Girls' school attendance: A Dynamic discrete choice structural approach*

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Abstract

This paper studies the determinants of girls' schooling choices in a rural area of Pakistan where drop-out rates are considerably high for older girls. The paper estimates a dynamic structural model that allows for the analyses of interrelations between girls' schooling and mother's labour market participation decision. The model explicitly takes into account the role of home production as an important economic factor. Moreover, the paper simulates the impact of different policies to increase girls educational attendance. Our results suggest that monetary incentives, as the conditional cash transfer (CCT), are a good mechanism to increase girls' school enrollment, but not necessarily the most cost effective. From a policy perspective, a school building program and the availability of free daycare centers would induce a greater impact on school enrollment at similar cost. The impact of the CCT program on older girls school enrollment rate for the secondary school was only 34% and 91% as large as the school building program and the availability of free daycare centers, respectively.

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1 Introduction

It is widely acknowledged that human capital plays a critical role in economic growth and in income inequality in developing countries. In particular, there is an important link with human capital of future generations as highlighted in modern growth models (e.g. Becker (1994)). Since the early nineties, education is recognized as a force for social and economic development, in particular for women that face many socio-economic and cultural hurdles. Around this period, universal completion of primary education was set as a 20-year goal, as was wider access to secondary and higher education among girls and women. This idea is emphasized by Summers (1993): "...once all the benefits are recognized, investment in the education of girls may well be the highest-return investment available in the developing world....Increased schooling has similar effects on the incomes of males and females, but educating girls generates much larger social benefits.". In Pakistan, particularly in rural and sub-urban areas, women are situated largely at the bottom or lower end of the educational system in comparison to their male counterparts. In this situation, education can play a vital role in enhancing the status of women.

Parents' education, especially the mother's education, is highly related to their children's educational attainment. There is an extensive empirical literature on the strong association between parental schooling and children's outcomes focusing on developed and developing countries surveyed in Behrman (1997). An educated mother tends to have more influence in household decisions and may allow her to get more resources for her children, providing better education and health care. An educated girl is more likely to be self-confident and to take more informed decisions. Moreover, they tend to participate more in the formal labour market, earn more income, marry later and have smaller families. These benefits transmit across generations, as well as to the communities. Nevertheless, women's literacy rates are dramatically lower than men's in Pakistan and in most developing countries.

The aim of this paper is to examine the determinants of girls schooling in a developing/low income country. This paper estimates a decision model in which parents (mother) make labour and consumption decisions along with children's (girls) schooling decisions. The benefits of schooling are assumed to be uncertain and possibly learned over time, while the costs of schooling change (probably increase) as the child grows. Such a model allows for the analyses of interrelations between girls schooling choices and mothers' labour participation decision. The model allows for relatively complex dynamic interactions in parental-decision making. For example, it can be expected that a girl whose mother participates in the labour market would be more valuable at home, replacing for her mothers' housework. A decision model in which parents decide simultaneously labour market condition and children schooling emphasizes the relation between both decisions. The model also allows for a cost of attending school that is higher when a child needs to go to another village.

One of the main advantages of having a structural model is the possibility of performing policy experiment. In this framework, it is possible to analyse the effect of policies intended to increase children school participation on girls' schooling and also the impact on mothers labour market participation.

Overall, the contribution of this paper is twofold. First, it addresses important policy issues. It explains why drop-out rates for girls are so high and suggests how to increase girls educational participation in developing countries[1]. Second, the paper contributes to a growing literature that addresses empirical questions using discrete choice dynamic programming models of individual behaviour.

Despite the efforts made by policy makers in increasing enrollment rates, educational participation is far from targets proposed by several international institutions, in particular for Pakistan[2]. To increase school attendance rates among poor children in developing countries, policy makers have implemented several measures, namely

[1]As part of my future research agenda, the policy concern regarding gender discrimination it will be addressed. In the family decision it will be added the boys decision and it will be discussed which factors explain gender discrimination and what are the policy mechanisms that may help to mitigate this problem.

[2]In what concerns education, Pakistan is far behind the Millennium Development Goals (MDG). According to the MDG (2010) report, the Pakistani net primary enrollment ratio was around 60 per cent, while the MDG target for 2010 was close to 80 per cent. Another important indicator, the percentage of literacy rate is also behind. For girls, the target was around 65 per cent in 2010 but the real figure is below 50 per cent.

conditional cash transfers (CCT) programs[3]. World Bank data shows that, in the last decade, girls' primary net school enrollment increased by around 20 p.p. Nevertheless, percentage is still below 65 per cent. In addition, the figures are even worse when looking for girls' secondary education. In the same period, the secondary net school enrollment increased by around 7 p.p., reaching only 30 per cent in 2010. In what concerns gender gap, the figures show some progress in terms of primary level but a stagnation in terms of the secondary school level[4]. This problem is particularly relevant and exacerbated in rural areas, which is the focus of our analysis, affecting in a dramatic way older girls. Data from LEAPS project shows that in rural areas girls time allocated to school decreases dramatically after 12 years old (from above 6 to around 4 hours per day) and also that these girls leave school to work at home, and not to work for a salary.

Poverty, cultural constraints, and an inadequate supply of government schools for girls in some rural areas are three possible factors explaining the gender gap in school enrollment and the persistent disadvantage of rural girls in Pakistan. All these features will be addressed by the model.

The model considers poverty through the household budget constraint. In particular, it studies the impact of monetary incentives on household decisions, namely the impact of providing cash transfer incentives conditional on children's school attendance. In addition, the effect of increasing mother's wages on girls' school enrollment rate is also analysed through an employment/wage subsidy scheme. In this framework mother's wage may have opposite effects on girls' school attendance. On the one hand, it may increase school attendance through a "pure" income effect. On the other hand it creates an incentive for older girls to stay at home, as they may be replacing for her mothers' housework. The presence of the home production constraint in the model emphasizes another important mechanism on the determination of school attendance.

[3]For more details regarding these programs see a policy research report of the World Bank by Fiszbein and Schady (2009).

[4]The ratio female to male primary enrollment increased from below 70 per cent to above 80 per cent, while the secondary figures remained relatively constant and below 75 per cent.

Cultural reasons are also present in the home production constraint, where the value of having an older girl at home may be greater if there are very young children in the household[5]. The most traditional attitudes towards girls' schooling tend to be held by the older and least educated. This paper also studies the importance of this cultural aspects incorporating in the model mothers' age and education and unobserved permanent characteristics.

Finally, another mechanism that is analysed in the model is the availability of secondary schools for girls in a village. This factor is added to the budget constraint as a cost (e.g. transport cost) that households have to support to send a girl to school in another village where a secondary school is available.

This study also contributes to a growing literature that addresses empirical questions using discrete choice dynamic programming models of individual behaviour. These models are attractive as structural parameters have a clear interpretation and they are useful tools for the evaluation of counterfactual policies (Aguirregabiria and Mira (2010), Keane et al. (2011) and Todd and Wolpin (2010)). The schooling-labour decision model developed in this paper builds on several literatures, including dynamic models of occupational choices as in Keane and Wolpin (1997), dynamic model of employment-child care decisions of women as in Bernal (2008) and more closely related are the work of Attanasio et al. (2012) and Todd and Wolpin (2006) where a dynamic schooling behavioural model is used to evaluate the impact of monetary incentives provided to families to increase their children's school attendance (PROGRESA program). We extend the literature to a low-income developing country using detailed information on the school choices decision in rural Punjab province, the largest state in Pakistan using the LEAPS dataset. In this paper, the mother makes a time allocation decision for herself and for each child age 6 to 15 in a similar way to Bernal (2008) and Todd and Wolpin (2006)[6]. However, we depart

[5]The home production constraint mechanism is also strongly linked with cultural reasons.

[6]In Bernal (2008) mother makes child care and labour market participation decisions. In Todd and Wolpin (2006), married couples are assumed to make sequential decisions over a finite horizon about the time allocation of all of their children age 6 through 15, including their school attendance and labour market participation, and about the timing and spacing of births. Parents labour supply decisions are not included in their model.

from their approach as we allow for mother's labour supply decision and let girls dropout from school to work at home (home production constraint)[7]. The household receives utility in each period from their children current school attendance and from the mothers' working decision. The model also allows the household to receive utility from consumption and from an home production constraint that depends on children's age and the number of very young kids. The household's budget constraint includes the parent's exogenous income, the wage income of the mother and the educational expenditure with the children that go to school. There is an extra utility cost to attending school (at secondary level) that depends on the availability of school in the village. Households differ in their preferences for the choice variables according to children's age, mothers' age and education and according to discrete "type" regarding tastes according to the mutually exclusive decisions. The parameters of the model are estimated by simulated maximum likelihood.

The estimated model fits the actual data reasonably well. In particular, it replicates the observed distribution of schooling choices for each particular children's age, i.e., the key decision analysed in the paper.

Policy simulations suggest that monetary incentives are a good mechanism to keep and increase girls' school enrollment, as the conditional cash transfer case, but not necessarily the most cost effective. This mechanism seems less effective in rural areas as these older girls leave school to help in housework, instead of working for a salary. For girls in the secondary school, the enrollment rate increases from less than 1 p.p. to around 5 p.p., when the grant level is around 4 and 30 per cent of average income, respectively. From a policy perspective reducing transportation costs in secondary school through a school building program and the availability of free daycare centers are good alternatives at a similar cost. In particular, the impact on older girls school enrollment rate of the CCT program for the secondary school is only 34% and 91% as large as the school building program and the availability

[7] In contrast to Todd and Wolpin (2006) we also assume that there is no newborn children in the girls' families. Despite being a potentially interesting feature we are not considering fertility decision in the model. This will be the focus for future research.

of free daycare centers, respectively. A combination of the different measures may be a valid option as they act throughout different mechanisms. The effect of these measures on mother's labour market participation turns out to be negligible. Nevertheless, for older girls, if the mother wages increases by 10 and 20 per cent, with an employment/wage subsidy, mothers labour market participation raises by 1 and 1.8 p.p., respectively.

The paper is organized as follows. In Section 2, we describe the structure of the model and estimation method. Section 3 describes the LEAPS data on which we estimate the model and highlights the overall patterns in the data. Section 4 presents the estimates of the model and evaluates its ability to fit the data. Section 5 shows the results from several policy experiments. Section 6 concludes and discusses future research.

2 Behaviour Model and Estimation

This section presents a structural model of mothers' sequential decisions about work and children's schooling decision. In each discrete time period t, the mother makes a time allocation decision for herself and for each girl age 6 to 15. In particular the mother decides whether to send a daughter to school or to let the girl remain at home (after age 12 this implies working at home). At age 16 children are assumed to become independent and make their own schooling and work decisions. In contrast to mother labour supply decision, the contribution of the father to household income is exogenous and the household cannot save or borrow. Educational expenditure with children is also added to parental income in determining household market consumption. Specifically, we allow for two mother working options {work, no work} and two child schooling choices {enrolled, not enrolled} with a total of 4 possible options in a mother's choice set. The choice set is denoted as: $J = \{h_t, s_t : h_t = \{0, 1\} \text{ and } s_t = \{0, 1\}\}$, where h_t is an indicator for whether or not the mother works in the market, and s_t is an indicator for whether or not the girl is going to school in period t.

2.1 Utility Function

The current-period utility function given choice of option (h_t, s_t) is given by:

$$U_t(h_t, s_t; \Omega_t) = \frac{1}{\gamma} C_t^{\gamma} + \alpha_1 s_t + \alpha_2 h_t + \epsilon_t^{(h_t, s_t)} \tag{1}$$

where C_t is total consumption, α_1 and α_2 are, respectively, the utility/disutility from sending a children to school and from working, and $\epsilon_t^{(h_t,s_t)}$ is an alternative-specific preference shock. The utility function has the common CRRA form in consumption (γ). $\Omega_t = \{f_t, v_t, y_t, educ_t^m, educ_t^c, age_t^m, age_t^c, n_{05,t}, z_t, \epsilon_t, \xi_t^w, \pi\}$ represents the state space (all the relevant factors affecting current or future utility) at time t.

2.1.1 Consumption

Total consumption is a composite of goods and services purchased in the market, c_t^M, and goods and services produced in the home, c_t^H. In particular,

$$C_t = [\theta c_t^{M\rho} + (1-\theta) c_t^{H\rho}]^{\frac{1}{\rho}} \tag{2}$$

and the parameter ρ controls the household's willingness to substitute between c_t^M and c_t^H (the larger is ρ , the greater is this willingness).

Consumption in the market, c_t^M, is given by the budget constraint

$$c_t^M = y_t + w_t h_t - f_t s_t - \psi v_t s_t \tag{3}$$

The direct costs of attending school (f_t) are the costs of buying books as well as clothing items such as shoes[8]. The model allows for transport costs, a parameter to be estimated (ψ) that captures the effect of a village without an elementary/secondary school. If there is no school in a village it can become very costly to

[8]If a child is going to private school it should also include the tuition fee. However, the results do not change if we add this cost to the model. In the sample, around 30 per cent of the students goes to private school but the private schools are relatively affordable (see Carneiro et al. (2012) for details).

send a girl to school and this may be an important mechanism to explain the high drop-out rates among older girls. v_t is a categorical variable that takes value 1 if the village has no elementary or secondary school. y_t represents father's income and w_t the wage income earned by the mother if she decides to work.

The mother's wage affects the children's schooling decision in two opposite ways. On one hand, if w_t increases or accept a job there is an income effect that increases the utility of a child going to school. On the other hand, if the mother accepts a job because of an higher wage offer this may lead older girls to stay at home to replace mothers, decreasing in this case the utility of sending a girl to school.

In addition to the budget constraint in the spirit of Greenwood et al. (1993) mother faces also an home production constraint that influences her work and girl schooling decision. This constraint is given by

$$c_t^H = (\delta_0 + \delta_1 n_{05,t})[(1 - h_t) + (\eta_0 age^c_{1213,t} + \eta_1 age^c_{1415,t})(1 - s_t)] \qquad (4)$$

The home production function yields consumption of the home goods and services (c_t^H) as a function of the time spent in home work of both mother ($1 - h_t$) and children ($1 - s_t$), and household characteristics, in particular the number of children with less than five years old ($n_{05,t}$). This is another important mechanism that may lead girls to drop-out because their value at home may be greater if there are very young children in the household. The number of young children enter as a joint production ($\delta_0 + \delta_1 n_{05,t}$), implying that home goods are produced at the same time and younger kids do not change productivity of other home goods. This function assumes also increasing marginal productivity. In addition, working at home is an option only after age 12 and we allow the value of having older girls at home to vary with age (η_0 and η_1), which captures the effect of girls with 12-13 and 14-15 years old, respectively[9]. These terms try to capture the increasing weight for children of hours working at home by age observed in the data[10]. $age^c_{1213,t}$ and $age^c_{1415,t}$ are

[9]Different specification were used, in particular a quadratic form for children's age. This specification of the home production was determined in part using model fit criteria.

[10]Mothers spent on average around 9 hours per day working at home. Girls with 12 and 13 years

dummy variables that take value 1 when children have 12 to 13 and 14 to 15 years old, respectively.

This specification of the home production function implies that c_t^H is more/less valuable when family have very young children if δ_1 is positive/negative[11].

2.1.2 Wage

An extra constraint regarding mother choices is related to wage. In what follows, we need to estimate a wage equation as we do not observe wages for mothers who are not working. We thus specify a standard Mincer type wage equation, where the wage of a woman is determined by her age (age_t^m), education ($educ_t^m$) and local labour market conditions (z_{tv}) in village v according to

$$\ln w_t^m = \varphi_0 + \varphi_1 age_t^m + \varphi_2 educ_t^m + \varphi_3 z_{tv} + \xi_t^m \tag{5}$$

where φ_0 represents the log price of human capital that we assume is the same across village, and $\xi_t^m \sim N(0, \sigma_w^2)$ represents a wage shock.

Following Attanasio et al. (2012), we estimate this wage equation separately from the rest of the model using an Heckman selection model. As in rural Mexico, there are no selection effects on wages due to participation[12]. The estimation will be discussed below in more detail. We then use predictions from this equation in place of actual wages and use $\widehat{\sigma}_w^2$ ($\xi_t^m \sim N(0, \widehat{\sigma}_w^2)$) to introduce the wage shock in the model.

2.1.3 Heterogeneity

Finally, we allow for observed and unobserved heterogeneity in mother's tastes for work (α_2)

$$\alpha_{2,k} = \alpha_{21} educ_t^m + \alpha_2 age_t^m + \alpha_{2,k} \tag{6}$$

old working at home spent, on average, around 70 per cent of the mothers time, while the older ones (between 14 and 15) spent more or less the same amount of time as mothers.

[11]Despite being a potentially interesting feature we are not considering fertility decisions in the model. This will be the focus for future research.

[12]In addition, in some extent the returns to education are also obtained by migrating to urban areas once education is complete.

and in their tastes for children schooling (α_1):

$$\alpha_{1,k} = \alpha_{11} educ_t^m + \alpha_{12} age_t^m + \alpha_{13} age_t^c + \alpha_{14} (age_t^c)^2 + \alpha_{1,k} \tag{7}$$

where $\alpha_{1,k}$ and $\alpha_{2,k}$ represent the unobservable heterogeneity of the children and mother, respectively. We assume there are two different types (k=low and high). Associated type proportions are denoted by $\Pi = \{\pi_l^m, \pi_h^m, \pi_l^c, \pi_h^c\}$, which are parameters to be estimated (Heckman and Singer (1984)).

Finally, we allow the term $\epsilon_t^{(h_t,s_t)}$ to be correlated across alternatives, capturing the fact that some alternatives are more similar than others[13]. We assume to have a joint normal distribution and are serially uncorrelated.

2.2 Value Function

At every period, the agent chooses his action $(h, s) \in J$ to maximize expected utility at t, the value function, which is given by

$$V_t(\Omega_t) = \max_{(h,s)_{t,\dots T}} E\left\{\sum_{\tau=t}^{T} \beta^{\tau-t} U(h_\tau, s_\tau; \Omega_\tau) + \beta^{T+1-t} V_{T+1}(\Omega_{T+1}) \mid \Omega_t \right\} \tag{8}$$

where $\Omega_t = \{f_t, v_t, y_t, educ_t^m, educ_t^c, age_t^m, age_t^c, n_{05,t}, z_t, \epsilon_t, \xi_t^w, \pi\}$ represents the state space (all the relevant factors affecting current or future utility) at time t. The parameter β represents the discount factor[14].

Household maximizes the expected utility subject to

Budget Constraint

$$c_t^M + f_t s_t + \psi v_t s_t = y_t + w_t h_t$$

[13]It is expected that the alternative going to school and mother working is correlated with going to school and mother not working but completely unrelated with not going to school and mother not working.

[14]Since we do not model savings and borrowing this will reflect liquidity constraints or other factors that lead the households to disregard more or less the future.

Home production equation

$$c_t^H = h((1-h_t),(1-s_t),n_{05,t},age_t^c)$$

Mothers Time Constraint

$$h_t \in \{0,1\}$$

Child Time Constraint

$$s_t \in \{0,1\}$$

Mother wage equation:

$$\ln w_t^m = \varphi_0 + \varphi_1 age_t^m + \varphi_2 educ_t^m + \varphi_3 z_{tv} + \xi_t^m$$

Children may not be successful in completing the grade originating an important source of uncertainty to the model.

Child Education law of motion:

$$\begin{aligned} educ_{t+1}^c &= educ_t^c + 1 \quad if \quad s_t \neq 0 \quad and \quad progress \\ &= educ_t^c \qquad\quad if \quad s_t = 0 \quad or \quad fail \end{aligned}$$

In a dynamic programming framework, the value function can be written as the maximum over alternative-specific value function, $V_t(h_t, s_t; \Omega_t)$,

$$V_t(\Omega_t) = \max_{\substack{h_t \in \{0,1\} \\ s_t \in \{0,1\}}} [V_t(h_t, s_t; \Omega_t)] \tag{9}$$

The choice specific value function can be written as the expected discounted value that satisfies the Bellman equation:

$$V_t(h_t, s_t; \Omega_t) = U_t(h_t, s_t; \Omega_t) + \beta E\left[\max_{\substack{h_{t+1} \in \{0,1\} \\ s_{t+1} \in \{0,1\}}} V_{t+1}(h_{t+1}, s_{t+1}; \Omega_{t+1}) \mid \Omega_t, h_t, s_t\right] \tag{10}$$

If a grade is not completed successfully, we assume that the level of education does not increase. This may be important since failure may discourage school attendance. We assume that the probability of failing to complete a grade is exogenous and does not depend on the willingness to continue schooling. We allow however this probability to vary with the grade in question, with the age of the individual and with the mother's education. Moreover, we assume it is known to the individual[15].

In this case the choice-specific value function becomes:

$$\begin{aligned} V_t(h_t, s_t; \Omega_t) = U_t(h_t, s_t; \Omega_t) + \beta E\{pV_{t+1}(h_{t+1}, s_{t+1}; educ^c_{t+1} = educ^c_t + 1, \widetilde{\Omega_{t+1}}) \\ +(1-p)V_{t+1}(h_{t+1}, s_{t+1}; educ^c_{t+1} = educ^c_t, \widetilde{\Omega_{t+1}})\} \end{aligned}$$

where

$$\begin{aligned} p &= p(educ^c_{t+1} = educ^c_t + 1 \mid s_t \neq 0 \;\; and \;\; progress) \\ 1-p &= p(educ^c_{t+1} = educ^c_t \mid s_t = 0 \;\; or \;\; fail) \\ \widetilde{\Omega} &= \Omega \setminus \{educ^c\} \end{aligned}$$

At $T = 11$ (girl with 16 years old) the children schooling decision is taken by the child and not by the mother. We assume a terminal value function that is a function of children level of education:

$$V_{T+1}(\Omega_{T+1}) = V_{T+1}(educ^c_{T+1})$$

Specifically, following Eckstein and Lifshitz (2011), we use a linear approximation

$$V_{T+1}(educ^c_{T+1}) = \phi educ^c_{T+1} \tag{11}$$

Using different specifications as in Bernal (2008), Attanasio et al. (2012) or del Boca and Flinn (2012) does not seem to be critical to the main results[16].

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[15] We estimate the probability of progressing for each grade as the ratio of individuals who passed to the next grade compared to the year before at a particular age and mother's education (see table A-2 in appendix).

[16] Bernal (2008)):$V_{T+1}(educ^c_{T+1}) = U_{T+1}(h_t, s_t, \Omega_t) + f(educ^c_{T+1})$,
Attanasio et al. (2012): $V_{T+1}(educ^c_{T+1}) = \frac{\delta_1}{1+\exp(-\delta_2 educ^c_{T+1})}$ and

2.3 Likelihood

Having solved the dynamic optimization problem we are able to get the likelihood function. The probability that a mother chooses alternative $(h, s) = j$ at time t from her choice set J is given by:

$$\Pr((h_t, s_t) = j \mid \Omega_t) = \Pr[V_t^j(\Omega_t) \geq V_t^q(\Omega_t), \forall_{q \neq j \in J}]$$

An individual contribution to the likelihood is:

$$L_{it} = \sum_{\pi \in \Pi} \{ \prod_{t=t_i}^{T} \prod_{j \in J} \Pr((h_t, s_t) = j \mid \Omega_t)^{1[(h_t, s_t) = j]} \} \pi \tag{12}$$

where t_i is the first observation available in the data for each individual i.

2.3.1 Initial Condition

We assume that the initial conditions are exogenous conditional on type except for the children level of education ($educ_t^c$). The presence of stock of education generates an important initial conditions problem because we do not observe the entire history of schooling for the children in the sample, with the exception of those with 6 years old with information of education level. We cannot assume that the random variable in equation (7) is independent of past school decisions as reflected in the current level of schooling ($educ_t^c$). To solve this problem we simulate life from 6 years old until first observation is available to get the education level simulated for each individual and each type[17]. Then, conditional on each type and age, we get the probability of each girl be with a certain education level ($f(educ_t^c | \pi_i)$, i.e., we construct the distribution of initial condition ($\widehat{f}(educ_t^c | \pi_i)$[18].

del Boca and Flinn (2012): $V_{T+1}(educ_{T+1}^c) = \delta educ_{T+1}^c (1 - \beta)^{-1}$

[17]A girl with 7 years old have 0 years of education (if not enrolled or failed) or 1 year of education (if pass). With 8 years old, a girl can have 0, 1 or 2 years of education. The same logic is applied for the following ages.

[18]For example, $educ_5^c$ (first observation available) implying that $educ_1^c, educ_2^c, educ_3^c$ and $educ_4^c$ are not observed. With many draws we simulate life from 1 to 5 obtaining $educ_5^c$ simulated for each type and get $f(educ_5^c | \pi)$.

Then we incorporate this correction in the likelihood[19]:

$$L_{it} = \sum_{\pi \in \Pi} \{ \prod_{t=t_i}^{T} \prod_{j \in J} \Pr((h_t, s_t) = j \mid \Omega_t)^{1[(h_t,s_t)=j]} f(educ_t^c|\pi)\} \pi \tag{13}$$

where t_i is the first observation available in the data for each individual i.

Evaluation of the likelihood itself requires the calculation of three-variate integrals. We use a GHK recursive probability simulator (Keane (1994)) of the choice probabilities and form a simulated maximum likelihood estimator[20].

2.3.2 Identification Issues

Finally, note that identification of the effects of interest relies on the structure of the model being correct, the distributional assumptions required to estimate the model being correct, certain exclusion restrictions[21], and on enough variation displayed by data.

One of the main advantages of having a structural model, is the possibility of performing policy experiments. In this paper we use the model to simulate school participation under different scenarios, such as (conditional) cash transfers, increase in the number of communities where a secondary school is available and an employment subsidy scheme. This sub-section, in particular, will address the identification issues related to the effects of the policy experiments performed in the paper, i.e., policy relevant variation. It is important to note that, in this paper, the policy

[19] Let $t = t_i, T$

$$\Pr((h_t, s_t) = j \mid \Omega_t)^{1[(h_t,s_t)=j]} f(educ_t^c|educ_{t-1,...,}^c educ_{t_i}^c, \pi) f(educ_{t-1}^c|educ_{t-2,...,}^c educ_{t_i}^c, \pi)...f(educ_{t_i}^c|\pi)$$

In this case, $f(educ_t^c|educ_{t-1,...,}^c educ_{t_i}^c, \pi)$ and $f(educ_{t-1}^c|educ_{t-2,...,}^c educ_{t_i}^c, \pi)$ are deterministic and equal to 1. Then, the correction to the contribution to the likelihood becomes only the term $f(educ_{t_i}^c|\pi)$. This term is simulated as discussed above.

[20] Geweke et al. (1994) present a detailed discussion and in a Monte Carlo study of alternative approaches to simulation based inference concluded that classical methods based on GHK outperformed classical methods based on kernel smoothed probability simulators. Train (2009) provides also a good discussion of GHK probability simulator.
The GHK probability simulator was calculated conditional on the wage shock (ξ_t^m).

$$\widehat{P_j} = \frac{1}{D} \sum_{d=1}^{D} \widehat{P_{GHK}}((h_t, s_t) = j|\xi_t^m)$$

[21] In the sense that some variables enter some equations of the model and not others.

effect is estimated without direct policy variation, i.e., we did not need to observe households in both states of the world, for example, with and without the cash transfer program. What is critical for identification is to get exogenous variation independent of preferences, for example, the appearance of at least one variable in one equation that is independent of preferences.

Employment subsidy (Wage variation)

In this case, as mentioned before, to get policy relevant exogenous variation requires the presence of one variable in the wage equation that does not affect directly the utility of sending a girl to school. For example, female local labour market conditions enter wage equation but do not affect directly preferences. Therefore, we assume that variation in the female local labour market factors might cause exogenous variation in employment and schooling decision while not affecting directly preferences. For this argument to be valid we require the following assumptions: these local labour market conditions cannot vary across villages due to supply changes, for example, a common shock to women (for example to tastes to work) cannot affect local female unemployment rate and there is no systematic variation in women unobserved heterogeneity across villages.

Cash Transfer

In the case of the cash transfer policy the argument is similar but applied to father family income instead of mothers wage[22]. As before, in this case male local labour market conditions in the fathers income equation provide us the required exogenous policy-relevant variation.

School building program

In what concerns the school building program, we assume that, conditional on other variables, variation in the variable not having a school in the village might plausibly generate exogenous variation in girls schooling decision. In that case, this assumption is enough to provide policy-relevant exogenous variation.

[22]The endogeneity of fathers income is addressed in sub-section 4.3

3 Data

The paper uses the Learning and Education Achievement in Punjab School (LEAPS) project data set[23]. The LEAPS data is collected from 112 villages in the Punjab province, the largest state in Pakistan, located in the three districts of Attock (North), Faisalabad (Center), and Rahim Yar Khan (South). Villages were randomly chosen from a list of those with at least one private school according to the 2000 census of private schools. This allows for the study of the differences between private and public schools in the same village. The baseline survey in 2004 covered 823 schools (government and private) and around 1800 households (with almost 6000 children, 48 per cent of which are girls). Table 1 presents the girls' age distribution between 6 and 15, which represents around 75 per cent of all girls with less than 15 years old.

Table 1: Girls' age distribution

Age	Observations	Percentage
6	158	8.0
7	191	9.7
8	227	11.5
9	195	9.9
10	245	12.4
11	180	9.1
12	225	11.4
13	188	9.6
14	219	11.1
15	141	7.2
	1969	100.0

Note: This table shows the girls' age distribution between 6 and 15 years old, which represents around 75 per cent of all girls with less than 16 years old.

Table 2 presents mean characteristics of the variables used in the model estimation. The mean age of the girls in the sample is 10.5 years old with a level of education only slightly above 2 years. On average, the school enrollment rate is below 75 per cent (around 80 between 6 and 11 years old and about 55 per cent from 12 to 15) and only around 11 per cent of the mothers work in the labour market. In

[23]The project details are available at www.leapsproject.org.

Table 2: Sample summary statistics

	Obs	Mean	Std.Dev	Min	Max
Girls' school attendance^d	1969	0.72	0.45	0	1
Mother's working status^d	1969	0.11	0.32	0	1
Girls' age	1969	10.5	2.73	6	15
Girls' education	1969	2.28	2.23	0	8
Mother's education^d - (with at least some education)	1969	0.25	0.43	0	1
Mother's age^d - (with more than 40 years old)	1969	0.40	0.49	0	1
Mother's with at least one young children^d	1969	0.62	0.49	0	1
Mother's with more than one young children^d	1969	0.29	0.46	0	1
Girls' in villages with elementary/secondary school^d	1969	0.62	0.49	0	1
Female Local Labour Market Conditions					
Good (low village unemployment rate)^d	1969	0.36	0.48	0	1
Medium (medium village unemployment rate)^d	1969	0.28	0.45	0	1
Bad (high village unemployment rate)^d	1969	0.35	0.48	0	1
Father's income	1969	7.11	8.51	0.34	209.73

Notes: d - Categorical variables were used in order to get a more reasonable state space size.
Budget constraint variables are expressed in rupees divided by 1000. For example, the monthly average parents income is equal to 7110 rupees (≈ 83 U.S. dollars).
Female Local Labour Market conditions is measured as the village female unemployment rate. Using the household census data we split the 125 villages in 3 categories according to their female unemployment rate (up to 25th percentile, 25th to 75th percentile and above 75th percentile). More specifically, the 25th percentile corresponds to an unemployment rate just below 6 per cent and the 75th percentile just above 30 per cent.

addition, the mothers' mean age is 38 years old (around 40 per cent have more than 40 years old) and 75 per cent of the mothers have no education. Households have on average 1 young children (with less than 5 years old), and around 30 per cent of the households have more than one. In what concerns school availability, only around 60 per cent of the sample have an elementary/secondary school in the village[24]. Father's income is, on average, about 7110 rupees (approximately 83 U.S. dollars). Among those mothers who worked, the average wage was about 1200 rupees (around 14 U.S. dollars)[25].

Figure 1 displays mother employment and child schooling choices of women in the sample with children between 6 and 15 years old. Enrollment rates decrease dramatically after 12 years old reaching levels around 40 per cent for the 14 and 15 years old girls. In general, mother labour market participation is low without a clear girls age pattern.

[24] For only secondary schools the availability drops to around 40 per cent.

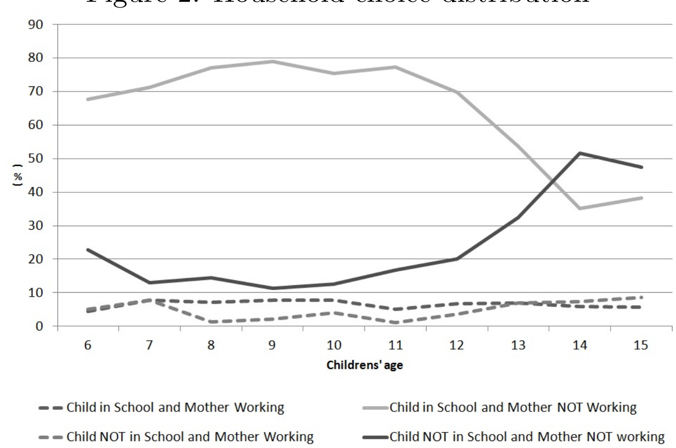
[25] 1 U.S. dollar ≈ 85.6 Pakistani rupees

Figure 2 displays the 4 mutually exclusive choices used in the model. Until 12 years old, around 75 per cent of the mothers stayed at home and send their girls to school while 15 per cent both mother and children stay at home. Furthermore, 7 per cent work and send their girls to school, and the remaining 3 per cent work but the girls stay at home. When girls get older (between 13 and 15) it changes completely, the percentage of girls not in school with mother working in the market increased to around 8 per cent, and in the case where mother stays at home increased as well to around 40 per cent.

Figure 1: Girls' school enrollment rate and mother working status

Note: This figure shows the girls' school enrollment rate and the percentage of mothers working in the labour market for girls between 6 and 15 years old.

Figure 2: Household choice distribution



Note: This figure shows the 4 mutually exclusive household choices distribution.

4 Results

This section presents estimates of the structural model presented in Section 2. The estimation procedure involves a maximization of the likelihood function given by equation (13). We first solve the dynamic programming problem for each individual conditional on a given type and then write the probability function. As usual we consider the reasonableness of the parameter values and the within sample fit. The use of some discrete variables, as described in section 3, allowed us to get a size of state space that does not make the problem computationally intractable[26].

4.1 Estimation

Estimates of the model structural parameters are presented in this sub-section. Table 3 reports the estimates of the parameters in the utility function, budget constraint, home production constraint and observed heterogeneity. The second panel presents the unobservable heterogeneity parameters. Finally, the variance-covariance matrix is reported in table A-1 in the appendix. The wage equation parameters used in the estimation of the model are reported in table 4. The probability of a girl passing grade at age t with a mother's education ($educ^m$) used in the estimation are reported in Table A-2 in the appendix.

Overall the estimated parameters in particular the most relevant from the policy perspective have the expected signs and are statistically significant [27]. The discount factor was estimated to be 0.91 and it was obtained from a grid search over several values.

The results indicate significant heterogeneity among mother's types regarding both work and child education. In particular women are very different in their tastes for children's education. Although one of the types derives utility from sending children to school ($\alpha_{1,h} = 4.0$), the other type derives disutility from doing so ($\alpha_{1,l} =$

[26] We discretize the continuous state variables and solve for the Emax functions only on the grid of discretized values, i.e., we interpolate between grid points (see Keane et al. (2011)).

[27] The estimated CRRA parameter is similar to the result presented in Ahmed et al. (2012) of 0.58 and lies within the ranges of 0.05 and 2.57 for developing countries in Cardenas and Carpenter (2008).

Table 3: Structural Parameters Estimates

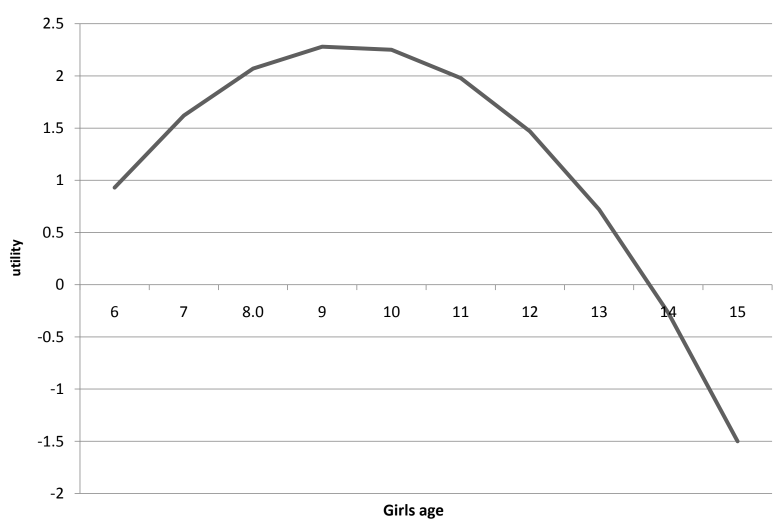
Parameter	Estimate	Std. Error
Utility Function		
Consumption		
CRRA (γ)	0.70	0.0001
Proportion of market and home production (θ)	0.63	0.0009
Willingness to substitute between c_t^M and c_t^H (ρ)	0.95	0.0001
Budget constraint		
Transport cost - Secondary School Not Available in the village (ψ)	2.29	0.0016
Home Production		
Other goods/technological factor (δ_0)	4.81	0.0006
Children from 0 to 5 years old (δ_1)	4.31	0.0003
child contribution - 12 and 13 years old (η_0)	0.32	0.0001
child contribution - 14 and 15 years old (η_1)	2.90	0.0001
Observed heterogeneity in taste for child education		
Mother's education (α_{11})	2.47	0.0009
Mother's Age (α_{12})	-1.08	0.0007
Children's age (α_{13})	1.04	0.0002
Children's age squared (α_{14})	-0.12	0.0002
Observed heterogeneity in taste for work		
Mother's education on taste for work (α_{31})	-0.37	0.0001
Mother's Age on taste for work (α_{32})	0.21	0.0009
terminal value function - child education in T+1 (ϕ)	1.96	0.0003
Unobservable heterogeneity		
Children (taste for child education)		
α_{1l} (type I - low)	-3.15	0.0001
α_{1h} (type II - high)	3.98	0.0007
Type proportions		
π_l^c - type I	0.35	0.0023
π_h^c -type II	0.65	-
Mother (taste for work)		
α_{3l} (type I - low)	-2.41	0.0001
α_{3h} (type II - high)	0.54	0.0006
Type proportions		
π_l^m - type I	0.54	0.0026
π_h^m - type II	0.46	-
Log likelihood	5709.9	

Notes: This table shows the estimated structural parameters and asymptotically standard errors.

−3.2). Younger and more educated mothers have a clear preference for education in contrast to what happens with older and less educated ones. Mother's education impact seems more important than age effect (2.5 and 1.1, respectively).

Interestingly, utility is concave regarding children's age explaining in some extent the hump-shaped form of the enrolment rate for girls (Figure 3). The utility from sending a girl to school increases up to 9/10 years old decreasing dramatically for the following ages. In particular, the results suggest that parents derive very low utility if girls have 13 years old and disutility from sending girls to school when they reach 14 or 15 years old. Interestingly, with 6 years old girls seem to be considered yet too young to go to school as the utility that parents get from sending them to school is as lower as the one derived from sending a 13 year old girl. Nevertheless, the main results are driven by the economic factors as shown in sub-section 4.3 - some robustness checks.

Figure 3: Preferences by age



Note: This figure shows the girls' age profile of mother's preferences in taste for child education in utility terms.

These results can be explained in some extent with cultural factors and constraints, as seclusion, toward girls that limit parents willingness to send their girls to school. In addition, the most traditional attitudes toward girls' schooling tend to be held by the least educated, which derive less utility from educating girls as seen before leading to a perpetuation of girls disadvantage.

In what concerns tastes for work, one of the types dislikes work while the other one gets very low utility from work. Mother's education increases the disutility derived from work while age has the opposite effect. Nevertheless, both have a very modest impact on utility.

Among other economic factors, the presence of home production constraint is important to explain the high drop-out rate among girls, in particular the older ones (more than 12 years old).

The results indicate that home production is more valuable when family have very young children in the household as δ_1 is positive[28]. Another implication of this result is that if the number of younger children increase, we get less market consumption. Despite not so intuitive, this result become reasonable given that c_t^H and c_t^M are highly substitutes (ρ =0.95).

The child contribution to home production imply a significant difference between girls aged 12-13 to the older ones. The coefficient associated with the first ones is around 0.3 while the one for the those with 14-15 is significantly higher (2.9). These results should be compared to the mothers' term which is normalized to 1, the case where girls spent the same time working at home as mothers or are as productive as mothers[29]. Data suggests that girls aged 14 to 15 spent at home around the same time as mothers. Therefore, the high figure presented by the model can partly be explained if girls are more productive than mothers[30]. In addition, this parameter may be capturing the effect of other household members that are not taken directly into account in the model. Results for girls aged 12-13 are in line with the less time spent at home observed in the data.

These results suggest that home production and in particular the presence of

[28]Despite being a potentially interesting feature we are not considering fertility decision in the model. This will be the focus for future research.

[29]These coefficients can be higher/lower than 1 can only be explained by two reasons: spending more/less time than mothers at home and/or being more/less productive than mothers.

[30]We don't have a way to confirm if girls are more or less productive than mothers. Having less responsability in the remaining household activities with some extra pressure from family may help to explain this issue. Nevertheless, the magnitude is in some extent too high.

young children in the household is an important mechanism explaining the high drop out rates among girls from 12 to 15 years old.

Finally, the estimated cost of going to school if there is no secondary school available in the village is significantly high (around 2290 rupees $\approx$ 27 U.S. dollars), which is around 6 times the average educational expenditure for those in grade 5 or more and around 30 per cent of household income. Given the high percentage of villages without elementary/secondary schools (more than 40 per cent) this result suggests that this might be an important factor explaining the high drop-out rate among older girls. From a policy perspective this is something that can not be ignored by the authorities.

As discussed in Section 2, we estimate wage equation outside the model and then use predictions from that equation in place of actual wages. We use an Heckman selection model to estimate wage equation and test if selection is an issue or not. To obtain the Inverse Mills ratio to be used in the wage equation, we estimate a reduced form probit for labour market participation as a function of variables used in the structural model. These variables are mothers' age and education, number of children with less than 1 year old, girl school attendance, secondary school availability and female unemployment rate in the village.

The resulting estimated wage equation is presented in table 4. As mentioned before, the selection effect is not an issue as the Inverse Mills ratio coefficient is not significant reflecting in some extent the fact that female labour is relatively homogenous given age and education[31]. Table 4 also shows that the education effect is significant and has the expected sign, while the age effect has the expected sign but not significant. Local labour market conditions (female unemployment rate in the village) seems also to have some significant impact on wages. Nevertheless, the key determinant of wages at the individual level is education.

Note that, in this type of models, to get identification we need at least one independent variable that affects selection but not the outcome. In our case we have

[31]The Inverse Mills ratio has an unexpected sign, implying that those who go to labour market tend to have lower wage. This result may be due to a strong income effect. Those who do not get a job are from a wealthier family.

Table 4: Wage equation

Parameter	Estimate	Std.Error
Log wages equation		
Mother education	0.79	0.21
Mother age	0.08	0.12
Mother age squared / 100	-0.09	0.14
Female Local Labour Market Conditions		
Medium (medium village unemployment rate)	-0.63	0.21
Bad (high village unemployment rate)	-0.39	0.20
Inverse Mills ratio (λ)	-0.14	0.21
Constant	-1.13	2.50
First Step (Labour market participation)		
Mother education	0.07	0.12
Mother age	0.01	0.07
Mother age squared /100	0.01	0.08
Female Local Labour Market Conditions		
Medium (medium village unemployment rate)	0.19	0.12
Bad (high village unemployment rate)	0.03	0.11
Children from 0 to 5 years old	-0.24	0.12
Children in school	-0.18	0.10
Log income (father)	-0.53	0.07
Secondary school availability in the village	0.05	0.11
Constant	-1.22	1.34

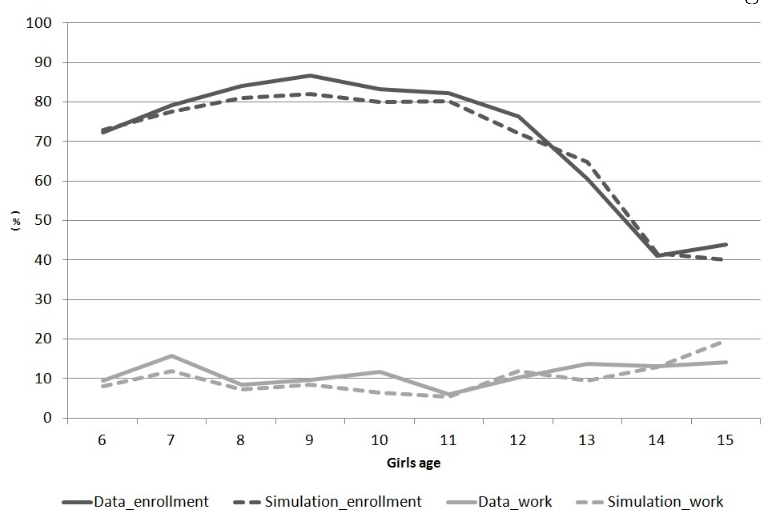
Notes: This table shows the results of the wage equation estimated outside the model. The first block displays log wages equation (second step) while the second block displays mother's labour market participation decision. Female Local Labour Market conditions is measured as the village female unemployment rate. Using the household census data we split the 125 villages in 3 categories according to their female unemployment rate (up to 25th percentile, 25th to 75th percentile and above 75th percentile). More specifically, the 25th percentile corresponds to an unemployment rate just below 6 per cent and the 75th percentile just above 30 per cent.

number of children with less than six years old, father's income, if child is in school and secondary school availability in the village[32]. All appear with the correct sign and significant except the availability of secondary schools in the village. Therefore, a women with young kids, with higher father income and with children at school are less likely to work in the market.

4.2 Model Fit

Figure 4 depicts the fit of the model to the choice distributions, based on a simulation of 10000 individuals. It compares the model's prediction of the distribution of children (school, or home) and mother (work, or home) activity allocations at individual ages with the actual distribution.

Figure 4: Model Fit - Girls school enrollment and mother working status



Notes: This figure shows the fit of the model to the mother's labour market participation (Data work vs. Simulation work) and girls' schooling (Data enrollment vs. Simulation enrollment), based on a simulation of 10000 individuals. It provides the fit of the model at each girls' age between 6 and 15 years old.

As can be observed, the model matches the data quite well, in particular looking at the girl school enrollment decision. Despite not being the main focus of the paper, the mother working status presents a reasonable result but a clear lower fit

[32]The availability of secondary schools in the village increases the likelihood of a women participate in the labour market. This means that more secondary schools would increase the girls enrollment and then more mothers will need to stay at home. Nevertheless, this result is not statistically significant.

with data[33]. More specifically, figure A-1 in appendix, shows that the within-sample fit of our model is particularly good in the case of the most chosen alternative, i.e., mother staying at home with children enrolled in school. The other alternatives present a reasonable match, with the exception of the first half of the distribution of the alternative of mother working and children staying at home. Furthermore, in what concerns girl school enrollment decision, the model also matches the data well if we look to households with and without young children (see Figure A-2 in appendix).

4.3 Some Robustness Checks

In this section we present two robustness checks to our previous results. First, we consider a different model specification including father's income as endogenous to infer the reasonability in terms of identification of the conditional cash transfer experiment. Second, we check what happen to our results if we do not allow taste for school to vary with children's age.

Endogenous father's income

In this setup we re-estimate the model considering father's income as endogenous. In particular, it depends on wife age and education, male local labour market conditions and an income shock:

Father income wage equation:

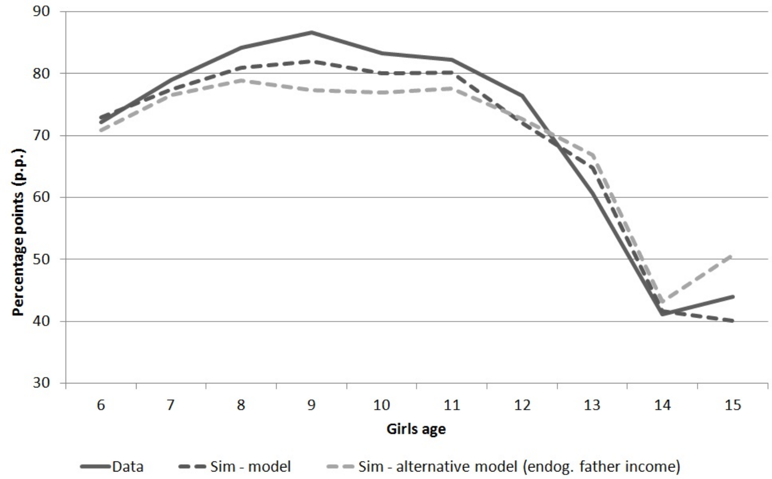
$$y_t = g(age_t^m, educ_t^m, z_{tv}^{male}, \varsigma_t^y)$$

The estimation results are similar but the fit is not as good as in the exogenous case (Figure 5)[34]. Nevertheless, the similarity with the exogenous case gives some insurance about the identification and interpretation of the cash transfer policy of our simulation.

[33]In some situations it is rejected the chi-square statistic associated with a test of the null that the predicted and actual distributions are the same.

[34]The results are available upon request.

Figure 5: Girls' school enrollment rate

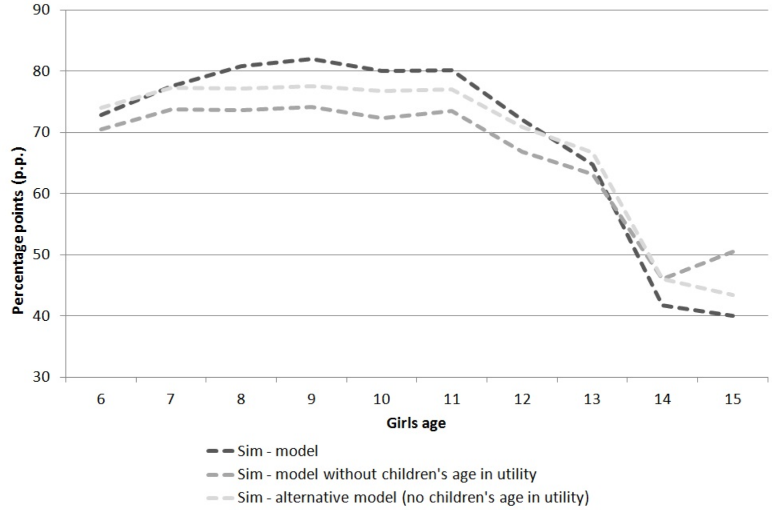


Notes: This figure compares the actual girls' school enrollment with the simulation of the model with and without father's income as endogenous. Alternative Model (endog. father income): The simulation of the alternative model implies the estimation of a new model with a different specification, including the father income (y_t) as endogenous. It depends on mother's age, mother's education, male local labour market conditions and income shock.

Children's age in the utility function

To check if economic factors are driving the results, in particular, the dramatic decrease of girls enrollment rate for older girls we perform two exercises: 1) simulate the model presented in the paper imposing the coefficients of children's age equal to zero ($\alpha_{13} = 0$ and $\alpha_{14} = 0$), and 2) re-estimate the model with a new specification excluding children's age from the utility. Figure 6 shows that in both cases age has naturally some relevance but the main conclusions are still coming from the economic factors discussed before, in particular for older girls. These exercises, simulation and re-estimation of the model without children's age in the utility function, confirm economic factors as the main determinants of the girls enrolment rate. The result is particularly strong for older girls but even the initial increase for younger girls is, in some extent, determined by economic factors and not entirely by the inclusion of age in a quadratic form in the utility function.

Figure 6: Girls' school enrollment rate



Notes: This figure compares the model simulation of the girls school enrollment rate with two different model specifications: 1) Model without children's age in utility function: we simulate the model presented in the paper with the coefficients of age and age squared equal to zero ($\alpha_{13} = 0$ and $\alpha_{14} = 0$); 2) The simulation of the alternative model implies the estimation of a new model with a different specification excluding the terms α_{13} and α_{14} from the estimation.

5 Policy Experiments

One of the main advantages of having a structural model, is the possibility of performing policy experiments. We now use the model to simulate school participation under different scenarios. We quantify the effect of demand-side policies such as (conditional) cash transfers, availability of daycare centers for young children and employment/wage subsidy. We also present results of the effect of a supply-side policy on school attendance, i.e., the increase in the number of communities where a secondary school is available.

5.1 School Subsidy

5.1.1 Conditional Cash Transfer

Conditional Cash Transfer (CCT) programs targeted to poor households are rapidly becoming a key policy instrument used by developing countries to reduce poverty and increase human capital investments.

We perform 3 simulations with a CCT program: i) one approach with a similar grant scheme to the well known CCT program in Mexico (PROGRESA) with different grants for primary and secondary school[35], ii) a scheme with the same grant for primary and secondary school and iii) a grant scheme that would close the enrollment rate gender gap.

i) Grant Scheme a la PROGRESA

The simulation includes monthly grants for children of a family qualified as beneficiary[36]. To be given a grant, children need to be enrolled in school. A child who does not pass a grade is still eligible for the grant[37]. The grant increases with the years of schooling completed in a very similar way to the well known CCT program in Mexico (PROGRESA). In addition, using also other previous CCT schemes (Fiszbein and Schady (2009)), we built a lower and upper bound for the impact on school attendance.

Table 5: Grant Scheme a la Progresa (in U.S dollars per month)

Grade	CCT (U)	CCT(L)
Primary education		
grade 1 to 4	5.8	0.9
grade 5	11.7	1.8
Elementary and Secondary education		
grade 6 to 7	23.4	3.5
grade 8 or more	29.2	4.4

Notes: This table shows the grant scheme of the conditional cash transfer simulated in the model similar to the PROGRESA scheme. CCT (U) represents the upper bound case where the secondary school grant represents around 30% of average income. CCT (L) represents the lower bound case where the secondary school grant represents around 4% of average income.

[35]See Attanasio et al. (2012) for more details on the PROGRESA grants.

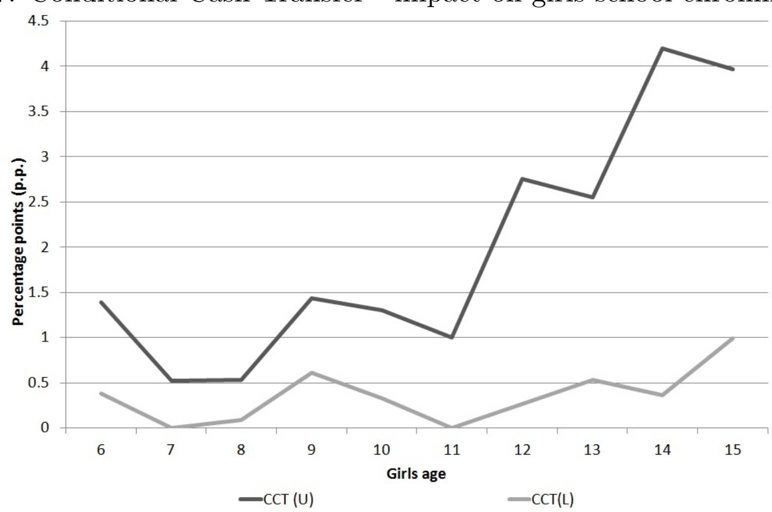
[36]In this case we've just excluded the ones above 95 percentile of the distribution.

[37]In PROGRESA if the child fails the same grade twice, she/he losses eligibility. This is not taking into account in this simulation.

Table 5 shows the grant scheme used in both scenarios, one where the secondary school grant is around 4 per cent of the average income of the household (Lower bound scenario - CCT(L)) and another one where the same grant reaches 30 per cent of the average income of the household (Upper bound scenario - CCT(U)).

Figure 7 shows that the CCT program would have a positive and increasing impact on school enrollment, in particular after 12 years old using the upper bound scenario (CCT(U)). The average impact for girls between 12 and 15 is around 3.5 p.p., while for younger girls is around 1 p.p..

Figure 7: Conditional Cash Transfer - impact on girls school enrollment rates



Notes: This figure shows the impact, in percentage points, on girls' school enrollment rate of the conditional cash transfer scheme presented in table 5. CCT(U) represents the upper bound case where the secondary school grant represents around 30% of average household income. CCT(L) represents the lower bound case where the secondary school grant represents around 4% of average household income.

Using the lower bound scenario (CCT(L)) the results become much smaller, reaching for older girls an impact of less than 1 p.p. and having a negligible effect on younger girls.

These results are much smaller when compared to the evaluation in Chaudhury and Parajuli (2006) for Pakistan[38]. In this study the impact for girls aged 12-14 is around 10 p.p. Nevertheless, the different results can be explained by two reasons.

[38] This paper is discussed and analysed in the Conditional cash transfers policy research report by Fiszbein and Schady (2009).

First, the baseline is much lower than the one studied in this paper (29 and 50 per cent, respectively). Second, the program was addressed to the less literate regions [39], where only one (Rahim Yar Khan) of our 3 districts would be included[40]. In this case, their results are naturally more sensitive to an income effect. In addition, the high percentage of private schools in our sample may affect the results in a non-clear way.

In general, the impact of this measure on mothers labour market participation is modest (see table A-3 in appendix).

ii) Same Grant for all grades

In this simulation, the grant does not increase with the years of schooling completed. Table 6 shows the grant scheme and Figure 8 shows the impact of this simulation. As before we simulate 2 different scenarios, one where the monthly grant is around 4 per cent of the average income of the household and another where the same grant reaches 30 per cent of the average income of the household.

Table 6: Same Grant for all grades (in U.S dollars per month)

Grade	CCT (U)	CCT(L)
All grades	23.4	3.5

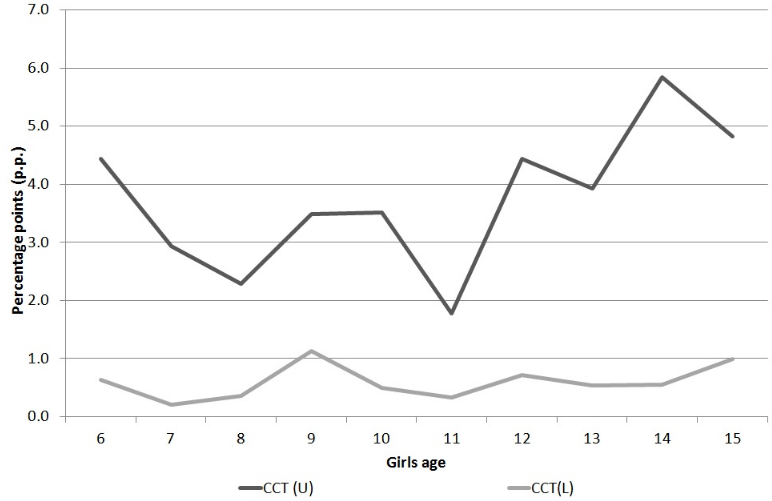
Notes: This table shows the grant scheme of the conditional cash transfer simulated in the model where the grant is the same for all grades. CCT (U) represents the upper bound case where the grant represents around 30% of average income. CCT (L) represents the lower bound case where the grant represents around 4% of average income.

Interestingly, even with the same grant for all years of schooling completed, the

[39] Fifteen of Punjabs 34 districts were selected as program districts on the basis of average literacy rate of population 10 years and older The average literacy was estimated from Population Census 1998 data. The cut-off literacy rate was 40 percent: 15 selected districts below the cut-off were stipend-eligible and the remaining 19 above the cut-off were not

[40] Rahim Yar Khan was not among the worst ones with a literacy rate of around 33 per cent (in a interval from 20 to 40 per cent). Attock and Faisalabad presented higher literacy rates (49 and 52 per cent, respectively).

Figure 8: Conditional Cash Transfer - impact on girls school enrollment rates



Notes: This figure shows the impact, in percentage points, on girls' school enrollment rate of the conditional cash transfer scheme presented in table 6. CCT(U) represents the upper bound case where the grant represents around 30% of average household income. CCT(L) represents the lower bound case where the grant represents around 4% of average household income.

CCT program would have a positive and increasing impact on school enrollment in particular after 12 years old using the Upper bound scenario (CCT(U)). The average impact for girls between 12 and 15 is around 5 p.p., while for younger girls is around 3 p.p.. In the Lower bound scenario the impact on girls' enrollment rate increases slightly, to be on average around 0.6 p.p. and similar for younger and older girls.

iii) Which grant would close the enrollment rate gender gap?

Finally, we present the results for the simulation where the CCT grant would close the school enrollment rate gender gap. Table 7 shows the observed school enrollment gender gap in the sample. For younger girls the average gender gap reaches on average 10 p.p., while for girls with 14 and 15 years old reaches an average of 25 p.p..

Table 8 shows the grant scheme required to close such big differences. In the Primary school the level of the grant need to be similar or slightly above the average

Table 7: School Enrollment Rate by age - Gender gap

	Age									
	6	7	8	9	10	11	12	13	14	15
Gender Gap	10.9	9.56	5.5	7.4	10.8	6.1	10.0	17.5	27.0	22.6

Notes: This table shows the school enrollment gender gap by age.

household income. In the Secondary school, for grades 6 and 7 the grant as to be almost 2 times the household average income and would need to be 3 times bigger for the students in grade 8 or more. As we can see, it would be really costly to close the gender gap using only a program like the conditional cash transfer. To close the gap the grant for older girls needed to be around 10 times bigger than the most generous CCT program that already took place, which reaches around 30 per cent of the household average income.

Table 8: Grant Scheme - Closing Gender Gap (in U.S dollars per month)

Grade	CCT	% of household average income
Primary		
grade 1 to 4	82	100.0
grade 5	94	114.3
Elementary/Secondary		
grade 6 to 7	152	185.7
grade 8 or more	245	300.0

Notes: This table shows the grant scheme of the conditional cash transfer simulated in the model which closes the gender gap in terms of school enrollment rates. It also shows the percentage of each grant in terms of the household average income.

5.1.2 Unconditional Cash Transfer

Table 9 compares the results of the conditional cash transfer (CCT) with an unconditional cash transfer (UCT) program. The impact of the UCT scheme is much smaller in both cases, lower and upper bound scenarios. Nevertheless, the higher the grant the bigger the difference between the two schemes. On average, for older girls, the impact of the UCT upper bound scenario is only 15 per cent as large as the CCT scheme and 28 per cent in the lower bound scenario. Furthermore, the CCT(L), which corresponds to a grant of around 4 per cent of household income gives results slightly better than the ones presented by UCT(U) with a grant 8 times bigger.

Table 9: Unconditional vs. Conditional cash transfer - Same Grant for all grades

	Girls age									
Policy measures	6	7	8	9	10	11	12	13	14	15
Upper Bound Scenario - (around 30 % of household average income)										
CCT (U)	4.4	2.9	2.3	3.5	3.5	1.8	4.4	3.9	5.8	4.8
UCT (U)	0.1	0.0	0.1	0.0	0.1	0.0	0.2	0.2	0.5	0.7
Lower Bound Scenario - (around 4 % of household average income)										
CCT (L)	0.6	0.2	0.4	1.1	0.5	0.3	0.7	0.5	0.5	1.0
UCT (L)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.3

Notes: This table compares the impact, in percentage points, of the unconditional with the conditional cash transfer policy on girls' school enrollment rate. CCT(U) and UCT(U) - It represents the upper bound case for the Conditional and Unconditional cash Transfer, respectively, where the secondary school grant represents around 30% of average household income. CCT(L) and UCT(L) - It represents the lower bound case for the Conditional and Unconditional cash Transfer, respectively, where the secondary school grant represents around 4% of average household income.

These results are in line with the recent paper (Baird et al. (2011)) confirming big effects of the conditionality[41]. Therefore, this exercise confirms and quantifies from a policy perspective the widespread use of CCT schemes. In particular, when education is to be targeted, it seems clear the need and importance of a conditional incentives scheme.

[41] Baird et al. (2011) assess the role of conditionality in a cash transfer program using an experiment at adolescents girls in Malawi. In their paper, the impact of the UCT scheme on dropout rate it was only 43% as large as the impact of the CCT.

5.2 Availability of elementary/secondary schools

Access to the school has been an important factor inhibiting girls' enrollment, particularly in rural areas. Changes in government educational policy in recent years, as well as the rapid growth of low-fee private schools in rural areas, may be changing the educational opportunity structure for poor rural girls.

Nevertheless, not having an elementary/secondary school available in the village of residence implies transportation and time costs. Both costs decrease the utility of attending school. For example, if the government establishes a secondary school in one of those villages a positive effect on school enrollment could be expected. In the next experiment we demonstrate the effects of a potential but ambitious school building program, where all villages would have at least one school for girls (Figure 9). The impact is increasing with children's age and reaches a maximum of around 2.5 p.p. for the oldest girls.

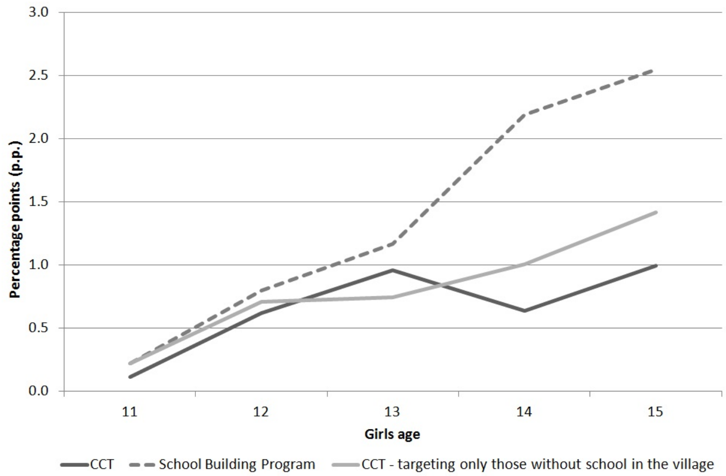
The results are significant and bigger than the cost comparable CCT scenario, in particular, looking for older girls (14 and 15 years old) the impact on the girls school enrollment rate is almost 3 times bigger. The cost per student of this type of measure was calculated to be of around 465 rupees per month ($\approx$ 5.4 U.S. dollars)[42]. This measure can be seen not only as an alternative but also as a complement from an education policy perspective that wants to target high drop-out rates among girls in a more effective and direct way. Even if the CCT program was targeting only those in villages without school the impact on girls' school enrollment is 50 % as large as the school building program (see Figure 9)[43].

Notice that, on one hand, the results may be underestimated since we are not taking into account the extra positive effect of building schools in villages where a school is already available and crowded. Furthermore, if we have used the same estimated total cost of the school building program (per year) instead of the cost

[42] The cost per student per month is calculated in the following way: From other school building programs (from World Bank and other institutions) we use an estimate of around $7000 per classroom. Then, assuming i) 20 years without major reforms, ii) on average 30 kids per classroom, and iii) a student will stay on average 5 years.

[43] In this case the grant is of around 1250 ruppes ($\approx$ 14.6 U.S. dollars).

Figure 9: School Building Program vs. Conditional Cash Transfer (impact on girls school enrollment rate)



Notes: This figure compares the impact, in percentage points, of the school building program with the conditional cash transfer program on girls' school enrollment rate. The two policies are cost comparable - the cost per student in a elementary/secondary school of around 465 rupees per month (≈ 5.4 U.S. dollars)) . The cost per student per month is calculated in the following way: Using an estimate of around $7000 per classroom (source: other school building programs) and assuming i) 20 years without major reforms, ii) on average 30 kids per classroom, and iii) a student will stay on average 5 years.
In the case of targeting only those in villages without school the grant is of around 1250 rupees (≈ 14.6 U.S. dollars).
1 US dollar ≈ 85.6 PAK rupees.

per student, the effect on the CCT scheme would have been even smaller. Finally, this effect relies on the assumption that government build a school in all villages initially without one.

Interestingly, table A-3 in appendix shows that there is a negative impact on mothers' labour market participation for older girls reaching a maximum impact of -0.65 p.p when the girl is 14 years old. This seems to be a result of the substitutability between mothers and girls on working at home.

5.3 Public/free Child care services

Suppose all the children aged five years old or less in the family are sent to a public (free) daycare center. Girls will be no longer needed at home to look after them and may go back to school. In the model, the utility of a girl going to school is negatively related with the number of children aged five or less years old in the family.

Introducing nursery in the model would change the home production function in the following way:

$$c_t^H = \delta_0 \Psi + \delta_1 n_{05,t}[(1-\chi-h_t)+(\eta_0 age^c_{1213,t}+\eta_1 age^c_{1415,t})(1-\chi-s_t)+\chi\tau] \quad (14)$$

where χ represents the nursery number of hours, τ the nursery productivity factor and $\Psi = (1-h_t)+(\eta_0 age^c_{1213,t}+\eta_1 age^c_{1415,t})(1-s_t)$.

The time spent by the mother and the daughter at home would be smaller if the young children goes to the nursery and it is reduced by χ. This work is replaced by the nursery and it has a productivity factor of τ.

The effect a free child care service for all children aged five or less on girls' school enrollment can be approximated by simulating girls' choices after setting the time in the nursery by 8 hours (χ=0.333) and nursery being half productive as the mother (τ=0.5)[44].

Table 10 shows that the impact is only significant for older girls school enrollment (aged 14-15) and on average of 0.67 p.p.. It should be noted that the effect of the free child care may be overestimated as it is not taking into account the age at which daycare accepts children. Interestingly, the results in table 10 shows also that the impact of a CCT scheme targeting only secondary school students is only 91 per cent as large as the impact of providing free child care services, when the two measures have a similar total cost [45]. If the CCT scheme wanted to target students in the primary school as well, the free child care service becomes much more effective as more students will be eligible for the grant [46]. The effect on mother's labour market

[44]Similar conclusions after using different specifications, as χ=0.25 $\equiv$ 6 hours in the nursery and different productivity factor for the nursery (0.25 and 0.75).

[45]Total Cost in the sample: the cost of a contract teacher per child is of around 1200 Rupees per year ($\approx$ 14 U.S. dollars) (the cost per month is of around 3000 rupees and dividing that by 20-30 kids to emerge at something around 1200 rupees per year). In the sample there are 1195 kids with less than 6, which means a total cost in the sample of 1434000 rupees per year (119500 per month). On the secondary school there are around 280 girls, which give a monthly cash transfer of around 420 rupees ($\approx$ 4.9 U.S. dollars) per student in the secondary school.

[46]If we consider all girls with 11 to 15 years old enrolled in school and not only the ones enrolled in the secondary school the monthly cash transfer drops to around 200 Rupees per month ($\approx$ 2.3 U.S. dollars) . In this case, this measure becomes more effective with an impact of around 2 times bigger the one presented by the CCT.

participation is decreasing and turns out to be negligible for older girls (see table A-3 in appendix). Nevertheless, for younger girls the maximum impact reaches only 0.3 p.p.

Table 10: Public Child Care vs. Conditional Cash Transfer

	Girls Age				
Policy measures	11	12	13	14	15
Impact on Girls School Enrollment Rate					
Free Child Care Services	-0.2	0.1	-0.1	0.7	0.6
CCT targeting only secondary school students	0.0	0.5	0.7	0.5	0.8

Notes: This table compares the impact, in percentage points, of a free child care service with a cost comparable conditional cash transfer program. The two policies are cost comparable presenting the same total cost in the sample. Total Cost in the sample: the cost of a contract teacher per child is of around 1200 Rupees per year ($\approx$ 14 U.S. dollars) (the cost per month is of around 3000 rupees and dividing that by 20-30 kids to emerge at something around 1200 rupees per year). In the sample there are 1195 kids with less than 6, which means a total cost in the sample of 1434000 rupees per year (119500 per month). On the secondary school there are around 280 girls, which give a monthly cash transfer of around 420 rupees ($\approx$ 4.9 U.S. dollars) per student in the secondary school.

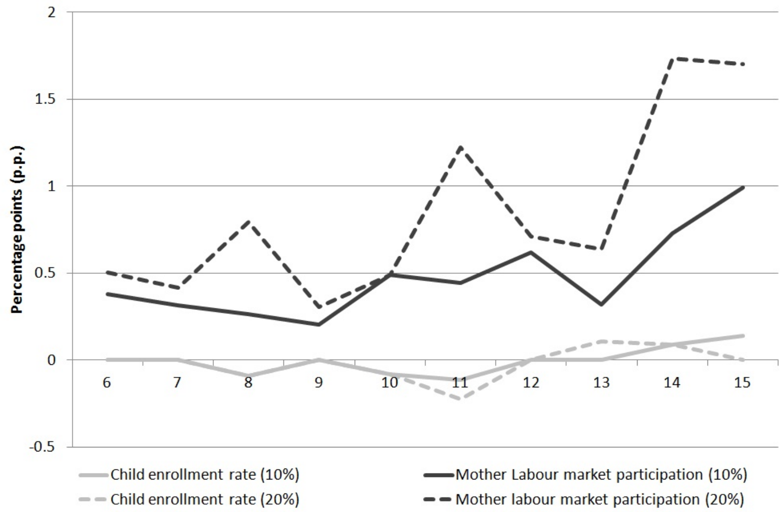
5.4 Employment subsidy

Another interesting experiment is the impact of an employment subsidy (or wage subsidy)[47] on school enrolment and mother labour market participation (Figure 10). We present the results of an increase in wages by 10 and 20 per cent.

In both cases, the effect on girls school enrollment is modest, in particular for the youngest girls. In large extent, this is explained by the high substitutability between home and market production (see table 3) observed in the model. Interestingly, for a mother with an older girl may end up with a small but negative impact. In this case, the substitution effect becomes more important than the income effect. As for the mother's labour market participation the impact is positive and increasing in both scenarios. The impact of an increase in wages by 20 per cent reaches a maximum of 1.8 p.p., when the child is 15 years old (around 1 p.p. for the 10 per cent increase).

[47]This policy would be in the same spirit of the Working Tax Credit in the United Kingdom.

Figure 10: Wage increase



Note: This figure shows the impact, in percentage points, on girls' school enrollment rate and mother's labour market participation rate of an increase in wages by 10 and 20 per cent.

5.5 The effect of a more educated generation

As mentioned before, the most traditional attitudes towards girls schooling tend to be held by older and least educated population. Therefore, there is a positive generation effect that is interesting to quantify and that should be taken into account. In this case, we simulate and quantify what happens to girls' school attendance if mothers' education distribution is different, i.e., in the way the model predicts. In one generation (10 to 15 years), the oldest population (50-65 years old) would be out and replaced by the generation analysed in the model. The figures are clear: among the oldest population, the percentage of educated mothers is around 5 per cent, compared to the 60 to 65 per cent in the youngest generation. In practical terms, the overall percentage of educated mothers rises from 25 to 30 per cent. This simple exercise is an underestimation of a pure generation effect as does not take into account other preference changes that naturally are also taking place. The impact on older girls is around 1.5 p.p., which is relatively modest. Despite the other factors that are not taking into account in this exercise, this is just a confirmation that any cultural change takes time to have a clear and visible effect.

6 Concluding Remarks

In this paper we focus on the labour supply and children school decisions of women using and estimating a dynamic behavioural model in rural Pakistan. Nevertheless, our research is relevant not only for Pakistan but also for other low-income countries, in particular, from the perspective of how these countries may deal with high drop-out rates among older girls. The mechanisms and the consequences of different policies may provide good insight to other low-income countries from a police perspective.

This paper is interested in understanding the high drop out rates among girls, in particular, the role of home production for older girls, and in assessing the impact of monetary incentives and supply side education policies to girls' school enrollment. Previous studies have provided evidence that these incentives are important to increase school attendance but never combine mother labour supply with children school decision, in particular, the key role played by home production. Results in this paper show that mothers' working status affects the girls' utility of staying at home. It can be expected that a girl whose mother works in the labour market would be more valuable at home, replacing for her mothers' housework. Also, the family composition, in particular the number of young kids have an important role for the value of both mother and girls at home. The model highlights the relevance of economic factors, through budget constraint and home production constraint, in the decision of children attending school. The importance of cultural factors is also analysed and presented in the model. Most importantly, estimation of the structural model allows us to explore the effects of counterfactual policy experiments. Our results may lead to relevant policy implications for developing countries. Simulations suggest that monetary incentives are a good mechanism to keep and increase girls school enrollment, as the conditional cash transfer case. Nevertheless, to get sizable effects it seems not to be costly effective. These targets can also be achieved by reducing transportation costs in secondary school and in a less extent with availability of daycare centers. Our paper shows that in rural areas, CCT programs are clearly not the only way to target educational attainment, in particular when some basic school environment and resources are not attained. Further, the effect of a more educated generation should not be ignored but it seems clear that it will take time (3 or 4 decades) to get a real and visible effect.

In future research, a natural and important extension to the current model is to consider also boys in the household decision. In this case, it will be possible to understand not only the high-drop out rates for girls but also what are the mechanisms driving the significant educational gender gap observed in this type of countries. Among other things, we will attempt to explain the dynamics of gender gaps in school attendance. From a policy perspective, the proposed framework would simulate investigations on the impact of different measures to mitigate the educational gender gap. Another interesting feature is to consider fertility decisions in the model, allowing for newborn children in the household. Finally, it would be also interesting to use a continuous time decision model instead of the current discrete choice model. These different and richer setups would improve the discussion on human capital investments, in particular from a policy perspective.

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Appendix

Table A-1: Variance-Covariance Matrix

Parameter	Estimate	Standard Error
school/not working	0	-
school/working	1	-
no school/not working	4.71	0.003
no school/working	0.04	0.005

Note: This table shows the variance-covariance matrix estimates and the asymptotic standard errors. The variance-covariance matrix was estimated using the GHK method.

Table A-2: Probability of passing grade

Mother' s Education - No Education

	Girls Age									
Girls Education	6	7	8	9	10	11	12	13	14	15
0	0.36	0.46	0.67	0.85	0.86	0.83	0.40	0.67	0.67	0.00
1	0.42	0.51	0.72	0.64	0.80	0.71	0.78	0.75	0.25	0.00
2	0.00	0.70	0.62	0.77	0.79	0.84	0.69	0.52	0.76	0.50
3	0.00	0.00	0.63	0.48	0.65	0.80	0.66	0.59	0.86	0.65
4	0.00	0.00	0.00	0.50	0.77	0.73	0.76	0.78	0.80	0.71
5	0.00	0.00	0.00	0.00	0.20	0.80	0.41	0.41	0.38	0.20
6	0.00	0.00	0.00	0.00	0.00	0.71	0.74	0.60	0.78	0.61
7	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.62	0.73	0.58
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.69	0.73
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.67
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50

Mother's Education - at least some education

	Girls Age									
Girls Education	6	7	8	9	10	11	12	13	14	15
0	0.52	0.74	0.86	0.78	0.67	0.67	0.40	0.67	0.67	0.00
1	0.38	0.63	0.67	0.76	0.86	0.68	0.75	0.75	0.50	0.00
2	0.00	0.50	0.82	0.77	0.86	0.89	0.87	0.76	0.50	0.00
3	0.00	0.00	0.72	0.59	0.67	0.83	0.74	0.79	0.95	0.00
4	0.00	0.00	0.00	0.82	0.74	0.78	0.83	0.68	0.82	0.88
5	0.00	0.00	0.00	0.00	0.50	0.63	0.42	0.63	0.36	0.14
6	0.00	0.00	0.00	0.00	0.00	0.57	0.79	0.78	0.95	0.43
7	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.60	0.78	0.73
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.92	0.85
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.64
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67

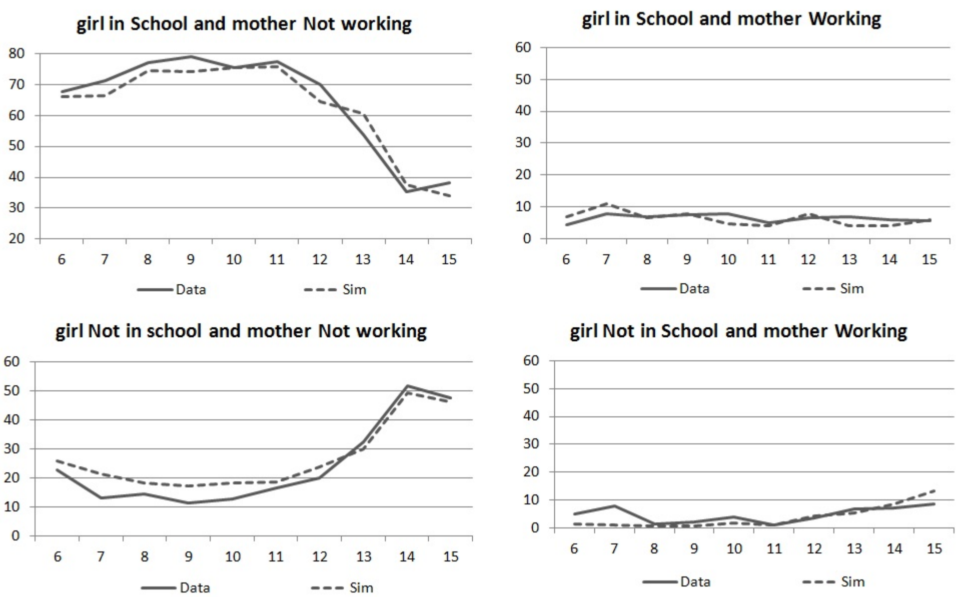
Notes: We estimate the probability of progressing for each grade as the ratio of individuals who passed to the next grade compared to the year before at a particular age, given their education and their mother's education. Mother's education is a binary variable, which can represent a mother with no education or a mother with at least some education.

Table A-3: Impact on mother's labour market participation rate

	Girls age	
Policy measures	6-10	11-15
CCT(U)	0.04	-0.02
School Building Program	0.06	-0.07
Free Child Care Services	0.06	-0.03

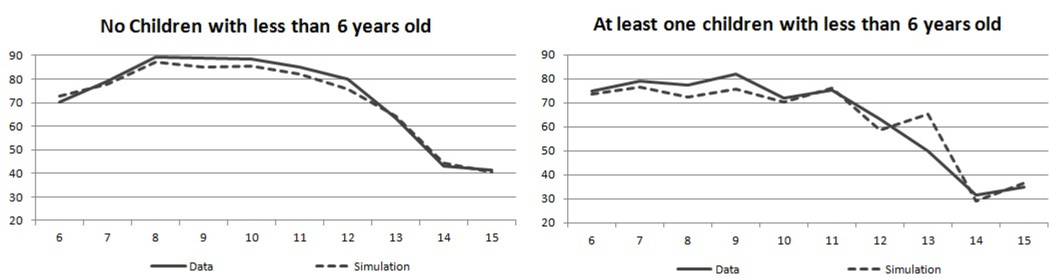
Notes: This table shows the impact, in percentage points, on mother's labour market participation rate of the Conditional cash transfer scheme (Upper bound scenario), the school building program and of the free child care services program. The table displays the average impact for younger girls (6 to 10 years old) and for older girls (11 to 15 years old).

Figure A-1: Model fit - household choice distribution



Note: This figure shows the model fit for the 4 mutually exclusive household choices.

Figure A-2: Model fit - Girls school enrollment rate by number of young children



Note: This figure compares the model fit for the girls' school enrollment rate for households with and without children with less than 6 years old.