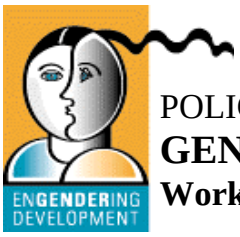

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The Effect of Early Childhood Development Programs on Women's Labor Force Participation and Older Children's Schooling in Kenya

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The costs of child care and the levels of mothers' wages influence school enrollment of older children. The effect of these factors on boys' and girls' schooling is different, however. While an increase in mothers' wage raises school participation of boys, it reduces the school enrollment of girls. Higher prices of child care have no significant effect on boys' schooling but significantly decrease girls' probabilities of being at school.

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ABSTRACT

We analyze the effect of child care costs on households' behavior in Kenya. For households with children three to seven years of age, we model mothers' participation in paid work, participation in paid work of other household members, households' demand for education for school-aged children, and households' demand for child care. We find that high costs of child care discourage households from using formal child care and have a negative effect on the level of mothers' participation in market work. The costs of child care and the levels of mothers' wages influence school enrollment of older children. The effect of these factors on boys' and girls' schooling is different, however. While an increase in mothers' wage raises school participation of boys, it reduces the school enrollment of girls. Higher prices of child care have no significant effect on boys' schooling but significantly decrease girls' probabilities of being at school.

Keywords: Kenya, Early childhood development, Labor supply, Schooling decision, Maximum likelihood, Non-parametric estimation.

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1. Introduction

The number of Early Childhood Development (ECD) centers grew very fast since Kenya gained its independence in 1963. While only a small proportion of children were enroled in ECD centers in early 60's, 20 thousand ECD centers provided day care and prepared for primary school over 1 million children three to seven years old (about 20 percent of the children in this age group) in 1995. The number of child care facilities reached 23,690 by the end of 1999. The labor market dynamics in this period was characterized by increasing rates of involvement of women in the outside-home work, migration of poor landless households to the urban areas, and rising proportion of women in industry.

The government's annual expenditures on ECD programs can exceed its expenditures for one year of primary education, according to various estimates in developing countries (Wilson 1995). Such expensive investments in small children compete for resources with many other programs and projects, and it is important to provide policymakers with information to judge the benefits of these investments (Gaag and Tan 1999).

The effectiveness of investments in ECD programs is often estimated based on improvements in the future productivity of ECD graduates. Growing evidence from diverse cultures shows that most ECD programs of relatively good quality have meaningful short-term effects on cognitive ability, early school achievement, and social adjustment (Hayes, Palmer, and Zaslow, 1990).[2] These *direct* improvements in child outcomes are the benefits that policymakers usually consider when making decisions about public investments in ECD. At the same time, the availability of affordable ECD facilities may offer *indirect* benefits (Myers 1996). Among these are increased participation of mothers in market work and increased school participation of older siblings (usually young girls) who are freed from the child care chores. The impact of these benefits on the welfare of households with small children could be substantial.

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[2] There is also increasing evidence that interventions can produce medium- to longer-run effects on school achievement, special education placement, grade retention, disruptive behavior and delinquency, and high school graduation (Reynolds et al. 1997).

Research in developing countries indicates that females, other than the mother, especially young daughters, act as providers of free child care, releasing mothers for market work (Pitt and Rosenzweig 1990; Wong and Levine 1992; Tiefanthaler 1997 ; Connelly, De Graph, and Levinson 1996; Deutsch 1998). Psacharopoulos and Arrigada (1989) found a significant negative effect of presence of younger siblings on school attendance of older children in Brazilian households. In Salvador, girls missed more school than boys because they were more often stayed home to help with chores (Bittencourt 1979). Deolalikar (1998) found significant differences in girls' (but not boys') primary and secondary enrollment by the presence of children under three in the households in Kenya. The author reports a particularly strong effect for girls of secondary school age. Conditional on the other determinants of enrollment, the probability that a girl aged 14-17 is enrolled in secondary school is reduced by 41 percent if there is a child under three years of age in the household. The corresponding effect for boys is only 5 percent. These results suggest that when the market child care services are unavailable, owing to high cost or a lack of facilities, older siblings are more likely to provide child care.

To date only a few studies – for example, Connelly, De Graph, and Levinson (1996), Wong and Levine (1992), Lokshin (1999) – have researched the relationship between child care and women's labor market activity in developing or transitional countries. Nearly all of these found that the price of child care has nontrivial effects on women's work patterns.

Present research aims at advancing the understanding of the interdependency of households' labor supply decisions, child care arrangements and schooling. We develop a simple theoretical framework of household utility maximization that yields empirically testable implications for the relationship between the price of child care and household behavior. We test these hypotheses by jointly estimating a system of reduced-form equations of the household demand for quality of child care, schooling for older boys and girls, and leisure of the mother and other household members.

The estimation results reveal that mothers' decisions to participate in the labor market are sensitive to wages and child care costs. Higher available wages encourage them to work outside of their homes, while high-cost child care suppresses maternal employment. Households' decisions to enroll young children to ECD programs are found to be quite sensitive to the cost of care: High-cost child care discourages use of ECD centers. Results also reveal that maternal wage rates and cost of

care for young children affect school enrollment of school-age children. The influence of wages available to the mothers on demand for schooling is expected through a combination of income and substitution effects. We show that the resulting effects differ for boys and girls. An increase in mothers' wage raises school participation of boys, e.g., income effect dominates the substitution effect. Higher mothers' wages, however, depress girls' school enrollment indicating that girls substitute mothers in home production. Higher prices for child care have no significant effect on boys' schooling and significantly decrease the number of girls at school.

The paper is organized as follows: Section 2 introduces the data, section 3 describes the system of early childhood development centers in Kenya and patterns of women's labor supply and presents descriptive statistics on the main outcomes of interest and their factors of influence. Sections 4 and 5, respectively, show the development of the theoretical model, give details of the empirical model, and discuss the conceptual issues involved in estimating a consistent model of household child care choice, schooling and labor supply. Section 6 presents and discusses estimation and simulation results. Section 7 concludes with a discussion of the findings and their implications for the policymaking.

2. Data

The data for this research come from two sources. The 1994 Kenya Welfare Monitoring Survey (WMS II) that provides information on 10,860 households (59,200 individuals), including about 6,624 households with children between ages three and seven. The survey is based on the multistage sampling framework drawn by the Kenya National Sample Survey and Evaluation Program and collected by the Central Bureau of Statistics and the Planning Unit of the Ministry of Planning and National Development.[3] The survey instruments include questions on household income and expenditures, employment and wages, education, health and child outcomes. These also yield data on the modes of child care arrangements, and formal child care expenditure. A drawback of the data

[3]WMS II was designed to cover the remote and low-density northen districts but had limited success in getting information in those areas. See Figure 1 for a map of population points where responses were solicited. For a fuller description of the sampling method see Dabalen (2000).

released for the present analysis is the unavailability of the urban-rural indicator. The most recent estimates indicate that 26 percent of the total population lived the urban areas in 1992 (The World Bank [1997]).

The Kenya Early Childhood Development Centers Survey (KECDCS) survey of child care facilities was commissioned by the World Bank and collected by the Kenyan Ministry of Education in 1995. The survey covered more than 800 child care facilities in 17 districts and urban centers in Kenya, representing urban, pastoralist, and other rural areas. KECDCS is based on a stratified random sample that represents centers from all types of sponsorship in the country. The survey instrument collected information on the center's location, enrollment, operating expenditures, financial status, and facilities for the last year. Data on the characteristics and salaries of teaching and non-teaching staff, the extent of turnover, and child feeding practices were collected. For more information about the sample selection procedure and descriptive statistics of the sample, see Mukui and Mwaniki (1995).

There is no direct way to match these two surveys. However, WMS II provides exact geographical coordinates for most households in the sample, and the addresses of the surveyed child care facilities were registered in KECDCS. The geographic coordinates of the towns in which the ECD centers are located were determined using a gazetteer maintained by the U.S. National Imagery and Mapping Agency.[4] The same source was used to identify the location of some of the households for which no location information was available in the survey. We identified the administrative district in which each household and ECD center is located by using a so-called point-in-polygon operation in a geographic information system.

3. Overview: patterns of female labor supply and ECD system

Nearly all women with small (3-7 years of age) children work, and more than half of them (53 percent) work for wages, according to the WMS II. Rural "for cash" female workers find

[4] The information is available at http://164.214.2.59/gns/html/index.html. The digital map of Kenyan districts that we used was produced by the International Livestock Research Institute in Nairobi, Kenya.

employment as casual laborers on the tea, coffee, sisal, and sugar plantations, as tenders of cash crops or food crops of their wealthier neighbors, and at the various rural enterprises. Urban low-skilled women earn cash as domestic servants, petty traders or small -scale retail traders. Women with more skills tend to be employed in garment making, sales, clerical work, teaching and health services (Stichter 1990). Clearly, some market activities are more relaxed about bringing children to work than the others. While it is quite possible that children accompany mothers while they do certain subsistence activities, (e.g., tendering their own food crops) or do house work, it is not usual for children to accompany mothers working as paid laborers or formal-sector workers.

We define labor market status based on individuals' earnings. Individuals who reported wage or salary earnings are classified as "working in cash occupations", henceforth *working* or *employed*. The employment rates of individuals from the different age gender groups by the presence of small children are presented in Table 1. The labor force participation rates of women with children are lower than they are for other population groups. Rates of male employment are significantly higher that the rates of female employment across all age groups. About 70 percent of men in 26-35 years age category work, compared with only 33 percent of women with children and in the same age category. The rate of market work declines with age among both men and women: 54 percent of all men and 25 percent of all women older than 46 years work outside home.

A household's decision about its members' labor supply is influenced by their productivity at home and in the labor market. Small children require care, and mother's productivity at home is in many cases higher than her potential return from outside work. Table 2 shows the proportion of *mothers working in cash occupations* by the number of children zero to six years old and by age of the mother. For all age groups the percentage of working mothers declines with the number of small children in the household. The employment rate of young mothers (age 18 to 25) is lower than the employment rate of the mothers from older age groups. Most economically active are 26- to 35-year-old mothers. Among them the rate of employment reaches 46 percent for women with one child, which is comparable to or higher than the proportion of working women with no children. In households with four or more children below age six, only about 25 percent of mothers work for a wage.

Other than the mother adult household members may participate in household production by substituting her as child care providers. Table 3 shows the probability of ECD centers participation across households with different number of elderly members. The data indicate that the more members of older age are present in the household, the less likely are the preschool-aged children to attends a center. Another alternative for the households to care for their children are ECD centers.

Typically, ECD centers provide day care and early education to children 3 to 7 years old. The first privately run preschools in Kenya appeared in the 1940s, catering exclusively to the European and Asian communities. Later, day care centers became established on coffee, tea, and sugar plantation and in urban centers. The expansion of preschools happened after independence in 1963. In the mid-1990s the majority of ECD centers in Kenya functioned as community-operated programs. The other types of early education and care centers were established and run by religious organizations, private individuals and companies, plantations, estates, NGOs, and local authorities. Altogether, they represent about 40 percent of all centers in the country.

An organized curriculum for Kenya ECD centers was not established until the late 1980s. By the mid-1990s, the central government assumed responsibility for training preschool teachers, supervising and inspecting preschool programs, and developing a locality-specific curriculum. All but the local government-run centers rely heavily on fees for paying their day-to-day operating expenses. The majority of ECD funds are spent on teacher salaries.

The prices charged by ECD programs vary considerably. Fees are not set nationally, but rather by village or urban dwelling parent-teacher associations. Fees vary depending on the quality of preschools. Centers that employ more educated teachers, have smaller classes, and provide food and other enhancing activities charge higher fees (Glinskaya and Garcia 1999). Land, buildings, furniture, and teaching and playing materials are donated by churches, local authorities, and parents themselves.

4. Theoretical model

The analysis applies to households with children 3-7 years of age. We assume that there are two forms of child care available to households in Kenya: *free* child care that can be provided by the

mother, by other adult household members, or provided by older siblings, and *paid* child care provided by ECD centers. For households with children and two parents, the husband is considered a potential provider of free child care. In a household with a single mother who has no relatives living with her, it is assumed that any informal child care is provided by children themselves or relatives who live outside the household.

The theoretical model used in this paper is based on the assumption that household members make choices about their consumption of child care quality, quality of children's schooling, market goods, and leisure. A household's decisions about the quality of child care and education for its children and about the amount of time each member of the household can work are motivated by the desire to achieve the highest level of household welfare.

The model is made tractable through a number of simplifying assumptions. *First*, it is assumed that children require continuous care. *Second*, the household structure and the number of children are assumed to be exogenous[5]. *Third,* it is assumed that household members derive utility from the quality of child care they choose. This utility is represented by the discounted value of a potential improvement in children resulting from a higher quality of child care or by the current utility of the family knowing that their children are in competent hands. *Fourth*, it is assumed that household members derive utility from the education of children of school age. This utility may be thought of as benefits that parents receive from well-educated children in the form of, for example, support in old age and the satisfaction of having educated children. *Fifth,* we assume that the total time available to children of school age can be divided into time spent caring for younger siblings and time spent on schooling. *Sixth*, it is assumed that mothers spend all their free time on child care – that is, the mother's leisure time equals the time she spends caring for children.

In the one-period utility maximization problem the household chooses its consumption of a Hicksian composite good G, the quality of child care Q, the quality of education S, the leisure time of the mother L_m, and the leisure time of other household members L_o subject to its budget and time

[5] This is a restrictive assumption. However, Blau and Robins (1988) and Conelly, et. al. (1997), showed that treating fertility decisions as endogenous does not change inferences about household child care modes and household members' labor force participation decisions.

constraints. The household utility function is assumed to be twice continuously differentiable and quasi-concave:

$$Max\ U = U(L_m, L_0, G, Q, S). \quad (1.1)$$

The total quality of child care Q is a function of the exogenous quality of the child care provided by the mother Q_m, the exogenous quality of care provided by siblings Q_s, the quality of child care purchased on the market Q_p, and the exogenous quality of child care provided by relatives Q_o:

$$Q = Q(Q_m, L_m, Q_p, Q_o, T_o, Q_s, T_s), \ \ such\ that\ Q' > 0\ and\ Q'' < 0 \quad (1.2)$$

where T_o is the time other household members spend on child care and T_s is the time that older siblings spend on child care.

The education production function is defined to be a continuous, twice continuously differentiable function S of the time children spend at school:

$$S = S(1 - T_s, \cdot), \ such\ that\ S' > 0\ and\ S'' < 0 \quad (1.3)$$

The budget constraint includes total household expenditures on child care as a function of the number of children in the household, the per-unit quality price of child care, the quality of formal care, and the time children spend in care:

$$G = E + W_m H_m + W_o H_o - N P_q Q_p (H_m - T_o - T_s), \quad (1.4)$$

where E is the exogenous nonwage household income, H_m is mother's time at work, H_o is the other household members' work time, N is the number of children ages three to seven years old in the household, P_q is the exogenous price per unit of quality of formal child care, W_m is the market wage available to the mother, W_o is the market wage available to the other household members, and the price of the composite good G is taken as a numeraire.

Finally, under the assumption that children require constant care, the model specifies the time constraints affecting the mother, the other household members, and the children:

$$L_m + H_m = L_o + H_o + T_o = S + T_s = 1 \quad (1.5)$$

$$H_m - T_o - T_s \geq 0 \quad (1.6)$$

$$0 \leq T_o, H_o, T_s, S, L_o, L_m, H_m \leq 1 \quad (1.7)$$

The household simultaneously solves its utility maximization problem for an optimal consumption of all goods that enter into the household utility function.

The structural form household demand equations can be derived from the first-order conditions (FOC) of the household utility maximization problem (1.1-1.7). Solving the FOC with respect to L_m, L_o, T_o, T_s and Q_p, the reduced-form demand system for child care and schooling, the mother's labor supply, and the labor supply of other household members can be derived as a function of the exogenous variables. The derived reduced-form demand functions are then:

$$\begin{aligned} H_m &= H_m(W_m, W_o, E, P_q, \cdot) \qquad Q = Q(W_m, W_o, E, P_q, \cdot) \\ S &= S(W_m, W_o, E, P_q, \cdot) \qquad H_o = H_o(W_m, W_o, E, P_q, \cdot) \end{aligned} \tag{1.8}$$

The next section develops an empirical model and discusses specifications for possible estimations of the household demand systems.

5. Empirical model and specifications

We specify a linear approximation of the system of household demand equations (1.8). They are (substituting H_m, Q, S, and H_o on four variables D_i^*'s):

$$D_i^* = \beta X + \alpha_1 \hat{P}_q + \alpha_{21} \hat{W}_m + \alpha_{22} \hat{W}_o + \varepsilon_i; \; i = 1..4, \tag{2.1}$$

where X is a vector of explanatory variables, β and α's are vectors of parameters, and ϵ_i is an equation-specific disturbance. We separate wages and child care price from other explanatory variables in equation (2.1) because we use predicted values (hat on the top) for these variables obtained from the different estimations.

The error terms ϵ_i of equation (2.1) are likely to be correlated. Examples of such correlation may be the unobserved presence of mothers' siblings in the area of residence or the existence of neighbor-help groups, that while uncorrelated with the explanatory variables, can have an effect on all outcomes of interest. Unobservable taste for education may influence both household decision for schooling and for the participation in the ECD programs.

In the data we do not observe actual household demand. What we do observe are the binary indicators (demand index functions) that correspond to the latent demand variables and are in the form:

$$\begin{aligned} D_i &= 1 \;\; if \;\; D_i^* > 0 \\ D_i &= 0 \; otherwise, \qquad i = 1..4 \end{aligned} \tag{2.2}$$

There are several options for estimating the system of equations (2.2). These range from ordinary least squares to estimating the fully simultaneous system of equations when each equation in the system includes as explanatory variables the dependent variables from the other three equations. The first two methods we describe below fall into a category of unconditional demand estimators, as they estimate demand for every good unconditional on other choices, while the last method estimates a conditional household demand system.

The simplest estimations of the demand system can be obtained by using binary technique – for example, a linear probability model or binary probit estimation. However, this method imposes an assumption of independence of the error terms between the system of equations (2.1). The coefficients estimated by four independent probits will be unbiased but inefficient in a general case.

It is possible to estimate the household demand system by specifying a joint distribution of the error terms in (2.1). For example, under an assumption of joint normality of the distribution of error terms, the system of equations (2.1) can be estimated by Full Information Maximum Likelihood.

Finally, the structural form of the household demand system can be estimated as a system of simultaneous equations, a so-called conditional demand system. This approach, however, presents two major problems. First, it is very hard to find and to justify a choice of identifying variables. Second, in the case of the fully simultaneous system of equations with binary dependent variables, there exists a problem of logical consistency (see, for example, Maddala 1983, p. 214) that makes it impossible to estimate this system of equations without imposing restrictive assumptions that may have no economic interpretation.

Thus, the best estimation method in this situation is the estimation of the reduced-form household demand system under an assumption that all error terms in equations (2.2) are correlated. For estimation we use the Semi-Parametric Full Information Maximum Likelihood (SPFIML) method developed by Laird (1978), and Heckman and Singer (1984), and applied to simultaneous equations by Mroz and Guilkey (1992), and Mroz (1999). The method allows us to estimate the system of simultaneous binary equations without specifying an exact functional form of the joint distribution of the error terms ϵ_i and approximating these distribution non-parametrically. The

method should provide more efficient estimators than FIML in a general case and is far less computationally expensive.

To account for possible error correlations we impose a factor structure on the disturbances in equations (2.1):

$$\varepsilon_i^j = \mu_i^j + \rho_1^j V_{1i} + \rho_2^j V_{2i} + \rho_3^j V_{3i}; \quad i = 1...N, \; j = 1...4 \tag{2.3}$$

where i is a household index, j is an equation index, N is a total number of observations, μ^j_i is an independent extreme value error. V_1, V_2, and V_3 are common factors among the equations. These factors are unobservable variables that influence the choices made by households and that are uncorrelated with the explanatory variables. ρ^j_1, ρ^j_2, and ρ^j_3, are factor loadings that represent the effect of a given factor in each equation. We introduce a three-factor structure for a system of four equations to account in the most unrestricted form for the possible sources of heterogeneity in the disturbances (Anderson and Rubin 1956).

We assume that the distributions of the v's in equations (2.2) may be approximated by the following step functions:

$$\Pr(V_1 = v_{1k}) = P_k, \; P_k \geq 0 \; and \; \sum_{k=1}^{K} P_k = 1 \tag{2.4}$$

$$\Pr(V_2 = v_{2l}) = P_l, \; P_l \geq 0 \; and \; \sum_{l=1}^{L} P_l = 1 \tag{2.5}$$

$$\Pr(V_3 = v_{3m}) = P_m, \; P_m \geq 0 \; and \; \sum_{m=1}^{M} P_m = 1 \tag{2.6}$$

where v's are the points of support in the distribution of the factors, P's are the probabilities that the factors take value v, and K, L, and M are the numbers of points of support of the distribution of each factor.

Then the likelihood function describing the mother's labor force participation decision, younger children's child care mode, older children's school participation, and other household members' work decisions is given by:

$$\Im = \sum_{i=1}^{N} Log\left\langle \sum_{k=1}^{K} P_k \left[\sum_{l=1}^{L} P_l \left\{ \sum_{m=1}^{M} P_m \left(\prod_{g=1}^{4} PR^g(x^g b^g \mid v_k, v_l, v_m) \right) \right\} \right] \right\rangle \tag{2.5}$$

where the probability terms, denoted by $PR^z(.)$, are the cumulative distribution functions for every demand index function conditional on the common factors, and N is the total number of observations in the sample.

Choosing a priori numbers of points of support K, L, and M, the log-likelihood function $\Im$ is maximized over β's, ρ's, P's, and v's. For identification purposes, the two points of support for both factors are normalized to equal 0 and 1, respectively.[6] The number of points of support is increased until the difference in the log-likelihoods of consequent maximizations satisfies the convergence criteria. The variance-covariance matrix Θ of the estimated coefficients in the model (2.1-2.2) is estimated by approximating the asymptotic covariance matrix by so-called "sandwich" estimator (see, for example, Davidson and MacKinnon 1993, 263).

Dependent variables

Summary statistics of binary outcomes in the system (2.1) are presented in Table 4. These statistics are calculated for the sample of households where small children are present. The definition of these variables is as follows.

Mother's work status: A household where a female who is the mother of preschool-aged children reported receiving cash earnings is defined as the one with a working mother. More than half of all households with small children have working mothers.

Use of child care facilities: A household where at least one out of the children aged three-to-six years is attending an ECD center is classified as a household that uses paid child care facilities. About 18 percent of households use child care facilities as a form of day care for their children.

School participation: The indicator dummy variable is equal to 1 for the households where all children of a school age are at school; otherwise this dummy variable is equal to 0. About a quarter of Kenyan households have at least one school-age child not in school.

Work status of the other household members: A household is classified as having "other working household members" if at least one adult reported working for cash. Seventy-five percent

[6] The functional forms for the normalization of probability weights, the points of support for the likelihood function (7) and a description of the convergence criterion are given in the Appendix.

of households are classified as households with working "other members" according to this definition.

Explanatory variables

The definitions and descriptive statistics for the explanatory variables in the system of equations (2.2) are presented in Table 4. Several key variables of interest are discussed in detail below.

Price per quality unit of child care (P_q): We identify the effect of child care prices on household behavior through district-level differences in these prices. There are two main sources of information about the child care prices. First, on the household level, information about total household expenditures on child care for the last month is available from the WMS II. Second, fees charged by day care facilities were reported in the facility questionnaire collected in KECDCS.

Ideally, we would like to have child care prices from the ECD centers that are in the choice set of every household. Neither source of prices provides us with such information. The household expenditure on child care is endogenous to the child care prices and represents the price in only one child care facility, chosen by the household. The child care facility survey clearly does not cover all ECD centers in a particular area, and only about 75 percent of the district surveyed by the household survey is covered by the facility survey. In this research we use both approaches to child care price estimation and compare the results based on the different measures.

Estimating care prices from the household expenditures on child care, we, following Blau and Robins (1988), Blau and Hagy (1998) assume that the price per unit of quality of child care is uniform within a district and use the average district-specific household expenditure as a proxy for the child care price. The average household expenditures on child care are calculated for 43 districts in Kenya with an average of 150 households in the district.

To calculate the price of care based on the information on centers' fees, we estimate the quality-adjusted price of outside-home care using the method suggested by Blau and Hagy (1998). KECDCS collected extensive information about the characteristics of the child care provided and the fees charged. These data are used to estimate a model of fees for formal child care facilities. The

quality-adjusted price of an hour of child care is determined by a location-specific hedonic price equation:

$$P_i = \pi_k + \beta x_i + \varepsilon_i$$

where P_i is the price of the formal care at the ECD center, x_i is a vector of variables that represents the characteristics of the facility, β is a vector of coefficients, ϵ_i is an error term. In that specification π_k can be interpreted as a market-specific, quality-adjusted, hourly price of ECD program in the location k.

We use the quality-adjusted price of care to compare the effects of price on household behavior for facilities that offer different quality of care. For example, suppose one facility offers several developmental programs and has a low teacher-child ratio. In other words, that facility provides a high quality of child care but charges a relatively high price for its services. The other institution does not offer such high quality of care, and the price it charges is low. Directly comparing the prices of these two facilities is not possible because these prices are charged for different services. The methodology suggested above allows us to adjust prices for differences in the quality of provided care and thus makes these quality-adjusted prices comparable.

Mother's offered wage (W_m): The wage rates available to each mother have been imputed using Mincer's (Mincer and Polachek 1974) type earning function regression with a control for selectivity.[7] We use the SPFIML approach described above as an alternative to the standard Heckman correction procedure. This semi-parametric method allows us to relax an assumption of joint normality of the error term of regression and selection equations. The method is applied to a subsample of women working in cash occupations. Monthly earnings have been calculated as a ratio of the reported women's earnings and the number of months she worked during the period of time for which she chose to report her earnings. If a woman, for example, reported her earnings for a week, these were adjusted to a monthly basis.

In the wage regression, the following explanatory variables have been used to predict mothers' monthly earnings: the mother's educational level, her age, the number of children she had

[7] Regression coefficients for the wage equations are shown in Appendix. For identification in the selection equation we use lagged district-specific unemployment rates and the lagged proportions of the population out of the labor force, calculated from the 1992 Kenya Welfare Monitoring Survey.

(as a proxy for work experience), her marital status, and the number of year she spent in her current main job. Imputations are made based on the women's predicted monthly earnings with the job tenure of nonworking mothers being equal to zero. Here the offered wage is assumed to be a wage that a mother could earn if she were to start a new job.

Offered wages of other household members (W_o): The wage rates available to other household members are calculated similarly to the wage rates available to mothers. Different regressions were run to predict wages for household members of different ages and genders. After the imputations, two methods were used to obtain the wage W_o. Under the first specification the offered wage of other household members is equal to the lowest potential wage that can be earned by any household member except the mother. The second specification uses the average potential wage that can be earned by adult household members except the mother as an explanatory variable in the model.

Nonwage household income (I_a, I_n) : We distinguish between agricultural and non-agricultural incomes. The first measure includes income from sales of grains and other agricultural produce, and the second one includes income from business activities, pensions, other transfers, and the other incidental income.

Other explanatory variables include the mother's age and her level of education, household size and demographic composition, and the number of children from various age groups, as well as the average level of wages in the district.

6. Results and simulations

The results of the estimation of the system of simultaneous equations (2.2) by SPFIML are presented for the specification with three points of support for each of the three common factors in the model. Further increasing the numbers of points of support did not significantly increase the value of the likelihood function. The estimated coefficients are shown for the model estimated with and without adjusting for unobservable heterogeneity and correlation of the error terms. The estimation of the model without adjusting for a possible correlation in the error terms between equations (2.2) is essentially a joint yet independent estimation of four probits.

The equation for the older children's schooling in both SPFIML and independent probits cases is estimated only for the sample of households that have school-age children. The contribution to the likelihood function from this equation for the households with no school-age children is set equal to unity when four equations are estimated simultaneously, and households without school-age children are excluded from the estimation in the case of independent probits.

Tables 5(a) and 5(b) present the estimated coefficients for the specification of the model (2.2) where we use the average local household expenditure on child care as a proxy for the price of child care. According to the likelihood-ratio test criterion, the independent specification is rejected in favor of the SPFIML estimation.

Both SPFIML and independent probits estimations show that the price of care has a negative effect on maternal employment. The higher the potential market wage rate of the mother, the more likely the mother will participate in the labor force. Mothers from single-parent households, younger mothers, and mothers from households where the education of the head is higher are more likely to work.

The results of the estimation indicate that a high price of care decreases the probability that the household will use outside-home care. Households where the mother has a higher market wage rate are significantly more likely to use paid care. The number of children in a household is negatively related to the household's likelihood of using ECD centers. Here, one explanation could be the existence of some economy of scale based on the number of children that increases the productivity of other household members at home. In other words, once someone is taking care of one child, they can take care of two, whereas if the household put these children in a child care center it would have to pay double the price. An important finding is that the presence of older children has a significant negative effect on the paid care use. This fact may support the hypothesis that older children act as substitutes for the mother in home production and particularly in child care.

The probability that school-age children attend school is negatively and significantly related to the price of day care. Higher wage rates for mothers have a positive, although statistically insignificant, effect on the likelihood of children's attending school. The presence of children younger than two years of age in the household and the presence of siblings of school age also

decrease the probability that children are at school. A higher level of education of the household head and education of the mother have a positive effect on children's school attendance.

The estimation of the model in which we approximate costs of child care through quality-adjusted prices in the locality is shown in Table A1 in Appendix (the calculation of the quality-adjusted prices is done using the hedonic regression method described above). The estimated coefficients of this specification are less precise than the coefficients estimated by the first method. One explanation for this may be the fact that we managed to merge only about half of our household sample – 3,846 observations out of 6,645 in the whole sample – with the information from the child care facility survey. The households that were matched with the child care facilities were located in urban areas of Kenya, and some selection bias may exist in the estimation results. For that reason we based our simulations in the next section on the first specification.

Nevertheless, the behavior of the main variables of interest in this model confirms the predictions of the model based on the average local household expenditure on child care. Mothers with higher potential market wages are more likely to work. The effect of wages on maternal employment is significant. Higher costs of child care prevent mothers from working outside the home, decrease the probability that school-age children attend school, and decrease the probability that small children attend preschool.

Simulations

To examine the effects of the estimates summarized above on the model (2.2), we simulate how households would respond to changes in the specific parameters used in the model. In a given simulation, a certain value of the variable of interest is assigned to all the households in the sample[8]. The simulated probabilities are generated for each household by integrating over the estimated heterogeneity distribution and averaging the probabilities across the sample. Next, the value of the variable of interest is changed, and this changed value is assigned to the entire sample of households.

[8] For that reason the proportion of the households in the "Base line" category that is used in the following tables is not the equal in the different simulations.

Then the new set of simulated probabilities is generated. The effect of the changes in the particular parameter is calculated as the difference in these simulated probabilities.

The results of SPFIML simulations[9] of the effects of the main variables of interest on household behavior are shown in Table 6. A 10 percent increase in the mother's potential wage rate would encourage mothers to work. The proportion of households with working mothers would increase from 53.1 percent to 62.3 percent, which corresponds to an elasticity of mother labor supply with respect to the market wage of 1.48. This elasticity measures the responsiveness of mother's switching from non-paid work to paid work. According to WMS II all prime-aged women participated *in the work activities*, and only those who worked for wage were classified as participating *in the labor market*. Such high labor supply elasticity is not unusual for Africa. Dabalen (2000a) reports the elasticity of women's labor supply with respect to the market wage close to one in South Africa.

This increase in wages has a strong effect on children's attendance in paid child care facilities. The proportion of households using preschool facilities would rise by 7.7 percent, indicating that households treat child care as a "normal good" and increase child care consumption with an increase in income. School participation is also positively correlated with mothers' wages. A 10 percent increase in wages would result in about a 3 percent increase in the proportion of households that send all of their school-age children to school. Changes in the market wages of women with children have a rather small effect on the labor supply of other household members.

The simulated effect of a 10 percent increase in the cost of child care is consistent with the predictions of the theory. Maternal rates of labor force participation would fall, small children's attendance in paid child care would decline, and the percentage of households with children at school would also drop. The effect of an increase in child care cost on other household members' labor supply is small.

It is informative to simulate a policy of fully subsidized child care. The results of simulation are shown in the bottom part of Table 6. Free child care would result in a fourfold increase in the use

[9] The results of the simulations based on the independent probit estimations are shown in Table A2 in the Appendix.

of ECD center facilities by Kenyan households with children [10]. This high elasticity suggests that households in Kenya are quite sensitive to the costs of care and that policies that affect child care costs can have a pronounced impact on household behavior.

An increase in the wage rates of household members other than the mother has a strong effect on their level of labor force participation. In 10.4 percent of households, other household members would enter the labor market. This increase in wages positively affects the use of child care facilities, although that effect is small compared with changes in mothers' wages or in costs of care. The percentage of households in which all the school-age children attend school would also increase.

Simulating the effect of household characteristics on the household behavior (Table 7) reveals that an increase in household non-wage income does not significantly affect the level of mothers' employment and participation of children in ECD. Income effect on school enrolment is non-trivial with the implied elasticity of 0.02. This estimate is on the lower bound of the estimates of the association between schooling and income in the 21 countries from 42 studies surveyed in Berhman and Knowles (1999) who found a median elasticity of 0.07. Single mothers are more likely to work than married women with children. According to the model, about 65 percent of single mothers participate in the labor force compared with 51.3 percent of married mothers. Households headed by a single mother are more likely to use ECD facilities and have lower rates of children's school enrollment. We also found that the educational level attained by the household head positively influences mothers' labor force participation, the use of outside home child care facilities, and children's school attendance. Mothers in larger households are less likely to work, larger households are more likely to use child care facilities, and the level of school enrollment among school-age children is higher in such households.

[10]Children's enrolment to ECD centers appears to be quite responsive to the cost of ECD. While we don't know of any studies that calculated comparable elasticities in Kenya, or in any other African country, the results from Uganda's National Commitment to Basic Education project (World Bank 2000) indicate that when free schooling was introduced in Uganda in 1997, primary school enrollment immediately doubled from 2.6 to 5.2 million children and reached 6.5 million in 1999. This result corresponds to elasticities comparable to those found in this paper.

Gender differences in children's school enrollment

The model and estimations we presented above allow us to analyze gender differences in households' demand for education. The heterogeneity in the household approach to school investment in girls and boys may mask the results presented above. To test how differently various parameters affect the schooling of children of different genders, we re-estimate our model of household demand separately for girls and for boys. For these estimations we create two new binary variables equal to 1 if all school-age girls (boys) in the household are in school and equal to 0 otherwise. We estimate the school enrollment equation simultaneously with other three demand equations in the system on the whole sample of households with small children, but the contribution of the schooling equation to the likelihood function is different from unity only for observations of households with school-age girls (boys). The simulated probabilities of school enrollment are shown in Table 8.[11]

There are striking differences in the effects of increased maternal wages and costs of child care on the school enrollment of boys and girls. While a 10 percent increase in mothers' wages *reduces* girls' enrollment by 8.8 percent (elasticity of -1.5), that increase in wages actually *raises* the school attendance of boys by 11 percent (elasticity of 1.27). These results may be driven by different interactions of income and substitution effects in households' decisions about girls' and boys' schooling. Higher wages for the mother would increase household income and induce the household to consume more schooling for its children. At the same time higher wages would make the time the mother spends at home more expensive, and the household may decide to substitute for the mother in some home production activities by relying on other household members. For boys the income effect clearly dominates the substitution effect. Higher wages of the mother increase boys' school enrolment. For girls the situation is the opposite. In response to an increase in mothers' wages, households would replace mothers with adolescent girls in home production activities, and girls' school enrollment would drop.

The effect of an increase in the cost of care confirms this hypothesis. A 10 percent increase in child care costs drops girls' school attendance rate by 3.3 percent whereas the effect of such an

[11] The estimated coefficients for these separate estimation for boys and girls are available from the authors.

increase on boys' school enrollment is insignificant. Higher costs of care would lower the household demand for paid care. To care for its small children, the household may either reduce the labor supply of the mother or use other household members as child care providers. As we can see from the simulation, the household decides to sacrifice girls' schooling and employ them in home production to allow the mother to work for wages. We observe no such effect in the case of school-age boys. Again, as in the case of a change in maternal wage rates, the effect of the changes in child care costs for all children's school enrollment results from a combination of the decline in enrollment for girls and the slight increase in school enrollment for boys.

Some caveats should be kept in mind while interpreting the findings of this paper. The above results were obtained under the partial equilibrium assumptions. The elasticities of women's employment and children's attendance to ECD programs found in Kenya may be too high and the actual response of the market could be quite different from the results presented in the paper if the ECD centers' occupancy and women's employment constraints are taken into account. It is not clear whether the labor markets could absorb such a large influx of women without a corresponding drop in women's wages or whether the existing ECD centers could accept many new children without changes in price or quality of care. On the other hand, when child care subsidies lead to increased demand for paid care, this can also result in the increase in the demand for the labor of prime age women, as most of the staff in the child care facilities are women. The research done in a general equilibrium framework would facilitate the understanding the actual responses of the economy on various government policies.

7. Conclusions

These estimations of household demand system confirm predictions of the theoretical model developed in this paper. We found that economic incentives have a powerful effect on the work behavior of women with children in Kenya. The level of wages available to them and the costs of child care can be expected to affect women's labor force participation. Child care costs affect which child care arrangements households choose. High costs of ECD programs discourage households

from using outside arrangements for their preschoolers and increases the number of households that rely on home-provided care. High child care costs were also found to have a negative effect on the level of maternal employment.

Both, the cost of care and the level of wages available to the mother, affect older children's school enrollment. However, these factors have different effects on boys' and girls' schooling. Whereas an increase in mothers' wages raises the school participation of boys, it depresses the school enrollment of girls. Higher prices of child care have no significant effect on boys' schooling and significantly decrease the girls' probability of being at school.

We found that the single mothers are more likely to work than married women with children. Households with single mothers rely more often on paid child care, and such households would be the most affected by changes in child care costs.

Changes in household nonwage income have no significant effect on the level of mothers' labor force participation or on the use of outside-home child care facilities. From this result we can conclude that non-targeted subsidies to households with children would be less effective than other policies in increasing levels of maternal employment, school enrollment, and small children's participation in ECD programs.

Government subsidies for child care may increase the number of mothers who work, thus increasing the incomes of poor households and lifting some families out of poverty. They would also have a positive effect on the school participation of older girls in the household.

The results of this study clearly indicate that in addition to increasing the future productivity of children, low-cost ECD programs would likely produce the twin effects of releasing the mothers' time for market work and allowing older girl siblings to participate in school. Thus, well-targeted ECD programs may be seen as optimal economic investments that affect both the current and future welfare of households with small children.

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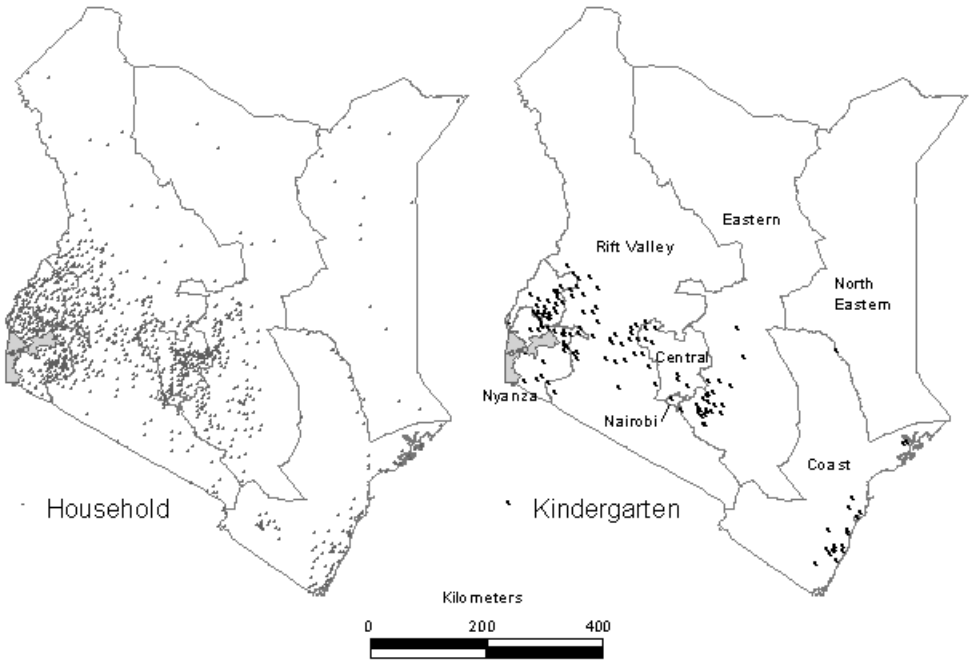
Household
Kindergarten
Eastern
Rift Valley
North
Eastern
Central
Nyanza
Nairobi
Coast
Kilometers
0
200
400

Table 1: Rates of labor force participation of various age-gender groups

Age group	Women with children	Women with no children	Women total	Men
18-25	0.27	0.20	0.23	0.28
26-35	0.33	0.44	0.35	0.70
36-45	0.30	0.36	0.31	0.68
46+	0.25	0.25	0.25	0.54
Total	0.30	0.26	0.28	0.53

Table 2: Percent of working mothers, by number of small children in the household

Number of children 0-6 years old	Age of the mother in years			
	18-25	26-35	36-45	46 +
1	29	46	34	28
2	27	32	30	22
3	24	27	24	21
4+	29	27	24	18

Table3: Probability of small children attending ECD center, by the number of elderly in the household

Number of elderly persons	Total	Boys	Girls
0	0.12	0.12	0.12
1	0.10	0.10	0.10
2	0.09	0.04	0.13
3+	0.08	0.03	0.06

Table 4: Summary statistics for the dependent and explanatory variables.

	Mean	STD		Mean	STD
Dependent variables			***Explanatory variables***		
Mother's work status	0.53	*binary*	Nuclear family and other relatives	0.05	*binary*
Younger children in ECD center	0.18	*binary*	Other types of households with children	0.07	*binary*
All children 8-16 years old are in school[1)]	0.64	*binary*	Agricultural income	5.75	*4.27*
All girls 8-16 years old are in school [2)]	0.68	*binary*	Nonagricultural income	6.88	*2.30*
All boys 8-16 years old are in school [3)]	0.71	*binary*	*Characteristics of the head*		
Other household members' work status	0.75	*binary*	Age of household head	41.36	*12.27*
Explanatory variables			Age of household head squared/100	18.60	*11.85*
Log of mother's wage	6.62	*0.35*	Gender of household head	0.80	*binary*
Log of other household members' wage	6.48	*2.13*	Education of the household head	0.02	*0.13*
Log of average expenditure on child care	2.45	*1.90*	*Characteristics of the mother*		
Log of quality-adjusted cost of care	2.18	*2.25*	Mother's age	32.15	*8.68*
Lagged average wage per locality	6.87	*0.47*	Mother's age squared/100	11.08	*63.95*
Household characteristics			Preschool education	0.01	*binary*
Total household size	6.84	*2.81*	Standard 1-8 (below CPE)	0.28	*binary*
Number of children 0-2 years old	0.70	*0.67*	Cert. of primary education (CPE)	0.15	*binary*
Number of children 3-5 years old	0.96	*0.65*	Junior sec. ed. (Form 1-4)	0.10	*binary*
Number of children 6-7 years old	0.72	*0.65*	Cert. of secondary ed. (KCSE)	0.07	*binary*
Number of children 8-12 years old	1.20	*1.12*	Trade test certificate	0.01	*binary*
Number of children 13-16 years old	0.63	*0.88*	Other postsecondary ed.	0.01	*binary*
Share of adult males in the household	0.16	*0.10*	University and above	0.00	*binary*
Share of adult females in the household	0.22	*0.09*	No education	0.37	*binary*
Share of elderly persons in the household	0.01	*0.05*			

[1)] Average is calculated on a sample of households with children age 8-16.
[2)] Average is calculated on a sample of households with girls age 8-16.
[3)] Average is calculated on a sample of households with boys age 8-16.

Table 5(a): Independent estimation of the system of household demand equations (probits)

	Mother's work status		Children in ECD centers		Children at school		Other household members' work	
	Coeff.	**Std. err.**	**Coeff.**	**Std. err.**	**Coeff.**	**Std. err.**	**Coeff.**	**Std. err.**
Log of mother's wage	3.936**	*1.831*	4.627**	*0.905*	0.788	*2.140*	-0.685	*0.978*
Log of other's wage	0.234	*0.167*	0.164	*0.437*	0.290	*0.185*	2.574***	*0.210*
Log expenditure on care	-0.529**	*0.299*	-2.869***	*0.821*	-1.446***	*0.333*	-0.074	*0.367*
Household characteristics								
Household size	-0.594	*1.366*	6.431*	*0.989*	3.866	*4.226*	2.035	*1.403*
Number of children 0-2	0.028	*0.390*	-1.374***	*0.064*	-1.221*	*0.779*	1.284*	*0.711*
# children 3-5	0.691	*0.440*	-0.431	*0.985*	-0.313	*1.062*	0.815	*0.843*
# of children 6-7	-0.009	*0.478*	3.022***	*0.064*	-0.251	*1.032*	-1.072	*0.807*
# of children 8-12	-0.109	*0.296*	-1.450**	*0.627*	-1.852**	*0.714*	-0.304	*0.620*
# of children 13-16	0.121	*0.309*	-1.393**	*0.060*	-2.468***	*0.716*	-0.082	*0.769*
Share of adult males	-0.091	*0.361*	-1.354***	*0.512*	-0.389	*0.687*	0.704	*0.459*
Share of adult females	0.042	*0.350*	-1.211***	*0.462*	0.073	*0.682*	0.505	*0.496*
Share of elderly	-0.245	*0.622*	-0.950	*0.952*	-0.395	*0.899*	0.830	*0.823*
Share of children				*Reference*				
Single-mother household	0.419***	*0.129*	0.059	*0.550*	-0.029	*0.150*	-1.060***	*0.148*
Single-mother and other	0.361**	*0.159*	0.089	*0.590*	0.002	*0.202*	-1.131***	*0.172*
Nuclear family household				*Reference*				
Nuclear family and other	0.091	*0.081*	0.170*	*0.112*	-0.012	*0.100*	0.342***	*0.119*
Other types of households	0.093	*0.099*	0.009	*0.303*	0.028	*0.140*	0.271**	*0.147*
Nonwage household income	0.223	*1.020*	1.000	*1.000*	2.308	*3.122*	9.560**	*3.303*
Nonwage household income	1.849	*1.023*	1.974	*1.000*	1.848	*1.315*	0.641	*1.026*
Age of household head	-1.518	*1.020*	-1.741	*0.794*	-0.580	*1.328*	2.262**	*0.747*
Age of head squared*100	1.038	*1.037*	0.730	*0.811*	0.455	*1.324*	-3.261**	*0.728*
Gender of household head	-0.388***	*0.095*	0.017	*0.379*	-0.193*	*0.121*	0.037	*0.130*
Education of household head	3.282***	*0.604*	2.203**	*0.982*	6.376***	*0.727*	3.278	*0.761*
Characteristics of the mother								
Mother's age	0.723***	*0.169*	2.391	*0.885*	4.722	*2.201*	0.018	*0.764*
Mother's age squared*100	-0.803	*0.212*	-1.631	*0.944*	-3.810	*2.718*	1.295	*0.936*
No formal education				*Reference*				
Preschool education	0.265	*0.215*	0.463*	*0.996*	0.924****	*0.268*	0.006	*0.276*
Standard 1-8	0.063	*0.088*	0.105	*0.084*	0.621***	*0.106*	0.182	*0.074*
Cert. of primary education	0.188***	*0.096*	0.169	*0.097*	0.815***	*0.119*	0.363**	*0.190*
Junior secondary education	0.235	*0.145*	0.013	*0.118*	0.815***	*0.176*	0.457***	*0.204*
Cert. of secondary education	-0.009	*0.205*	-0.039	*0.145*	0.331	*0.245*	0.382**	*0.154*
Trade test certificate	-0.163	*0.351*	-0.361	*0.994*	0.316	*0.452*	0.174	*0.439*
Other postsecondary educ.	0.402	*0.325*	-0.235	*0.249*	0.346	*0.390*	0.488	*0.328*
University and above	-0.426	*0.510*	-1.177	*0.999*	0.338	*0.698*	0.010	*0.545*
Mean salary in the district	-3.837***	*0.383*	4.641***	*0.725*	3.442***	*0.453*	0.143	*0.475*
Constant	-0.716	*0.988*	-5.511	*0.771*	-2.847**	*1.229*	-1.671	*0.632*
N [Log Likelihood]	6645 [-4235.60]		4735 [-2157.66]		6645 [-2843.89]		6645 [-2440.96]	

Note: Average per locality household expenditure on child care is used as a proxy for cost of child care.

Table 5(b): Simultaneous estimation of the system of household demand equations

	Mother's work status		Children in ECD centers		Children at school		Other household members' work	
	Coeff.	**Std. err.**	**Coeff.**	**Std. err.**	**Coeff.**	**Std. err.**	**Coeff.**	**Std. err.**
Log of mother's wage	7.637**	*3.344*	4.936**	*1.655*	3.118	*5.411*	-0.096	*3.199*
Log of other's wage	0.403	*0.281*	0.193	*0.194*	0.221	*0.335*	8.006***	*1.304*
Cost of child care	-0.886*	*0.536*	-3.229***	*0.401*	-1.721**	*0.613*	0.065	*0.472*
Household characteristics								
Household size	-0.955	*5.119*	7.824**	*3.657*	9.805	*8.025*	5.754	*4.905*
Number of children 0-2	-0.079	*1.004*	-1.623**	*0.700*	-2.294**	*1.389*	1.527*	*0.939*
# children 3-5	1.137	*1.004*	-0.567	*0.674*	-1.075	*1.343*	1.008	*0.907*
# of children 6-7	-0.036	*1.000*	3.242***	*0.691*	-0.662	*1.377*	-1.544*	*0.935*
# of children 8-12	-0.223	*0.895*	-1.700**	*0.632*	-3.812**	*1.365*	-0.538	*0.860*
# of children 13-16	0.075	*0.904*	-1.659**	*0.654*	-4.197***	*1.296*	-0.207	*0.865*
Share of adult males	-0.172	*0.774*	-1.557**	*0.569*	-0.404	*1.218*	1.054	*0.726*
Share of adult females	-0.007	*0.713*	-1.436**	*0.511*	-0.441	*1.185*	1.274*	*0.687*
Share of elderly	-0.829	*1.107*	-1.100	*0.829*	0.015	*1.734*	1.781*	*0.994*
Share of children				*Reference*				
Single mother household	0.696***	*0.234*	0.070	*0.168*	-0.230	*0.262*	-1.628***	*0.220*
Single mother and other	0.507**	*0.284*	0.116	*0.200*	-0.339	*0.338*	-1.708***	*0.256*
Nuclear family household				*Reference*				
Nuclear family and other	0.167	*0.151*	0.200**	*0.097*	-0.082	*0.165*	0.479***	*0.150*
Other types of households	0.187	*0.187*	0.016	*0.134*	-0.113	*0.205*	0.394**	*0.166*
Nonwage household income	0.065	*2.205*	1.262	*1.811*	10.288*	*6.604*	8.905**	*4.711*
Nonwage household income	2.750	*3.724*	2.179	*2.155*	6.739*	*3.256*	-0.046	*3.010*
Age of household head	-3.187*	*2.044*	-2.053	*1.399*	-0.607	*2.234*	1.680	*1.710*
Age of head squared*100	2.350	*2.011*	0.906	*1.461*	0.042	*2.159*	-3.333**	*1.747*
Gender of household head	-0.845***	*0.224*	0.015	*0.131*	-0.441**	*0.214*	-0.022	*0.160*
Education of household head	6.277***	*1.378*	2.452***	*0.814*	12.254***	*1.772*	1.571	*1.324*
Characteristics of the mother								
Mother's age	1.404***	*0.377*	2.937	*2.148*	3.260	*4.476*	1.867	*2.760*
Mother's age squared	-1.564***	*0.459*	-2.144	*2.719*	-0.795	*5.409*	-0.684	*3.470*
No formal education				*Reference*				
Preschool education	0.493	*0.391*	0.539**	*0.277*	1.820**	*0.605*	-0.003	*0.340*
Standard 1-8	0.090	*0.157*	0.120	*0.092*	1.106***	*0.297*	0.248	*0.159*
Cert. of primary education	0.372**	*0.179*	0.197**	*0.102*	1.515***	*0.328*	0.495***	*0.177*
Junior secondary education	0.469*	*0.268*	0.018	*0.145*	1.474**	*0.506*	0.570**	*0.262*
Cert. of secondary education	0.039	*0.356*	-0.014	*0.196*	0.624	*0.612*	0.436	*0.375*
Trade test certificate	-0.447	*0.628*	-0.386	*0.373*	0.356	*1.004*	0.010	*0.607*
Other postsecondary educ.	0.710	*0.548*	-0.231	*0.311*	1.151	*0.904*	0.609	*0.620*
University and above	-0.747	*0.925*	-1.275**	*0.565*	1.068	*1.725*	-0.318	*0.869*
Mean salary in the district	-3.061***	*1.010*	5.470***	*0.598*	8.411***	*1.487*	-0.256	*0.633*
Constant	0.104	*1.854*	-6.137***	*1.033*	-10.744***	*3.200*	0.832	*1.863*
N [Log Likelihood]	6645 [-11327.74]							

Note: Average per locality household expenditure on child care is used as a proxy for cost of child care.

Table 6: Simulation of the effects of various policies on the household behavior (SPFIML estimation)

		Simulated probability			
Increase by 10%		Mother's work status	Children in ECD centers	Children at school	Other household members' work
Mother's wage rate	Baseline	53.1(*)	17.2(*)	64.3	75.5
	Baseline + 10%	62.3(*)	24.9(*)	67.3	76.4
Elasticity		*1.48*	*3.09*	*0.45*	*0.12*
Cost of child care	Baseline	52.9(*)	17.7(*)	63.5(*)	75.5
	Baseline + 10%	51.1(*)	13.6(*)	61.3(*)	75.6
Elasticity		*-0.35*	*-3.01*	*-0.36*	*0.01*
Cost of child care	Baseline	52.9	17.8	63.5	75.5
	Fully subsidized	63.2	78.7	77.5	74.9
Other household members' wage	Baseline	52.9	17.7	63.8(*)	70.5(*)
	Baseline + 10%	53.3	17.9	64.1(*)	80.4(*)
Elasticity		*0.08*	*0.11*	*0.05*	*1.23*

Note: (*) means that the corresponding estimated coefficient is significant with at least 90% probability.

Table 7: Simulation of the effects of various household characteristics on household behavior (SPFIML estimation)

		Simulated probability			
		Mother's work status	Children in ECD centers	Children at school	Other household members' work
Household nonwage income	Baseline	52.9	17.7	63.8(*)	75.6(*)
	Baseline + 10%	53	17.7	63.9(*)	75.6(*)
Elasticity		*0.02*	*0.00*	*0.02*	*0.00*
Household type	Single mother	65.3(*)	19.3	60.9	46.6(*)
	All other	51.3(*)	17.4	64.3	77.6(*)
Education of household head	Baseline	53.1(*)	17.4(*)	67.1(*)	75.9
	Baseline + 1	54.3(*)	17.9(*)	68.9(*)	76.2
Elasticity		*0.22*	*0.28*	*0.26*	*0.04*
Household size	Baseline	53.0	17.9	62.1	75.6
	Baseline + 1	52.4	19.5	63.5	75.6
		-0.11	*0.82*	*0.22*	*0.00*

Note: (*) means that the corresponding estimated coefficient is significant with at least 90% probability.

Table 8: Simulation of the effects of various policies on children schooling (SPFIML estimation)

Increase by 10%		Simulated probability of a household's having all its children in school: Girls 8-16 years old	Boys 8-16 years old	All children in school
Mother's wage rate	Baseline	67.3(*)	75.5(*)	64.3
	Baseline + 10%	58.5(*)	86.5(*)	67.3
Elasticity		*-1.50*	*1.27*	*0.45*
Cost of child care	Baseline	68.1(*)	70.2	63.5(*)
	Baseline + 10%	64.8(*)	70.3	61.3(*)
Elasticity		*-0.51*	*0.01*	*-0.36*
Other household members' wage	Baseline	68.7	70.3	63.8
	Baseline + 10%	70.0	70.7	64.1
Elasticity		*0.19*	*0.06*	*0.05*

Note: (*) means that the corresponding estimated coefficient is significant with at least 90% probability.

Appendix

Functional forms of probabilities and points of suppor

In the SPFIML estimation the following functional forms were assumed in estimating the probability weights P_k, P_l, and P_m, and the points of support for factors V_1, V_2, and V_3:

$$P_{mn} = \frac{\exp(b_{mn})}{1 + \sum_{1}^{N-1} \exp(b_{mn})} \quad n = 1, \ldots, N-1 \qquad P_{mN} = \frac{1}{1 + \sum_{1}^{N-1} \exp(b_{mn})}$$

$$v_{mn} = \frac{\exp(a_{mn})}{1 + \exp(a_{mn})} \quad n = 2, \ldots, N-1 \qquad v_{m1} = 0; \quad v_{mN} = 1$$

Description of convergence criteria for optimization algorithm

We use a likelihood ratio χ^2-test at a significance level of 25% to determine the rejection or acceptance of the model with one point of support. If the model without heterogeneity is accepted in favor of the model with the control for unobserved heterogeneity, no further search is done. If the simple model specification is rejected, than we perform a χ^2-test for whether to accept or reject the two points of support specification versus the three points of support model, etc.

The log-likelihood value for the independent estimates is -11672.12 based on 136 parameters. The log-likelihood value for the SPFIML estimate based on 3 points of support for each of 3 factors is -11327.38 based on 157 parameters. This is an increase of 344.74 in the log-likelihood value for 21 additional parameters.

Table A1: Simultaneous estimation of the system of household demand equations

	Mother's work status		Children in ECD centers		Children at school		Other household members' work	
	Coeff.	**Std. err.**	**Coeff.**	**Std. err.**	**Coeff.**	**Std. err.**	**Coeff.**	**Std. err.**
Log of mother's wage	30.685***	*11.010*	0.693	*2.477*	0.080	*9.558*	-2.332	*5.651*
Log of others' wage	0.692	*0.666*	0.406	*0.261*	0.798	*0.639*	5.544	*6.045*
Cost of child care	-3.517	*4.806*	-0.111	*0.260*	-0.607	*0.443*	1.497***	*0.322*
Household characteristics								
Household size	-23.916	*34.559*	8.957*	*5.429*	13.333	*14.303*	13.736**	*7.264*
Number of children 0-2	1.816	*8.520*	-2.292	*1.209*	-3.449	*2.888*	-0.285	*1.352*
# children 3-5	5.732	*7.437*	-0.606	*0.847*	-0.852	*2.097*	-0.056	*1.330*
# of children 6-7	5.046	*6.938*	3.377**	*1.164*	-2.583	*2.677*	-2.660**	*1.267*
# of children 8-12	2.591	*6.793*	-2.031*	*0.997*	-4.025	*3.206*	-1.792	*1.191*
# of children 13-16	3.764	*5.100*	-2.008*	*1.070*	-5.517	*3.842*	-1.821*	*1.116*
Share of adult males	1.316	*5.508*	-2.150	*0.977*	-1.814	*1.854*	-0.107	*0.955*
Share of adult females	2.600	*4.521*	-1.560	*0.813*	-0.708	*1.677*	-0.278	*1.064*
Share of elderly	2.154	*7.285*	-1.861	*1.266*	-1.641	*2.380*	0.907	*1.652*
Share of children				*Reference*				
Single mother household	0.163	*0.607*	0.116	*0.229*	-0.265	*0.639*	-2.162***	*0.324*
Single mother and other	-1.142	*0.882*	0.014	*0.262*	-0.488	*0.878*	-2.185***	*0.375*
Nuclear family household				*Reference*				
Nuclear family and other	-0.046	*0.510*	0.134	*0.130*	0.087	*0.251*	0.270**	*0.196*
Other types of households	-0.005	*0.612*	-0.282	*0.195*	-0.668	*0.552*	0.468	*0.204*
Nonwage household income	18.600*	*9.573*	7.594	*5.987*	8.894	*11.715*	1.630	*7.872*
Nonwage household income	-2.705	*6.115*	2.295	*2.393*	1.265	*5.234*	-2.422**	*1.160*
Age of household head	-6.793	*7.372*	-1.864	*1.947*	3.771	*3.486*	-1.755	*2.341*
Age of head squared*100	2.298	*6.525*	0.957	*1.958*	-3.883	*3.283*	-0.608	*2.265*
Gender of household head	-2.256**	*1.148*	0.033	*0.188*	-0.353	*0.528*	-0.298	*0.206*
Education of household head	10.118	*6.325*	1.863*	*1.095*	6.015*	*3.481*	0.353	*4.250*
Characteristics of the mother								
Mother's age	33.105**	*11.387*	6.430*	*3.778*	-1.426	*8.606*	7.050**	*3.535*
Mother's age squared	-35.860**	*13.369*	-7.265*	*4.520*	2.876	*11.081*	-6.406	*4.331*
No formal education				*Reference*				
Preschool education	1.002	*1.154*	0.396	*0.333*	1.353	*1.114*	0.078	*0.352*
Standard 1-8	-0.700	*0.609*	0.207	*0.161*	0.750**	*0.374*	0.269	*0.225*
Cert. of primary education	0.139	*0.491*	0.469*	*0.244*	1.105***	*0.422*	0.561**	*0.256*
Junior secondary education	-0.553	*0.726*	0.293	*0.255*	1.035	*0.663*	0.516	*0.507*
Cert. of secondary education	-1.854*	*1.018*	0.415	*0.350*	0.033	*0.932*	0.661	*0.691*
Trade test certificate	-3.651	*3.446*	0.091	*0.554*	-1.261	*1.851*	-0.082	*1.053*
Other postsecondary educ.	-0.686	*1.861*	0.259	*0.514*	1.387	*1.108*	1.119	*0.933*
University and above	-4.495**	*2.200*	-0.100	*0.741*	-0.616	*2.613*	-0.019	*1.454*
Mean salary in the district	-8.364*	*4.402*	2.888**	*1.108*	7.713	*5.908*	1.450	*0.876*
Constant	-15.295**	*7.269*	-4.485***	*1.396*	-8.535	*9.424*	1.368	*2.861*
N [Log Likelihood]	3846 [-6777.11]							

Note: Average per locality quality adjusted cost of child care is used as a proxy for cost of child care.

Table A2: Simulation of the effects of various policies on the household behavior (independent probit estimations)

Increase by 10%		Simulated probability			
		Mother's work status	Children in ECD centers	Children at school	Other household members' work
Mother's wage rate	Baseline	53.2(*)	17.2(*)	64.1	75.4
	Baseline + 10%	62.7(*)	25.4(*)	65.6	74.5
Elasticity		*1.52*	*3.23*	*0.23*	*-0.12*
Cost of child care	Baseline	53.1(*)	17.7(*)	63.5(*)	75.5
	Baseline + 10%	51.8(*)	13.7(*)	60.7(*)	75.4
Elasticity		*-0.25*	*-2.92*	*-0.46*	*-0.01*
Cost of child care	Baseline	53.1(*)	17.7(*)	63.5(*)	75.5
	Fully subsidized	65.1(*)	77.1(*)	86.3(*)	76.5
Other household members wage	Baseline	53.0	17.6	64.0	75.7(*)
	Baseline + 10%	53.5	17.8	64.6	79.8(*)
Elasticity		*0.09*	*0.11*	*0.09*	*0.51*

Note: (*) means that the corresponding estimated coefficient is significant with at least 90% probability.

Table A3: Selection bias corrected estimation of wage equation for mothers.

Wage equation		
	Coefficient	Standard Error
age	0.044	*0.081*
age^2	-0.025	*0.217*
age^3	-0.037	*0.188*
Education in years	-0.080***	*0.017*
Education in years squared	0.015***	*0.002*
Number of children	-0.018	*0.012*
Constant	5.654***	*1.016*
Selection equation		
age	0.175***	*0.047*
age^2	-0.291*	*0.131*
age^3	0.136	*0.115*
Education in years	0.043***	*0.011*
Education in years squared	0.001	*0.001*
Number of children	0.101***	*0.016*
Household size	-0.100***	*0.012*
Maried	-0.334***	*0.039*
Lagged proportion of population out of labor force	-0.270**	*0.088*
Lagged unemployment rate	0.393	*0.471*
Constant	-2.655***	*0.542*

Table A4: Selection bias corrected estimation of wage equation for other household members.

Wage equation		
	Coefficient	Standard Error
age	0.174***	*0.023*
age^2/1000	-0.325***	*0.047*
age^3/10000	0.182***	*0.030*
Male	0.112	*0.232*
Male-age interaction	0.012	*0.010*
Male-age^2 interaction/100	-0.009	*0.011*
Education in years	0.036**	*0.011*
Education in years squared	0.006***	*0.001*
Male-education interaction	0.008	*0.009*
Male-number of children interaction	-0.006	*0.016*
Number of children	-0.025*	*0.014*
Constant	3.520***	*0.395*
Selection equation		
age	0.282***	*0.012*
age^2/100	-0.518***	*0.025*
age^3/10000	0.289***	*0.016*
Male	0.897***	*0.142*
Male-age interaction	0.059***	*0.006*
Male-age^2 interaction/100	-0.056***	*0.007*
Education in years	0.046***	*0.009*
Education in years squared	-0.002**	*0.001*
Male-education interaction	0.028***	*0.006*
Male-number of children interaction	-0.005	*0.010*
Number of children	0.061***	*0.011*
Married	0.238***	*0.029*
Household size	-0.106***	*0.006*
Lagged proportion of population out of labor force	0.067	*0.071*
Lagged unemployment rate	-0.836***	*0.277*
Constant	-4.304***	*0.181*