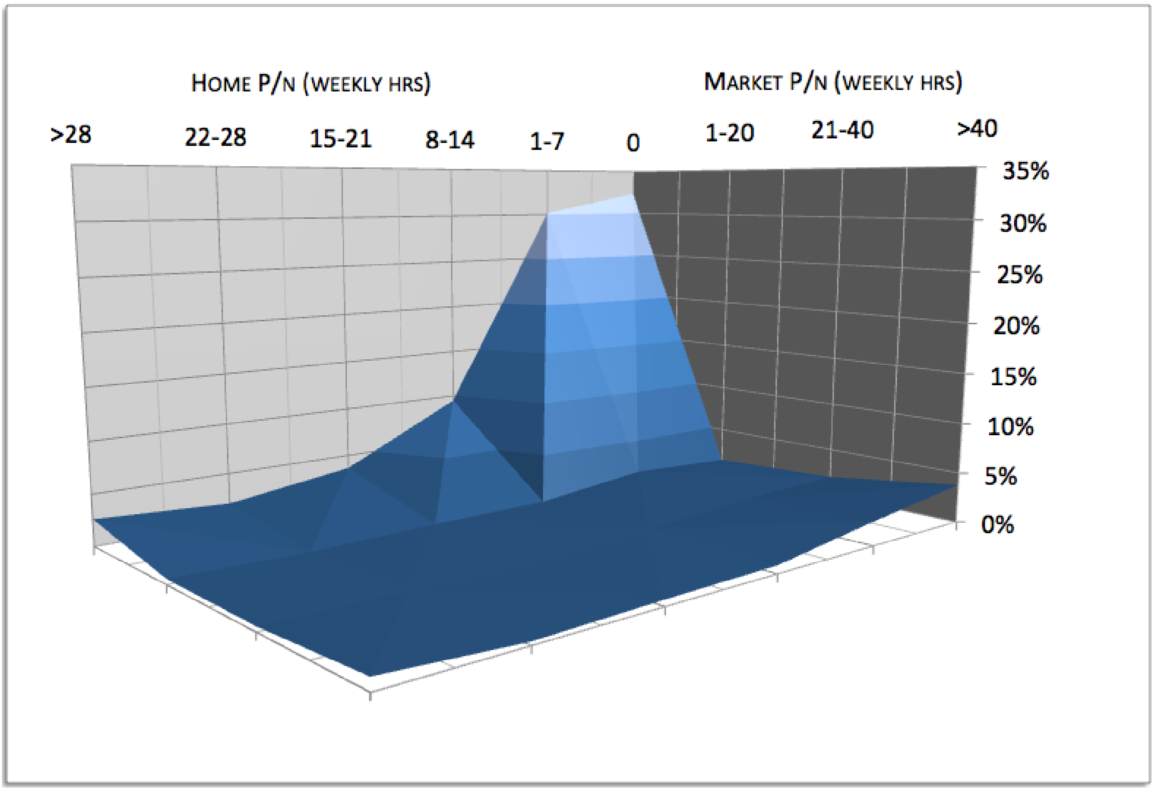


Figure 4: School attendance rates by working hours per week in home production activities

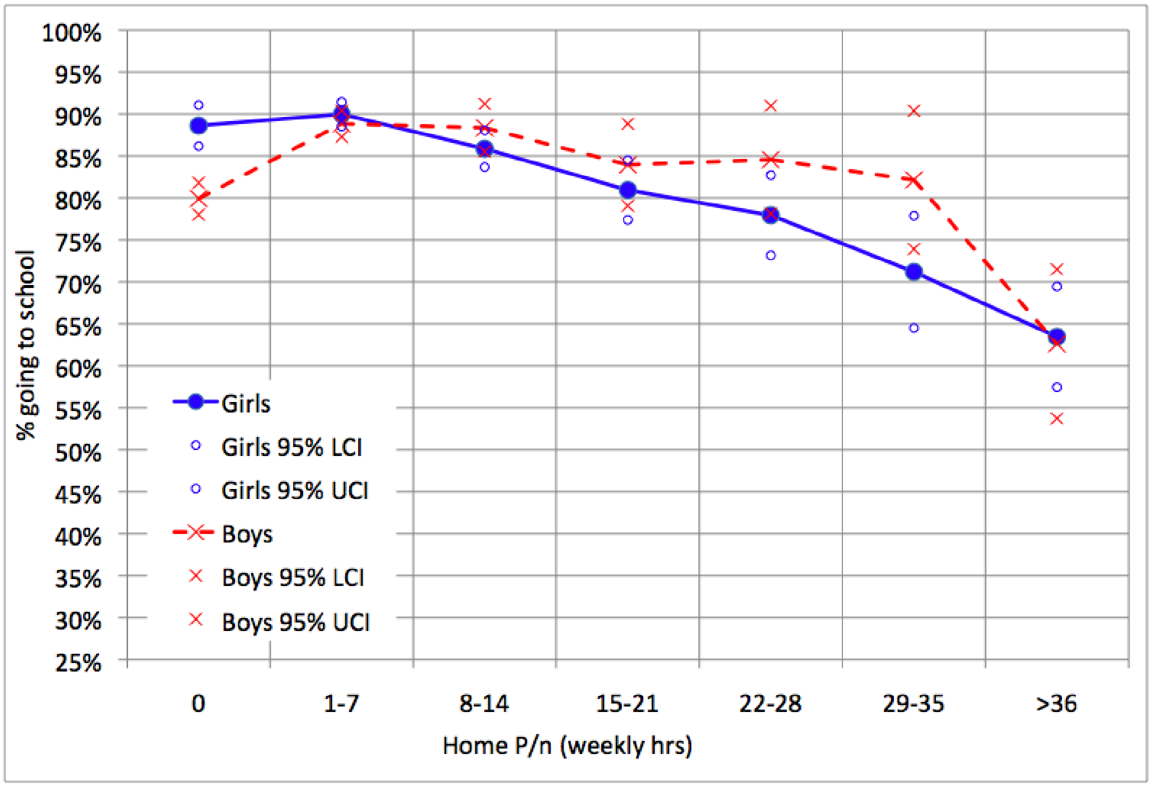


Figure 5: School attendance rates by working hours per week in market activities

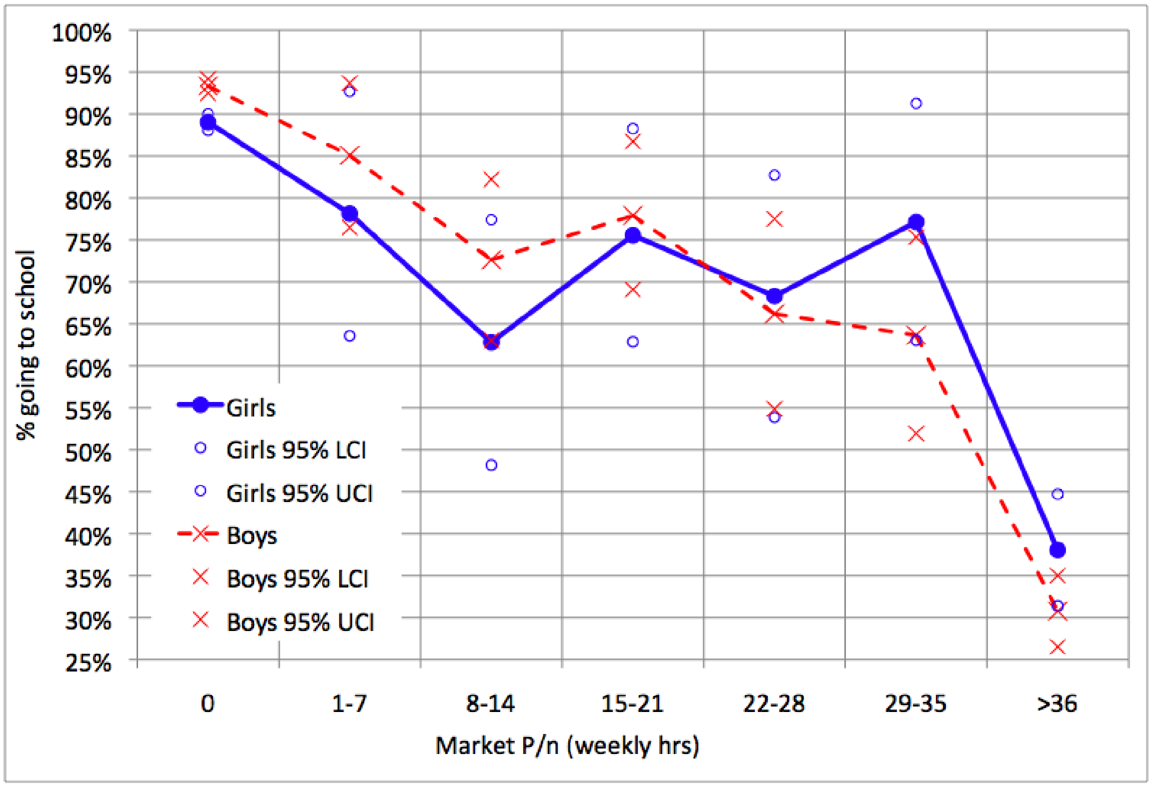


Figure 6: Nonparametric Kernel Distribution Estimation of Total Labor Supply (weekly hours): Firstborns vs. Others

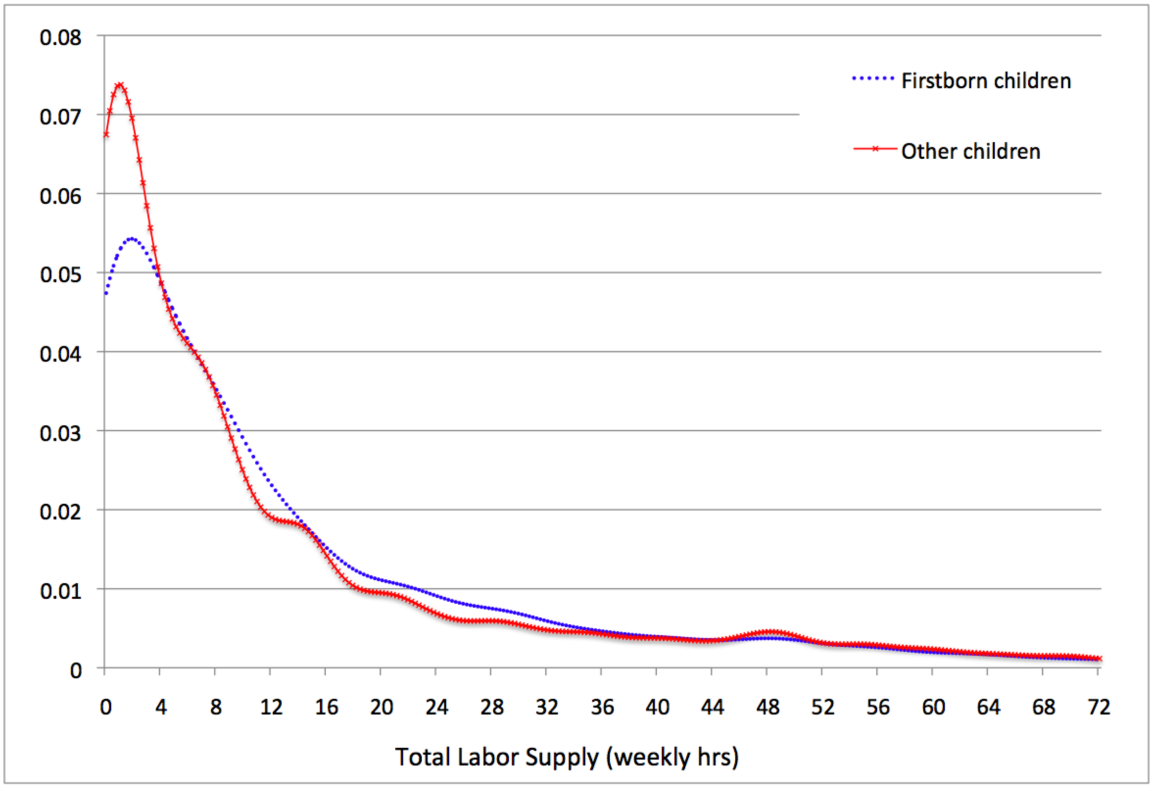


Figure 7: Nonparametric Kernel Distribution Estimation of Total Labor Supply (weekly hours)

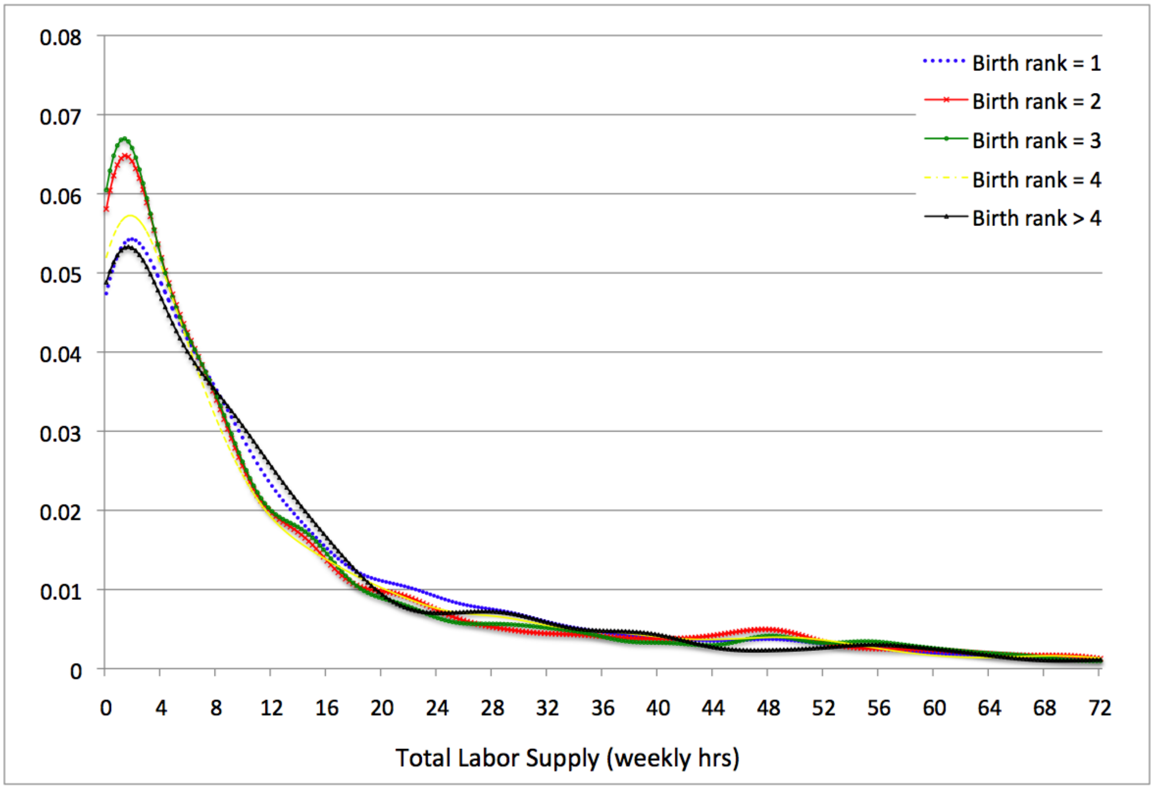


Figure 8: Nonparametric Kernel Distribution Estimation of Total Labor Supply (weekly hours)

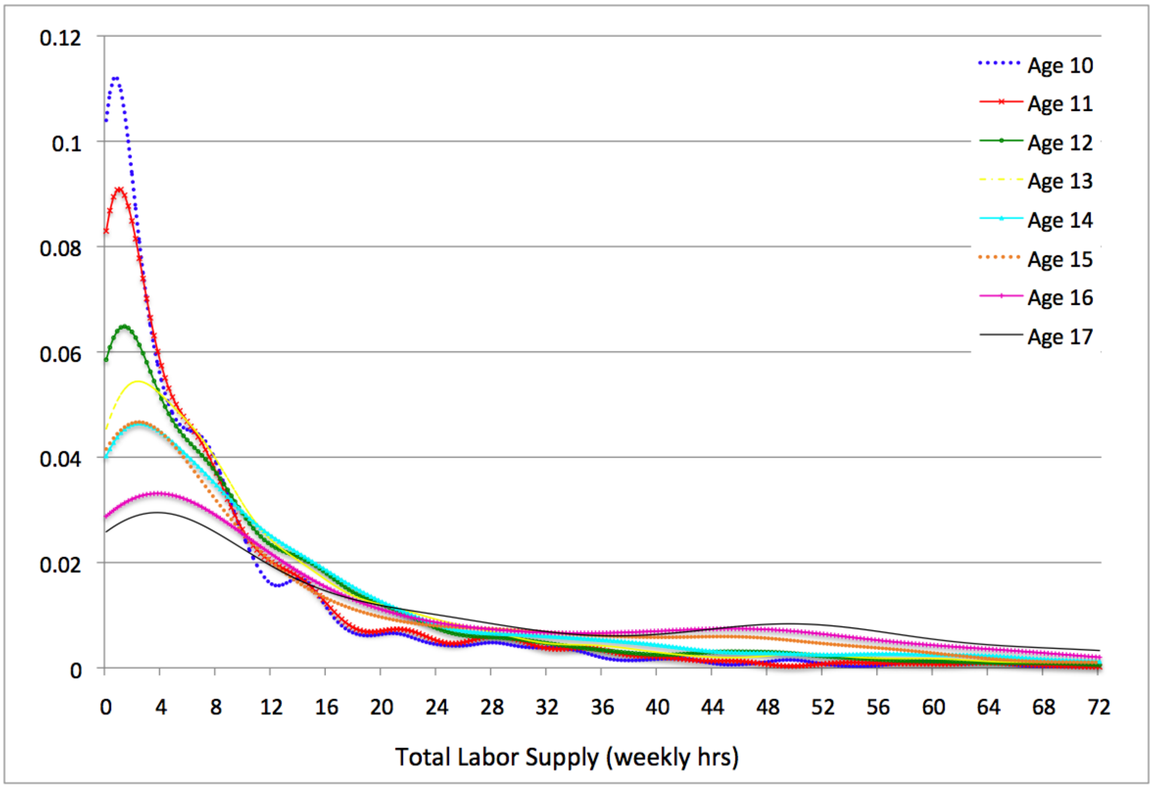


Figure 9: Timing of the Structural Model

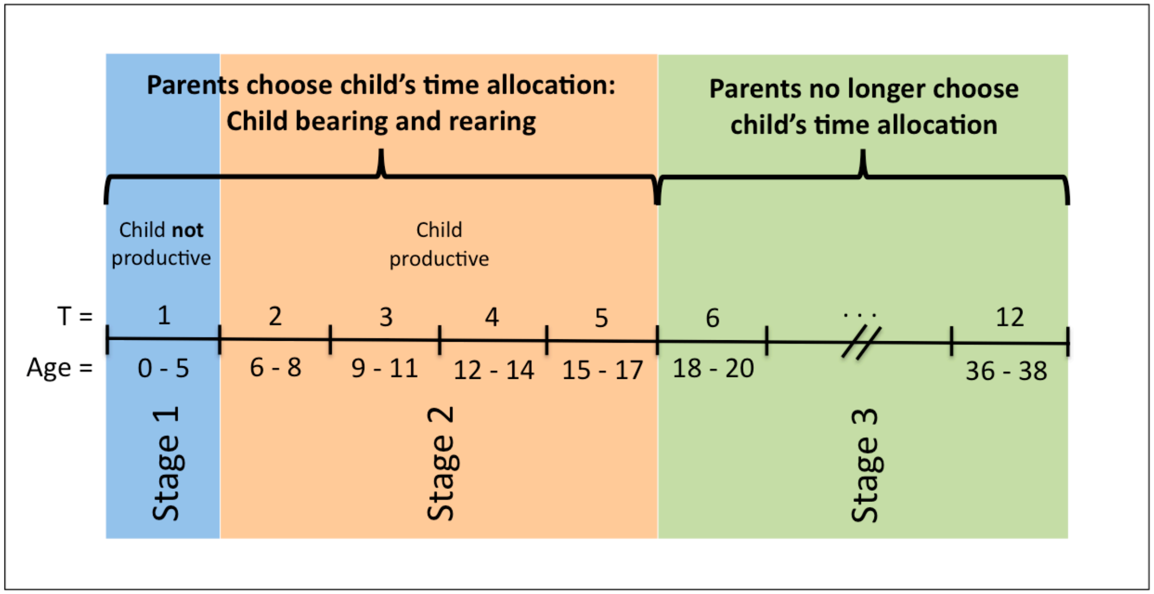


Figure 10: Ex-ante Evaluation of Policy Exercise 1

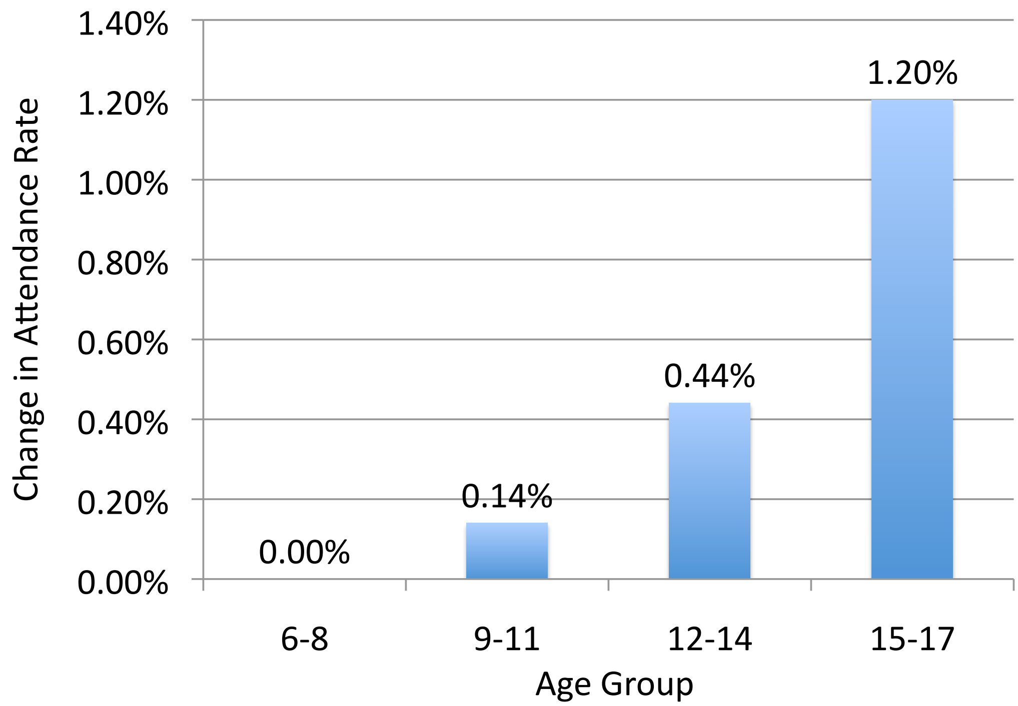
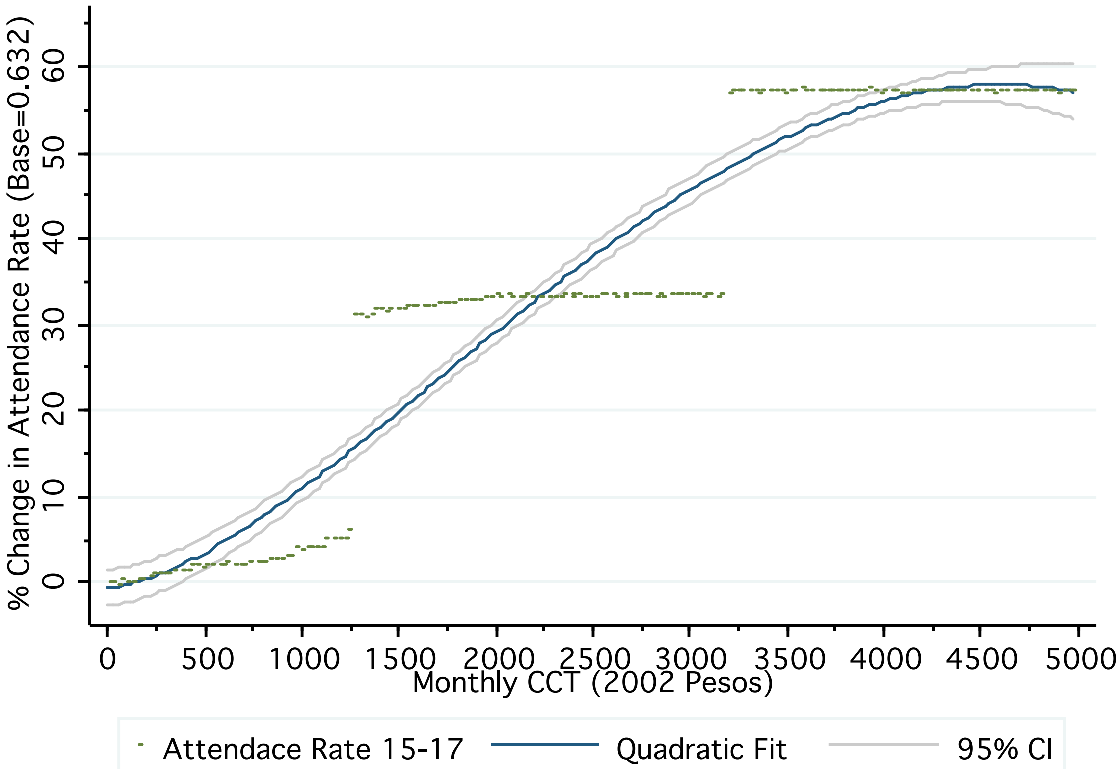


Figure 11: Ex-ante Evaluation of Policy Exercise 2



10 Tables

Table 1: Oportunidades CCT Values - Educational Component

Level	Grade	Monthly Transfer*	
		Boys	Girls
Lower Primary	1	0	0
	2	0	0
	3	100	100
Upper Primary	4	115	115
	5	150	150
	6	200	200
Lower Secondary	7	290	310
	8	310	340
	9	325	375
Upper Secondary	10	490	565
	11	525	600
	12	555	635

*2002 Mexican Pesos (1US=10pesos).

Table 2: Children's participation and birth order: Logit with household fixed effects and age-gender controls

	(1)		(2)		(3)	
	I(Total Work Hrs>0)		I(Home Production Hrs>0)		I(Market Production Hrs>0)	
	coef	se	coef	se	coef	se
I(BirhtOrder=2)	-0.697***	(0.149)	-0.752***	(0.139)	-0.175	(0.192)
I(BirhtOrder=3)	-1.444***	(0.190)	-1.239***	(0.175)	-0.672***	(0.243)
I(BirhtOrder=4)	-2.508***	(0.256)	-2.050***	(0.232)	-1.235***	(0.329)
I(BirhtOrder>4)	-2.853***	(0.314)	-2.345***	(0.285)	-1.561***	(0.375)
I(BirhtOrder=2)*I(Girl)	-0.0462	(0.271)	0.104	(0.253)	-0.0127	(0.320)
I(BirhtOrder=3)*I(Girl)	-0.230	(0.290)	-0.108	(0.270)	0.0916	(0.354)
I(BirhtOrder=4)*I(Girl)	0.109	(0.339)	0.217	(0.317)	-0.105	(0.427)
I(BirhtOrder>4)*I(Girl)	-0.217	(0.365)	0.0543	(0.345)	-0.0395	(0.450)
I(Girl)	1.213***	(0.294)	1.113***	(0.282)	-0.665	(0.524)
I(age=11)	0.269	(0.199)	0.339*	(0.191)	0.797**	(0.373)
I(age=12)	-0.0186	(0.191)	0.0321	(0.185)	1.050***	(0.344)
I(age=13)	0.405**	(0.182)	0.356**	(0.175)	0.927***	(0.333)
I(age=14)	0.0870	(0.191)	-0.128	(0.184)	1.796***	(0.335)
I(age=15)	-0.623***	(0.209)	-1.004***	(0.200)	2.303***	(0.342)
I(age=16)	-0.117	(0.223)	-0.701***	(0.210)	2.747***	(0.355)
I(age=17)	-0.140	(0.229)	-1.190***	(0.218)	3.047***	(0.364)
I(age=11)*I(Girl)	-0.238	(0.292)	-0.355	(0.284)	0.103	(0.581)
I(age=12)*I(Girl)	0.507*	(0.298)	0.478*	(0.289)	-0.117	(0.541)
I(age=13)*I(Girl)	-0.0262	(0.281)	0.117	(0.273)	0.150	(0.512)
I(age=14)*I(Girl)	0.363	(0.301)	0.581**	(0.289)	-0.259	(0.517)
I(age=15)*I(Girl)	0.692**	(0.310)	1.025***	(0.295)	-0.918*	(0.529)
I(age=16)*I(Girl)	-0.223	(0.337)	0.285	(0.312)	-0.877	(0.535)
I(age=17)*I(Girl)	0.106	(0.356)	1.096***	(0.330)	-0.842	(0.533)
Observations	3758		4188		2662	
Number of hhid	1036		1153		693	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the birth order dummies is the male first-born children (i.e. I(BirthOrder=1) and I(BirthOrder=1)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). Given that "household" fixed effects are included, 2357 groups (4767 obs) were dropped because of all positive or all negative outcomes within household. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 3: Girls' participation and birth order: Logit with household fixed effects

	(1) I(Total Work Hrs>0)		(2) I(Home Production Hrs>0)		(3) I(Market Production Hrs>0)	
	coef	se	coef	se	coef	se
I(BirhtOrder=2)	-1.120***	(0.267)	-0.802***	(0.240)	-0.530*	(0.275)
I(BirhtOrder=3)	-2.289***	(0.357)	-1.729***	(0.313)	-0.760**	(0.342)
I(BirhtOrder=4)	-2.959***	(0.456)	-2.086***	(0.403)	-1.969***	(0.471)
I(BirhtOrder>4)	-4.582***	(0.692)	-3.370***	(0.582)	-2.208***	(0.629)
I(age=11)	0.00899	(0.278)	-0.0664	(0.264)	0.650	(0.503)
I(age=12)	0.552*	(0.290)	0.483*	(0.275)	0.882*	(0.457)
I(age=13)	0.181	(0.245)	0.240	(0.238)	0.876**	(0.422)
I(age=14)	0.143	(0.272)	0.137	(0.261)	1.405***	(0.437)
I(age=15)	-0.348	(0.308)	-0.460	(0.289)	1.188***	(0.460)
I(age=16)	-0.425	(0.321)	-0.613**	(0.306)	1.645***	(0.461)
I(age=17)	-0.575	(0.380)	-0.596*	(0.344)	2.106***	(0.477)
Observations	925		997		660	
Number of hhid	325		350		214	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the birth order dummies is the male first-born children (i.e. I(BirthOrder=1) and I(BirthOrder=1)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). Given that "household" fixed effects are included, 2357 groups (4767 obs) were dropped because of all positive or all negative outcomes within household. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 4: Boys' participation and birth order: Logit with household fixed effects

	(1) I(Total Work Hrs>0) coef	se	(2) I(Home Production Hrs>0) coef	se	(3) I(Market Production Hrs>0) coef	se
I(BirhtOrder=2)	-0.680***	(0.170)	-0.709***	(0.158)	-0.167	(0.221)
I(BirhtOrder=3)	-1.204***	(0.225)	-1.061***	(0.206)	-0.637**	(0.295)
I(BirhtOrder=4)	-2.103***	(0.307)	-1.607***	(0.275)	-1.233***	(0.420)
I(BirhtOrder>4)	-2.202***	(0.392)	-1.730***	(0.355)	-1.435***	(0.511)
I(age=11)	0.316	(0.217)	0.372*	(0.211)	0.608	(0.426)
I(age=12)	0.180	(0.214)	0.214	(0.210)	0.943**	(0.390)
I(age=13)	0.441**	(0.192)	0.358*	(0.186)	1.008***	(0.371)
I(age=14)	0.151	(0.207)	-0.0589	(0.201)	1.813***	(0.384)
I(age=15)	-0.530**	(0.228)	-0.884***	(0.219)	2.266***	(0.395)
I(age=16)	-0.0833	(0.249)	-0.650***	(0.236)	2.670***	(0.408)
I(age=17)	-0.0255	(0.253)	-1.072***	(0.242)	3.014***	(0.417)
Observations	1579		1752		1140	
Number of hhid	557		621		389	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the birth order dummies is the male first-born children (i.e. I(BirthOrder=1) and I(BirthOrder=1)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). Given that "household" fixed effects are included, 2357 groups (4767 obs) were dropped because of all positive or all negative outcomes within household. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 5: Working children's labour supply and birth order: LS with household fixed effects and age-gender controls

	(1) Total Work Hrs		(2) Home Production Hrs		(3) Market Production Hrs	
	coef	se	coef	se	coef	se
I(BirhtOrder=2)	-4.470***	(1.315)	-4.151***	(0.854)	-0.320	(1.032)
I(BirhtOrder=3)	-6.321***	(1.803)	-5.134***	(1.119)	-1.187	(1.446)
I(BirhtOrder=4)	-9.770***	(2.454)	-7.567***	(1.443)	-2.203	(1.883)
I(BirhtOrder>4)	-10.95***	(2.796)	-7.054***	(1.742)	-3.894	(2.600)
I(BirhtOrder=2)*I(Girl)	2.747	(1.744)	2.421**	(1.213)	0.326	(1.386)
I(BirhtOrder=3)*I(Girl)	-0.342	(2.065)	0.516	(1.364)	-0.858	(1.666)
I(BirhtOrder=4)*I(Girl)	-0.542	(2.593)	2.410	(1.629)	-2.951	(2.060)
I(BirhtOrder>4)*I(Girl)	-2.418	(2.584)	0.146	(1.634)	-2.564	(2.227)
I(Girl)	-1.119	(1.952)	-0.205	(1.372)	-0.913	(1.429)
I(age=11)	0.955	(1.502)	-0.436	(1.030)	1.391	(1.167)
I(age=12)	2.186	(1.441)	-0.226	(0.909)	2.412**	(1.184)
I(age=13)	2.234	(1.508)	-0.564	(0.968)	2.798**	(1.191)
I(age=14)	8.280***	(1.703)	0.800	(1.075)	7.481***	(1.311)
I(age=15)	8.262***	(2.068)	-0.563	(1.261)	8.825***	(1.556)
I(age=16)	13.12***	(2.237)	-1.994	(1.271)	15.12***	(1.881)
I(age=17)	17.48***	(2.212)	-2.448**	(1.238)	19.93***	(1.791)
I(age=11)*I(Girl)	1.067	(1.933)	1.677	(1.373)	-0.610	(1.459)
I(age=12)*I(Girl)	2.305	(1.818)	3.500***	(1.222)	-1.195	(1.459)
I(age=13)*I(Girl)	2.325	(1.946)	4.075***	(1.267)	-1.750	(1.459)
I(age=14)*I(Girl)	-1.321	(2.106)	3.067**	(1.424)	-4.387***	(1.626)
I(age=15)*I(Girl)	-2.367	(2.497)	4.928***	(1.669)	-7.295***	(1.843)
I(age=16)*I(Girl)	-3.566	(2.584)	6.780***	(1.702)	-10.35***	(2.121)
I(age=17)*I(Girl)	-8.455***	(2.566)	6.127***	(1.581)	-14.58***	(2.093)
Constant	17.01***	(1.732)	12.95***	(1.101)	4.054***	(1.307)
Observations	6557		6557		6557	
R-squared	0.119		0.071		0.149	
Number of hhid	3003		3003		3003	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the birth order dummies is the male first-born children (i.e. I(BirthOrder=1) and I(BirthOrder=1)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). "Household" fixed effects are included. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 6: Working girls' labour supply and birth order: LS with household fixed effects

	(1) Total Work Hrs		(2) Home Production Hrs		(3) Market Production Hrs	
	coef	se	coef	se	coef	se
I(BirhtOrder=2)	-3.370***	(1.113)	-1.802**	(0.871)	-1.568*	(0.850)
I(BirhtOrder=3)	-8.783***	(1.665)	-5.746***	(1.195)	-3.037**	(1.229)
I(BirhtOrder=4)	-13.11***	(2.376)	-5.229***	(1.697)	-7.885***	(1.886)
I(BirhtOrder>4)	-15.65***	(3.223)	-7.594***	(2.059)	-8.055***	(2.426)
I(age=11)	1.028	(1.345)	0.509	(0.962)	0.519	(1.006)
I(age=12)	3.460***	(1.286)	2.332**	(0.957)	1.128	(0.929)
I(age=13)	4.498***	(1.326)	3.534***	(0.950)	0.964	(0.887)
I(age=14)	5.333***	(1.480)	3.046***	(1.091)	2.287**	(1.135)
I(age=15)	4.533***	(1.595)	3.327***	(1.234)	1.206	(1.174)
I(age=16)	9.107***	(1.959)	4.851***	(1.454)	4.256***	(1.492)
I(age=17)	7.208***	(1.896)	2.869**	(1.371)	4.339***	(1.471)
Constant	17.96***	(1.549)	13.55***	(1.143)	4.408***	(1.155)
Observations	3741		3741		3741	
R-squared	0.094		0.054		0.050	
Number of hhid	2123		2123		2123	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the birth order dummies is the male first-born children (i.e. I(BirthOrder=1) and I(BirthOrder=1)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). "Household" fixed effects are included. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 7: Working boys' labour supply and birth order: LS with household fixed effects

	(1) Total Work Hrs		(2) Home Production Hrs		(3) Market Production Hrs	
	coef	se	coef	se	coef	se
I(BirhtOrder=2)	-3.890**	(1.671)	-3.739***	(1.052)	-0.151	(1.287)
I(BirhtOrder=3)	-4.618*	(2.575)	-5.057***	(1.519)	0.439	(2.096)
I(BirhtOrder=4)	-9.849***	(3.641)	-7.647***	(2.087)	-2.202	(2.727)
I(BirhtOrder>4)	-8.033*	(4.607)	-6.549***	(2.353)	-1.484	(4.124)
I(age=11)	-0.00594	(2.040)	0.118	(1.293)	-0.124	(1.597)
I(age=12)	2.085	(1.806)	0.334	(1.097)	1.751	(1.416)
I(age=13)	3.332*	(1.841)	-0.0745	(1.110)	3.406**	(1.481)
I(age=14)	8.408***	(2.097)	1.473	(1.270)	6.935***	(1.602)
I(age=15)	7.876***	(2.537)	-0.0814	(1.480)	7.958***	(1.903)
I(age=16)	13.24***	(2.889)	-1.785	(1.509)	15.02***	(2.426)
I(age=17)	17.11***	(2.986)	-3.027**	(1.503)	20.13***	(2.342)
Constant	16.59***	(2.373)	12.50***	(1.362)	4.091**	(1.813)
Observations	2815		2815		2815	
R-squared	0.121		0.034		0.159	
Number of hhid	1764		1764		1764	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the birth order dummies is the male first-born children (i.e. I(BirthOrder=1) and I(BirthOrder=1)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). "Household" fixed effects are included. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 8: Participation and number of younger siblings: Logit with household fixed effects

	(1) I(Total Work Hrs>0)		(2) I(Home Production Hrs>0)		(3) I(Market Production Hrs>0)	
	coef	se	coef	se	coef	se
All children						
I(YoungerSibs=1)	1.042***	(0.159)	0.825***	(0.146)	0.428*	(0.227)
I(YoungerSibs=2)	1.479***	(0.197)	1.171***	(0.182)	1.001***	(0.274)
I(YoungerSibs=3)	2.396***	(0.260)	1.691***	(0.237)	1.219***	(0.332)
I(YoungerSibs>3)	2.973***	(0.337)	2.346***	(0.299)	1.826***	(0.394)
I(YoungerSibs=1)*I(Girl)	-0.389	(0.257)	-0.102	(0.242)	-0.0596	(0.365)
I(YoungerSibs=2)*I(Girl)	0.141	(0.281)	0.309	(0.265)	-0.447	(0.391)
I(YoungerSibs=3)*I(Girl)	-0.304	(0.351)	0.0474	(0.322)	0.184	(0.433)
I(YoungerSibs>3)*I(Girl)	0.162	(0.402)	0.196	(0.363)	-0.187	(0.430)
Age-gender effects	Yes		Yes		Yes	
Observations	3753		4186		2662	
Number of hhid	1035		1153		694	
Girls						
I(YoungerSibs=1)	1.026***	(0.251)	1.025***	(0.241)	0.309	(0.317)
I(YoungerSibs=2)	2.231***	(0.344)	1.958***	(0.314)	0.474	(0.380)
I(YoungerSibs=3)	2.758***	(0.465)	2.228***	(0.420)	1.556***	(0.476)
I(YoungerSibs>3)	4.377***	(0.707)	3.286***	(0.568)	1.853***	(0.626)
Age effects	Yes		Yes		Yes	
Observations	925		997		660	
Number of hhid	325		350		214	
Boys						
I(YoungerSibs=1)	1.154***	(0.186)	0.919***	(0.167)	0.342	(0.255)
I(YoungerSibs=2)	1.481***	(0.242)	1.143***	(0.218)	0.896***	(0.334)
I(YoungerSibs=3)	2.168***	(0.318)	1.497***	(0.290)	1.194***	(0.428)
I(YoungerSibs>3)	2.569***	(0.421)	2.073***	(0.376)	2.059***	(0.559)
Age effects	Yes		Yes		Yes	
Observations	1579		1752		1140	
Number of hhid	557		621		389	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the YoungerSibs dummies is a boy with no younger siblings (i.e. I (YoungerSibs=0) and I(YoungerSibs=0)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). Given that "household-year" fixed effects are included, 2356 groups (4765 obs) were dropped because of all positive or all negative outcomes within household. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 9: Participation and number of younger sisters and brothers: Logit with household fixed effects

	(1) I(Total Work Hrs>0) coef	se	(2) I(Home Production Hrs>0) coef	se	(3) I(Market Production Hrs>0) coef	se
			All children			
I(YoungerGirls=1)	0.821***	(0.214)	0.676***	(0.195)	0.528*	(0.284)
I(YoungerGirls=2)	1.563***	(0.299)	1.293***	(0.270)	1.239***	(0.390)
I(YoungerGirls>2)	2.260***	(0.415)	1.585***	(0.367)	1.870***	(0.517)
I(YoungerGirls=1)*I(Girl)	0.112	(0.242)	0.0835	(0.225)	0.167	(0.310)
I(YoungerGirls=2)*I(Girl)	-0.124	(0.336)	-0.244	(0.304)	-0.114	(0.384)
I(YoungerGirls>2)*I(Girl)	0.0721	(0.481)	-0.0149	(0.420)	-0.159	(0.473)
I(YoungerBoys=1)	0.908***	(0.136)	0.803***	(0.126)	0.528***	(0.179)
I(YoungerBoys=2)	1.431***	(0.227)	1.089***	(0.205)	0.847***	(0.278)
I(YoungerBoys>2)	1.507***	(0.371)	1.102***	(0.340)	1.349***	(0.427)
I(YoungerBoys=1)*I(Girl)	-0.232	(0.224)	-0.205	(0.210)	-0.366	(0.307)
I(YoungerBoys=2)*I(Girl)	0.315	(0.333)	0.494	(0.306)	-0.329	(0.373)
I(YoungerBoys>2)*I(Girl)	0.690	(0.481)	0.780*	(0.438)	-0.0848	(0.470)
Age-gender effects	Yes		Yes		Yes	
Observations	3753		4186		2662	
Number of hhid	1035		1153		694	
			Girls			
I(YoungerGirls=1)	1.026***	(0.205)	0.910***	(0.193)	0.542**	(0.256)
I(YoungerGirls=2)	2.094***	(0.351)	1.765***	(0.322)	1.087***	(0.384)
I(YoungerGirls>2)	2.969***	(0.578)	2.386***	(0.508)	1.911***	(0.600)
I(YoungerBoys=1)	1.394***	(0.496)	1.051***	(0.402)	0.167	(0.418)
I(YoungerBoys=2)	2.024**	(0.840)	0.917	(0.645)	0.803	(0.619)
I(YoungerBoys>2)	1.142	(1.204)	-0.373	(1.010)	14.21	(491.4)
Age effects	Yes		Yes		Yes	
Observations	925		997		660	
Number of hhid	325		350		214	
			Boys			
I(YoungerGirls=1)	0.766**	(0.299)	0.306	(0.254)	1.277**	(0.572)
I(YoungerGirls=2)	0.782*	(0.439)	0.550	(0.395)	1.199	(0.778)
I(YoungerGirls>2)	0.384	(0.641)	-0.268	(0.616)	2.243**	(1.015)
I(YoungerBoys=1)	0.933***	(0.150)	0.835***	(0.140)	0.482**	(0.206)
I(YoungerBoys=2)	1.504***	(0.246)	1.224***	(0.228)	0.744**	(0.319)
I(YoungerBoys>2)	1.676***	(0.403)	1.286***	(0.375)	1.669***	(0.519)
Age effects	Yes		Yes		Yes	
Observations	1579		1752		1140	
Number of hhid	557		621		389	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the YoungerGirls dummies is a boy with no younger female siblings (i.e. I (YoungerGirls=0) and I(YoungerGirls=0)*I(Girl) are excluded). The excluded category in the YoungerBoys dummies is a boy with no younger male siblings (i.e. I (YoungerBoys=0) and I(YoungerBoys=0)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). Given that "household-year" fixed effects are included, 2356 groups (4765 obs) were dropped because of all positive or all negative outcomes within household. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 10: Working children's labour supply and number of younger siblings: LS with household fixed effects

	(1) Total Work Hrs		(2) Home Production Hrs		(3) Market Production Hrs	
	coef	se	coef	se	coef	se
All children						
I(YoungerSibs=1)	2.428*	(1.450)	2.418***	(0.794)	0.00994	(1.294)
I(YoungerSibs=2)	6.270***	(1.922)	4.107***	(1.145)	2.163	(1.621)
I(YoungerSibs=3)	5.182**	(2.278)	3.013**	(1.306)	2.169	(1.976)
I(YoungerSibs>3)	9.816***	(2.837)	5.970***	(1.705)	3.847*	(2.331)
I(YoungerSibs=1)*I(Girl)	0.115	(1.963)	-0.218	(1.135)	0.333	(1.741)
I(YoungerSibs=2)*I(Girl)	-1.740	(2.154)	-0.0776	(1.308)	-1.662	(1.784)
I(YoungerSibs=3)*I(Girl)	5.467**	(2.540)	2.859*	(1.530)	2.608	(2.077)
I(YoungerSibs>3)*I(Girl)	6.117**	(2.995)	4.062**	(1.880)	2.056	(2.485)
Age-gender effects	Yes		Yes		Yes	
Observations	6553		6553		6553	
R-squared	0.120		0.068		0.151	
Number of hhid	3002		3002		3002	
Girls						
I(YoungerSibs=1)	1.745	(1.347)	1.844**	(0.878)	-0.0997	(1.100)
I(YoungerSibs=2)	4.376***	(1.649)	3.520***	(1.154)	0.857	(1.249)
I(YoungerSibs=3)	10.80***	(2.365)	5.296***	(1.615)	5.507***	(1.808)
I(YoungerSibs>3)	17.94***	(3.102)	10.09***	(2.217)	7.844***	(2.532)
Age effects	Yes		Yes		Yes	
Observations	3741		3741		3741	
R-squared	0.093		0.050		0.050	
Number of hhid	2123		2123		2123	
Boys						
I(YoungerSibs=1)	2.873	(1.989)	3.350***	(1.011)	-0.477	(1.788)
I(YoungerSibs=2)	6.589**	(3.000)	5.624***	(1.669)	0.965	(2.491)
I(YoungerSibs=3)	4.984	(3.690)	4.546**	(1.961)	0.439	(3.077)
I(YoungerSibs>3)	9.550**	(4.484)	8.011***	(2.514)	1.539	(3.674)
Age effects	Yes		Yes		Yes	
Observations	2815		2815		2815	
R-squared	0.119		0.030		0.158	
Number of hhid	1764		1764		1764	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the YoungerSibs dummies is a boy with no younger siblings (i.e. I (YoungerSibs=0) and I(YoungerSibs=0)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). Given that "household-year" fixed effects are included, 2356 groups (4765 obs) were dropped because of all positive or all negative outcomes within household. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 11: Working children's labour supply and number of younger sisters and brothers: LS with household fixed effects

	(1) Total Work Hrs		(2) Home Production Hrs		(3) Market Production Hrs	
	coef	se	coef	se	coef	se
I(YoungerGirls=1)	1.667	(1.788)	1.292	(1.044)	0.375	(1.492)
I(YoungerGirls=2)	5.825**	(2.562)	1.896	(1.519)	3.929*	(2.041)
I(YoungerGirls>2)	9.520***	(3.210)	3.896*	(2.150)	5.624**	(2.615)
I(YoungerGirls=1)*I(Girl)	1.317	(1.760)	0.144	(1.059)	1.174	(1.419)
I(YoungerGirls=2)*I(Girl)	1.696	(2.441)	1.674	(1.602)	0.0219	(1.901)
I(YoungerGirls>2)*I(Girl)	2.797	(3.185)	1.493	(2.098)	1.304	(2.521)
I(YoungerBoys=1)	3.209**	(1.305)	2.535***	(0.750)	0.674	(1.123)
I(YoungerBoys=2)	5.316**	(2.191)	3.557**	(1.435)	1.759	(1.744)
I(YoungerBoys>2)	7.217**	(3.292)	4.354**	(1.993)	2.863	(2.844)
I(YoungerBoys=1)*I(Girl)	-0.141	(1.722)	-0.134	(1.088)	-0.00639	(1.416)
I(YoungerBoys=2)*I(Girl)	2.933	(2.421)	2.932*	(1.635)	0.000835	(1.958)
I(YoungerBoys>2)*I(Girl)	8.878**	(3.661)	6.458***	(2.168)	2.420	(3.176)
Age-gender effects	Yes		Yes		Yes	
Observations	6553		6553		6553	
R-squared	0.123		0.071		0.151	
Number of hhid	3002		3002		3002	
Girls						
I(YoungerGirls=1)	3.519***	(1.025)	2.268***	(0.667)	1.250	(0.868)
I(YoungerGirls=2)	7.096***	(1.732)	4.075***	(1.205)	3.021**	(1.323)
I(YoungerGirls>2)	11.86***	(2.879)	5.634***	(2.070)	6.223***	(2.303)
I(YoungerBoys=1)	1.733	(2.259)	1.403	(1.524)	0.330	(1.540)
I(YoungerBoys=2)	11.86***	(4.194)	4.576	(2.871)	7.283**	(2.965)
I(YoungerBoys>2)	23.62***	(6.323)	10.99**	(5.135)	12.64***	(4.551)
Age effects	Yes		Yes		Yes	
Observations	3741		3741		3741	
R-squared	0.100		0.051		0.053	
Number of hhid	2123		2123		2123	
Boys						
I(YoungerGirls=1)	6.623*	(3.973)	-0.421	(1.761)	7.044**	(3.348)
I(YoungerGirls=2)	12.78**	(6.129)	4.029	(3.468)	8.748*	(4.477)
I(YoungerGirls>2)	27.93***	(7.518)	8.275*	(4.915)	19.66***	(5.728)
I(YoungerBoys=1)	2.382	(1.565)	2.632***	(0.844)	-0.251	(1.370)
I(YoungerBoys=2)	3.725	(2.687)	5.054***	(1.688)	-1.329	(2.093)
I(YoungerBoys>2)	7.150*	(3.850)	5.431**	(2.250)	1.719	(3.241)
Age effects	Yes		Yes		Yes	
Observations	2815		2815		2815	
R-squared	0.129		0.032		0.169	
Number of hhid	1764		1764		1764	

The children included in this sample satisfy the following criteria: aged 10-17 years, son or daughter of the household head, have at least one sibling and both parents live in the household. The excluded category in the YoungerGirls dummies is a boy with no younger female siblings (i.e. I (YoungerGirls=0) and I(YoungerGirls=0)*I(Girl) are excluded). The excluded category in the YoungerBoys dummies is a boy with no younger male siblings (i.e. I (YoungerBoys=0) and I(YoungerBoys=0)*I(Girl) are excluded). The omitted categories from the age-gender effects were: I(age=10) and I(age=10)*I(Girl). "Household-year" fixed effects are included. Standard errors (in parenthesis) use the robust or sandwich estimator of variance. ***p<0.01, **p<0.05 and *p<0.1.

Table 12: Definition of auxiliary statistics used in the indirect inference estimation

	Auxiliary Statistic Definition
Average school attendance rate of first-borns, by age group of child:	
1	$\mathbf{E}[e\|age = 6, 7, 8]$
2	$\mathbf{E}[e\|age = 9, 10, 11]$
3	$\mathbf{E}[e\|age = 12, 13, 14]$
4	$\mathbf{E}[e\|age = 15, 16, 17]$
Average school attendance rate of first-borns, by number of siblings:	
5	$\mathbf{E}[e\|N = 1]$
6	$\mathbf{E}[e\|N = 2]$
7	$\mathbf{E}[e\|N = 3]$
8	$\mathbf{E}[e\|N = 4]$
Average school attendance rate of first-borns, by gender:	
9	$\mathbf{E}[e\|Boy]$
10	$\mathbf{E}[e\|Girl]$
Average school attendance rate of first-borns, by education of father:	
11	$\mathbf{E}[e\|Edu_p = 0]$
12	$\mathbf{E}[e\|Edu_p = 1]$
Average school attendance rate of first-borns, by experience of father:	
13	$\mathbf{E}[e\|Exp_p = 0]$
14	$\mathbf{E}[e\|Edu_p = 1]$

Table 13: Definition of auxiliary statistics used in the indirect inference estimation (Continuation)

	Auxiliary Statistic Definition
Average time in home production of first-borns, by age group:	
15	$\mathbf{E}[h_c \mid age = 6, 7, 8]$
16	$\mathbf{E}[h_c \mid age = 9, 10, 11]$
17	$\mathbf{E}[h_c \mid age = 12, 13, 14]$
18	$\mathbf{E}[h_c \mid age = 15, 16, 17]$
Average time in home production of first-borns, by number of siblings:	
19	$\mathbf{E}[h_c \mid N = 1]$
20	$\mathbf{E}[h_c \mid N = 2]$
21	$\mathbf{E}[h_c \mid N = 3]$
22	$\mathbf{E}[h_c \mid N = 4]$
Average time in home production of first-borns, by gender:	
23	$\mathbf{E}[h_c \mid Boy]$
24	$\mathbf{E}[h_c \mid Girl]$
Average time in home production of parents, by age group of child:	
25	$\mathbf{E}[h_p \mid age = 6, 7, 8]$
26	$\mathbf{E}[h_p \mid age = 9, 10, 11]$
27	$\mathbf{E}[h_p \mid age = 12, 13, 14]$
28	$\mathbf{E}[h_p \mid age = 15, 16, 17]$

Table 14: Descriptive statistics of estimation sample

	Mean[a]		S.D.	Min	Max
Panel A: 2,347 Obs.					
Child's age	16.4	(0.194)	9.4	1	46
Child's sex (=1 if female)	0.51	(0.010)	0.5	0	1
School attendance rate:					
−Age 6-8	0.98	(0.009)	0.1	0	1
−Age 9-11	0.99	(0.006)	0.1	0	1
−Age 12-14	0.97	(0.012)	0.2	0	1
−Age 15-17	0.66	(0.032)	0.5	0	1
Num. of siblings	2.5	(0.026)	1.3	1	10
Father's education	6.7	(0.105)	5.1	0	18
Father's age	41.6	(0.217)	10.5	18	65
HH Labor Income[b]	42.5	(2.26)	95.9	0	2400

435 observations were dropped.

[a] Standard error in parenthesis.

[b] Total annual joint labor income of parents.

Thousands of 2002 Mexican Pesos (1US=10Pesos).

Table 15: Descriptive statistics of estimation sample (Continuation)

	Mean[a]		S.D.	Min	Max
Panel B: 1,912 Obs.					
Child's age	16.4	(0.219)	9.6	1	46
Child's sex (=1 if female)	0.50	(0.011)	0.5	0	1
School attendance rate:					
−Age 6-8	0.98	(0.011)	0.2	0	1
−Age 9-11	1.00	(0.005)	0.1	0	1
−Age 12-14	0.96	(0.014)	0.2	0	1
−Age 15-17	0.62	(0.036)	0.5	0	1
Num. of siblings	2.5	(0.030)	1.3	1	10
Father's education	6.0	(0.110)	4.8	0	18
Father's age	41.5	(0.247)	10.8	18	65
HH Labor Income[b]	34.0	(1.73)	66.4	0	1200

Panel B: Sample restricted to households with complete financial history. 435 observations were dropped.

[a] Standard error in parenthesis.

[b] Total annual joint labor income of parents. Thousands of 2002 Mexican Pesos (1US=10Pesos).

Table 16: Adult Labor Income Process: OLS Model

Parameter	Estimate	SE
ν_1	50.48	10.44
ν_2	157.43	13.32
ν_3	30.82	13.05
σ_ν	276.73	79.46

The dependant variable is the total labor income of the father and mother in a three year period, in thousands of 2002 Mexican Pesos (1US=10Pesos). 1,806 observations. $R^2 = 0.074$.

Table 17: Youth Labor Income Process: 2-Stage Heckman Selection Model

Parameter	Estimate	SE
	2^{nd} Stage	
ρ_1	-68.96	66.86
ρ_2	-23.12	12.51
ρ_3	7.69	1.58
σ_ρ	85.65	71.21
	1^{st} Stage	
Constant	-0.99	0.05
edu_p	-0.44	0.08

The dependant variable is the total labor income of children and young adults 8-26 in a three year period, in thousands of 2002 Mexican Pesos (1US=10pesos). 200 observations. $R^2 = 0.114$.

Table 18: Education Cost*

Parameter	Estimate	SE
Lower Primary P_2^e	3.80	0.07
Upper Primary P_3^e	4.19	0.06
Lower Secondary P_4^e	7.39	0.12
Upper Secondary P_5^e	12.50	0.91

* Thousands of 2002 Mexican Pesos (1US=10Pesos).

Table 19: Estimated Credit Limit by Educational Level*

Parameter	Estimate	SE
$s_{MIN}(edu_p = 0)$	3.035	0.147
$s_{MIN}(edu_p = 1)$	5.208	0.250

* Thousands of 2002 Mexican Pesos (1US=10pesos).

Table 20: Preferences and Home Production Technology Parameters

Parameter	Estimate	ASE
Household Preferences		
θ_1	2.3655	0.0060
θ_3	0.1421	0.0495
Home Prod. Technology		
α_1	0.1885	0.0072
α_2	0.0683	0.0063

ASE estimated using the asymptotic distribution of indirect inference estimators by Gourieroux et al. (1993).

Table 21: Model fit: data and simulated statistics

	Statistic	Data	Simulated	% Difference
1	$\mathbf{E}[e \mid age = 6, 7, 8]$	0.986	0.979	0.8
2	$\mathbf{E}[e \mid age = 9, 10, 11]$	0.992	0.977	1.5
3	$\mathbf{E}[e \mid age = 12, 13, 14]$	0.966	0.966	0.0
4	$\mathbf{E}[e \mid age = 15, 16, 17]$	0.658	0.632	4.0
5	$\mathbf{E}[e \mid N = 1]$	0.936	0.886	5.3
6	$\mathbf{E}[e \mid N = 2]$	0.953	0.863	9.4
7	$\mathbf{E}[e \mid N = 3]$	0.893	0.826	7.5
8	$\mathbf{E}[e \mid N = 4]$	0.764	0.783	2.5
9	$\mathbf{E}[e \mid Boy]$	0.888	0.861	3.1
10	$\mathbf{E}[e \mid Girl]$	0.918	0.852	7.2
11	$\mathbf{E}[e \mid Edu_p = 0]$	0.858	0.856	0.1
12	$\mathbf{E}[e \mid Edu_p = 1]$	0.944	0.856	9.3
13	$\mathbf{E}[e \mid Exp_p = 0]$	0.876	0.857	2.2
14	$\mathbf{E}[e \mid Exp_p = 1]$	0.934	0.842	9.9

Table 22: Model fit: data and simulated statistics (Continuation)

	Statistic	Data	Simulated	% Difference
15	$\mathbf{E}[h_c \mid age = 6, 7, 8]$	0.326	0.458	40.3
16	$\mathbf{E}[h_c \mid age = 9, 10, 11]$	0.383	0.404	5.5
17	$\mathbf{E}[h_c \mid age = 12, 13, 14]$	0.517	0.318	38.4
18	$\mathbf{E}[h_c \mid age = 15, 16, 17]$	0.369	0.330	10.8
19	$\mathbf{E}[h_c \mid N = 1]$	0.296	0.368	24.5
20	$\mathbf{E}[h_c \mid N = 2]$	0.372	0.361	3.0
21	$\mathbf{E}[h_c \mid N = 3]$	0.437	0.358	18.1
22	$\mathbf{E}[h_c \mid N = 4]$	0.469	0.368	21.5
23	$\mathbf{E}[h_c \mid Boy]$	0.336	0.340	1.3
24	$\mathbf{E}[h_c \mid Girl]$	0.461	0.385	16.6
25	$\mathbf{E}[h_p \mid age = 6, 7, 8]$	1.019	0.978	3.9
26	$\mathbf{E}[h_p \mid age = 9, 10, 11]$	0.996	0.960	3.6
27	$\mathbf{E}[h_p \mid age = 12, 13, 14]$	0.880	0.961	9.1
28	$\mathbf{E}[h_p \mid age = 15, 16, 17]$	0.833	0.951	14.1

Table 23: Oportunidades Total CCT Amount by 3-Year Educational Level

Level (grades)	CCT Amount*[a]		as % Min.Wage[b]		as % Educ.Cost	
	Boys	Girls	Boys	Girls	Boys	Girls
L. Prim. (1-3)	1,000	1,000	1.5	1.5	26.3	26.3
U. Prim. (4-6)	4,650	4,650	7.1	7.1	111.0	111.0
L. Sec. (7-9)	9,250	10,250	28.1	31.2	125.2	138.7
U. Sec. (10-12)	15,700	18,000	47.8	54.7	125.6	144.0

* Thousands of 2002 Mexican Pesos (1US=10Pesos).

[a] Total value of the subsidy granted by Oportunidades at each educational level. Each level has 30 academic months (10 months per year).

[b] The official minimum daily wage in 2002 was $42.15 Pesos ($32,877 for a 30 months period with 26 working days per month).

11 Appendix 1

After preliminary exercises, I noticed that the identification of the model's parameters are only given up to a scale, meaning that I could multiply the parameters by a scalar and still get the same simulated moments. To solve this issue, I impose a an ad hoc value to θ_2 —the relative importance of the first-born's leisure (l_{ct})—. The marginal rate of substitution of l_{ct} for C_t tells us how much consumption is the household willing to give up to increase the leisure of the eldest child:

$$MRS = \frac{\Delta C_t}{\Delta l_{ct}} = \frac{\frac{\partial U}{\partial l_{ct}}}{\frac{\partial U}{\partial C_t}} = \theta_2 \frac{C_t^{\theta_1}}{l_{ct}}$$

Take a household where the first-born works half-time in the market ($m_{ct} = 0.5$) and spends the rest of the time in leisure ($l_{ct} = 0.5$). To get 0.5 more of l_{ct} (to go from 0.5 to 1), the parents would give up the labor earnings of the kid ($w_{ct}0.5$), and this would directly diminish the disposable income of the household by that amount. Then, assuming they do not save that period, we get that: $MRS = w_{ct}$. Using this result and solving out for θ_2:

$$\overline{\theta}_2 = w_{ct} l_{ct} C_t^{(-\theta_1)} = 0.006529$$

To get this value of $\overline{\theta}_2$, I use: the average earnings of a household were only one low education and low experience parent works ($w_{pt} = 50$) and savings equal to zero (resulting in $C_t = 50$), the conditional mean of the wage offer to a 14 year old boy ($w_{ct} = 33$) and $\theta_1 = 2$.

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