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Intergenerational Mobility and Intrahousehold Balance of Power: A Theoretical Analysis

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A Theoretical Analysis

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Abstract. The study of intergenerational mobility deals with questions regarding the opportunities of children and how their long run economic outcome is related to their family background. Most importantly, from a policy point of view, it is trying to understand the sources of persistence in economic status across generations. In this paper we study how family's decisions about investments in human and non-human capital of children are an important determinant of adult's earnings, and thus of persistence in income differentials. We propose a theoretical model of investment in children that allows parents to have different preferences in the framework of a collective model of household behavior, and investigate how the intra-household distribution of power affects children outcomes and the transmission of economic status across generations. The results altogether suggest that failure to account for intrahousehold balance of power as source of household heterogeneity might affect the interpretation of the structural parameters of interest and the evaluation of both earnings and consumption persistence.

JEL Classification: D0, D1. **Keywords**: Intergenerational Mobility, Intra-household Power.

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1 Introduction

The term social mobility indicates the change from an initial to a final social position, which can be expressed in terms of absolute or relative income levels, social class, occupational status, and so on. In particular, *inter*generational mobility (as opposed to *intra*generational mobility) refers to changes in social status between different generations of the same family (Checchi and Dardanoni 2002), and represents an important aspect of a country's income inequality.

The topic of intergenerational mobility is particularly interesting from a policy point of view, since it deals with questions regarding the opportunities of children and how their long run economic outcome is related to their family background. If a child's economic success is largely unpredictable on the base of family background we could reasonably claim that the society provides equality of opportunity. On the contrary, it might be hard to accept differences in outcomes that are due for the most part to an unleveled *playing field*. If parents' money is an important determinant of children's future economic success, then government intervention might be warranted on both equity and efficiency grounds, providing a rationale for government programs that distribute resources to low income families or invest in children directly. Thus, an understanding of the extent of intergenerational mobility in different societies is important to inform public policies dealing, for example, with immigration issues, access to education and health care.

As reviewed by Piketty (2000), the topic of intergenerational mobility has been traditionally controversial over many dimensions since the 19th and 20th centuries. Not only there is a *relative* consensus about the patterns of intergenerational mobility within and across countries, but there is also a lack of consensus about the role of different mechanisms that determine the degree of intergenerational mobility across generations.

In dealing with opportunities of children, the study of the family might be seen as a natural starting point to analyze the transmission of economic status across generations. The family is, in fact, the building block of analysis in the seminal theories of intergenerational mobility (Becker and Tomes 1979, Becker and Tomes 1986, Mulligan

1997 among others). The standard convention in these models is to treat the household as a single decision maker rather than a decision unit composed by different members. The unitary model characterizes the household as a decision unit where individuals share the same preferences or pool their resources. In this sense the unitary approach fails to consider that the household is a dynamic organisation of individuals with different preferences. This is why the unitary models prove inadequate for the study of certain demographic issues and to evaluate the inequality underlying the intra-household distribution of the resources.

In this paper we propose an extension of Becker and Tomes (1979, 1986) and Mulligan (1997) models of intergenerational mobility using the collective models of the household (Chiappori 1988, 1992), and we analyze how this different approach affects the definition and interpretation of the structural parameters of interest in the analysis of intergenerational mobility.

2 Background and Related Research

The interest in the laws governing the transmission of characteristics across generations recognizes in Galton one of the earliest contributors. Galton (1877, 1886) argues that there is a positive correlation between parents' and children's characteristics. He observes a degree of *regression to the mean* (*mediocrity*) in the transmission of height across generations. This means that if parents have an "exceptional" characteristic (height), their children will inherit it only in part. Goldberger (1989) defines *mechanical* Galton's type models of intergenerational mobility, which are distinguished from *economic* – or choice based- models of intergenerational mobility. The characteristic of the *economic* approach is that it does not consider the transmission of economic status between generations as the result of a *mechanical* process, but it views individual choices and behaviors as its key determinant.

The existing literature has approached the topic of intergenerational mobility in two complementary ways. In the sociological tradition, transition matrices are primarily used to represent transition probabilities among different discrete categories defined on the base of education, social or occupational status, and in general relevant social ranks. In a transition matrix the comparison between the marginal distributions of fathers and children gives an indication of what in the literature is indicated as *structural mobility* (Erikson and Goldthorpe 2002: 35). This needs to be distinguished from the concept of *exchange mobility* which measures the association between the status of parents and children as summarized by the odds ratios[2]. An advantage of transition matrices is that they allow researchers to visualize how different transmission mechanisms may be at work at different points of the income distribution.

The other approach to measure intergenerational mobility, which is the most widely used in the economic literature, is based on the least square estimator of a first order autoregressive process linking father and child's income:

$$Y_t = c + bY_{t-1} + e_t, \tag{2}$$

where Y_t, Y_{t-1} indicate, respectively, the permanent income of the adult child and of his/her father (usually measured in logarithms[3]) and ε_t a random component capturing other influences. In this framework, b indicates the strength of the relation between father and children's incomes or, equivalently, the fraction of the income differences among parents that is typically observed among their adult children. Large values of b indicate high degree of intergenerational persistence (low degree of intergenerational mobility). Most empirical estimates report a value of b between zero and one, and the quantity $1-b$ is defined as the *degree of intergenerational mobility* or *degree of regression to the mean*. If $b<0$ high income parents have low income children and if $b>1$ income regresses away from the mean. A society characterized by a high degree of

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[2] The odds ratio is a measure of disparity of opportunities for children from different origins. An odds ratio of 1 indicates the absence of association between origin and destination (Checchi and Dardanoni 2002).

[3] Economists are usually more interested in regression to the mean in logarithmic or percentage terms. As noted by Mulligan (1997: 25), economic growth tends to multiply incomes and produce regression away from the mean in absolute terms but not in percentage terms.

intergenerational mobility is often said to be a society of "equality of opportunity", since children's position is not determined by their parents' socioeconomic status[4].

The fact that the mobility literature is far from achieving a consensus on how to measure mobility and make mobility comparisons, suggests that theoretical analysis might be of special help to identify the channels of transmission and causal mechanisms beyond intergenerational persistence. As described by Checchi (2006), many factors exhibit intertemporal persistence and can explain the association in economic status across generations. Transmission of genetic components related to ability, race, cultural influences, liquidity constraints, territorial segregation, discrimination and self-fulfilling beliefs are some examples. Different theoretical models emphasize different aspects and have implication for intergenerational mobility[5]. A clearer understanding of the channels of transmission appears crucial from a policy point of view: a society might be willing to level the playing field if disparities arise, for example, from the presence of liquidity constraints, discrimination or local segregation, but might be less willing to do so if disparities are the results of different genetic abilities, beliefs and so on.

Recently there has been a growing empirical literature (surveyed in Solon 1999, 2002) that examines the association between parents and children's income on the basis of equation (2). Pre Solon (1992) estimates revealed a high degree of intergenerational mobility especially in the United States (Becker 1991). However, Solon (1992, 1999) shows that first generation estimates are largely downward biased due to measurement errors and unrepresentative samples. When corrections based on multiyear averages of income or instrumental variables are applied, the estimated degree of intergenerational persistence is substantially higher, around 0.4 [6].

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[4] However, regarding this point, Roemer (2004) points out that we should be careful in interpreting equality of opportunities as complete intergenerational mobility He argues that equality of opportunities (EOp) "views inequality of outcomes as indefensible when and only when they are due to differential circumstances. Inequalities due to differential efforts are acceptable." (Roemer 2004: 50).

[5] See Piketty (2000) for an excellent review of the theoretical models of intergenerational mobility.

[6] For some recent work see, for example, Mazumder (2005), Lefranc and Trannoy (2005).

The theoretical framework for the estimation of equation (2) is represented by the seminal work of Becker and Tomes (1979)[7]. They assume two overlapping generations. Each family is composed by one parent and one child. Let $t-1$, t indicate the father and children's generation, respectively. Children's permanent income Y_t, is assumed to depend on parents investment in children's human and non-human capital, and children's ability (a_t). The parent maximizes his/her utility which depends on own consumption and children's permanent income subject to a budget constraint. Computing the optimal investment in children gives the following relationship between child and parent's permanent income:

$$Y_t = \beta Y_{t-1} + \alpha a_t . \qquad (3)$$

This equation summarizes Becker and Tomes (1979) main result and illustrates two channels of intergenerational correlation; β depends on the returns on investments and parent's degree of altruism, and represents the causal effect of parent income on children income. Furthermore, incomes might be correlated also because ability is correlated across generations. Thus, estimates of b in (2) can be considered as a reduced form estimate of equation (3). Reduced form estimates represent an important descriptive measure of intergenerational mobility, but they lack a structural interpretation. Identifying the magnitude of the different intergenerational sources of earnings correlation would appear crucial from a policy point of view, but identification issues are complex and relatively few studies have tried to identify the causal effect of parental income on child's economic success.[8]

Thus, rather then pursuing an abstract objective of zero intergenerational correlation, a better approach is to investigate the mechanisms of intergenerational transmission. Building on their previous work, Becker and Tomes (1986) emphasize the

[7] Solon (2004) extends Becker and Tomes and clarifies the links between theoretical and applied research in order to rationalize log-linear intergenerational income regressions commonly estimated

[8] See for example Shea (2000) and Maurin (2002) for a use of instrumental variables and semiparametric techniques to solve identification issues. A different approach has been followed by Bowles and Gintis (2002), who decompose the intergenerational correlation coefficient into additive components reflecting the contribution of various causal mechanisms.

importance of liquidity constraints in explaining income persistence. Investments in human and non human capital are now distinguished and capital markets are assumed to be imperfect. The introduction of credit constraints identifies two groups of families. For the first group credit constraints are not binding, and families act as if capital markets were perfect. Since children earnings do not depend directly on family characteristics but depend directly on ability, and since ability is correlated across generations, earnings regress to the mean at the rate predicted by the transmission of ability. For another group of families, however, constraints are binding. In this case children earnings depend on parental earnings directly -because credit constraints limit investments in the human capital of children- as well indirectly-because ability persists across generations. Thus, earnings regress to the mean at a slower rate in borrowing constraints families. As emphasized by Mulligan (1997), the model has implications also for the degree of intergenerational consumption mobility. Since earnings regress faster to the mean across generations in the first group, parents use bequests to smooth consumption across periods and allow children to consume beyond the child's own earnings. The theoretical prediction is that consumption does not regress to the mean. This can be viewed as an extreme form of a general prediction according to which intergenerational correlation of consumption is greater than that of earnings. For the other group of families, credit constraints means that parents are less able to smooth consumption across generations, and thus consumption regresses to the mean. As emphasized in Mulligan (1997, 1999), under some assumptions the Becker and Tomes (1986) model derives strong predictions about the degree of intergenerational mobility of consumption and earnings, predictions that are unique to the economic approach to the study of intergenerational mobility. Some of the predictions are refused and others accepted.

Some empirical literature used the insights of Becker and Tomes to test the presence of distortions caused by credit constraints. One way to investigate the importance of credit constraints is by means of cross countries studies (Björklund and Jännti 1997). If credit constraints are the key source of persistent inequality, then those countries with better welfare systems and institutional arrangements for the public provision of schooling and health, for example, should have greater intergenerational mobility, since institutions contribute to alleviate credit constraints. However, Grawe and Mulligan (2002) and Han and Mulligan (2001) provide an alternative explanation. The authors argue that if ability heterogeneity across countries is high, it is difficult to interpret differences across countries as results of difference in credit constraints.

One of the predictions of the model is that earnings in borrowing constrained families regress slower to the mean than earnings in non-borrowing constrained families. Furthermore, the direct relationship between child and parent's earnings is likely to be concave rather than linear "because obstacles to the self-financing investments in children decline as parents earnings increase." (Becker 1991: 251). Thus, a second approach investigates the presence of nonlinearities in the pattern of intergenerational mobility across the income distribution. This approach has been emphasized, among others, by Corak and Heisz (1999) and Grawe (2004) who reach different conclusions about the role of credit constraints in explaining intergenerational mobility.

Other authors divide families into two groups according to their likelihood of being constraint. Mazumder (2005) partitions families by net worth and finds evidence consistent with Becker and Tomes prediction. Mulligan (1997, 1999) partitions families based on the amount of bequests children receive or expect to receive. There is weak evidence that earnings regress to the mean at very different rates across the two groups. He also observes that consumption regresses to the mean in both groups, contrary to the prediction of the model. However, the data confirm the prediction of the model that consumption is more persistent than earnings. Mulligan (1997) stresses how the predictions of the model have implications for the way we model altruism and argues that only a model of endogenous altruism is able to explain the observed patterns of regression to the mean in consumption across generations. Mulligan develops a model in which rich people turn out to be less altruistic than the poor, so that consumption regresses to the mean among families in which wage-income is the most important source of household resources.

A related important issue is that very little is known about the effect of family structure on intergenerational mobility from both a theoretical and empirical point of view. More recently, some authors have started to investigate the role of family structure, and in particular marital sorting, on the patterns of intergenerational mobility (see, for example, Chadwick and Solon (2002), Ermish et al. (2006)).

However, all the models discussed above assume a consensus utility function, i.e. they treat the household as a single decision unit. We propose instead a theoretical model of investments in children that allows parents to have different preferences, and investigate how the intra-household distribution of power affects children outcomes and thus intergenerational mobility. This paper contributes to the literature by extending Becker and Tomes (1979, 1986) and Mulligan's (1997) models to a collective framework (Chiappori 1992). We then investigate the implications of this collective representation of the household for the interpretation of the structural parameters of interest and the evaluation of both earnings and consumption persistence.

3 Investments in Children and Intrahousehold Balance of Power

A. Assumptions and Framework

In this section we use a collective model of the household, an approach that allows different household members to have different preferences over goods consumed in the household. Consider an overlapping generation structure in which individuals live for two periods, and let $t-1$, t represent the parents and child's generation, respectively. Each family is composed by two parents, a man (m) and a woman (f), and one child[9]. Parents utility is assumed to depend on own consumption C_m, C_f and child's (expected) permanent income when adult, Y_t. At time $t-1$ the household divides the available

[9] For simplicity we consider all children altogether, abstracting from the issue of allocation of the resources among different children and birth order effects. Furthermore children are assumed to have no direct decision power.

resources between consumption and (monetary) investments in children's human and non-human capital, I_t. Thus, the household budget constraint takes the following form:

$$C_{t-1}^{m} + C_{t-1}^{f} + I_t = y_{mt-1} + y_{ft-1} + y_0, \tag{4}$$

where y_{it-1}, y_0, for *i=m,f* represent, respectively parents' earnings and household non-labor income. Following Becker and Tomes (1979), parents are assumed to transfer resources to the child by investing in children the amount I_t at the rate of return r. In this setting child's permanent income depends on three components: parental investment, ability (a_t) and the luck present in the market sector (ε_t):

$$Y_t = (1+r)I_t + a_t + \varepsilon_t. \tag{5}$$

Note that ability does not reflect exclusively genetic components, but it is a broad concept that refers to "endowments of capital that are determined by the reputation and connections of their families, the contribution of the ability, race, and other characteristics of children from the genetic constitutions of their families, and the learning, skills, goals, and other family commodities acquired through belonging to a particular family." (Becker 1979: 1158). Given this characterization of ability, we follow Becker and Tomes (1979) in assuming that ability is correlated across generations in the following way:

$$a_t = (1-\eta)\bar{a} + \eta a_{t-1} + v_t, \tag{6}$$

where $\bar{a}$ is the average ability in the parents' generation, a_{t-1} is the average parental ability[10], that is $a_{t-1} = \frac{a_{mt-1} + a_{ft-1}}{2}$ (see Becker 1991), $\eta \in [0,1]$ is the degree of inheritability and v_t is a white noise error term representing endowment luck.

[10] A richer transmission process of ability could be used that takes into account differently mother and father's ability. However, since we are manly interested in the effect of the intrahousehold distribution of the resources, the simple framework outlined in the text has no particular bearing on our results, as long as we make the reasonable assumption that a_{t-1} is a generic and increasing function of individual abilities. We also abstract from the degree of assortative mating in abilities and endowments.

B. The Household Problem

Individual i is characterized by differentiable, strictly increasing, strictly convex preferences on private consumption and (expected) child's permanent income. Preferences are represented by a twice continuously differentiable utility function U^i. Then, the collective household problem can be written as:

$$Max\ \lambda_{t-1} U^f\left(C_{t-1}^f, Y_t\right) + \left(1-\lambda_{t-1}\right) U^m\left(C_{t-1}^m, Y_t\right) \quad (7)$$

$$\text{s.t. } C_{t-1}^m + C_{t-1}^f + I_t = y_{mt-1} + y_{ft-1} + y_0$$

$$Y_t = (1+r) I_t + a_t + \varepsilon_t,$$

The household utility function is given by the weighted sum of individual utilities with weights $\lambda_{t-1}, 1-\lambda_{t-1}$ representing the bargaining-decision power[11] of the woman and of the man, respectively. The Pareto weight $\lambda_{t-1} \in [0,1]$ is a function of exogenous variables that affect the household environment including in this case earnings of its members and unearned income[12] (Bourguignon 1999). It can also depend on a vector of distribution factors $\mathbf{s}$ which affect the decision power of the members but not directly preferences, and a vector of preference factors $\mathbf{z}$[13]. λ_{t-1} is assumed to be continuously differentiable in its arguments. In the special case in which λ_{t-1} is constant the collective framework corresponds to the unitary model with weakly separable household preferences (Chiappori et. al. 2002).

If we assume that parents can anticipate their children's ability but not their market luck and we combine the two constraints, the household maximization problem can be rewritten in the following form:

$$Max\ \lambda_{t-1} U^f\left(C_{t-1}^f, Y_t\right) + \left(1-\lambda_{t-1}\right) U^m\left(C_{t-1}^m, Y_t\right) \quad (8)$$

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[11] In the rest of the paper the terms bargaining power, decision power, and intrahousehold balance of power are used interchangeably.

[12] We are assuming that the labor supply of both members is fixed. This is because both individuals are rationed on the labor market or because some separability property between leisure and consumption in individual preferences.

[13] Thus, we can write $\lambda_{t-1} = \lambda\left(y_m, y_f, y_0, \mathbf{s}, \mathbf{z}\right)$. In the rest of paper we will use λ_{t-1} as short notation, keeping in mind that it depends on the listed variables.

$$\text{s.t. } \frac{Y_t}{1+r} + C^m + C^f = Y_{t-1} + \frac{a_t}{1+r} = H_{t-1}$$

where $Y_{t-1} = y_{mt-1} + y_{ft-1} + y_0$ and H_{t-1} is defined as family income. The new constraint shows that own consumption and expected child's permanent income are determined not only by the exogenous parents' income but also by the value of child's endowment discounted to the parents' generation, entering the budget constraint as a resource to the household. The first order conditions of this problem are:

$$\begin{aligned} &\lambda_{t-1} U^f_{C_f} = (1-\lambda_{t-1}) U^m_{C_m} \\ &\lambda_{t-1} U^f_Y + (1-\lambda_{t-1}) U^m_Y = \frac{\lambda_{t-1} U^f_{C_f}}{1+r}. \end{aligned} \tag{9}$$

If the utility functions are assumed to be homothetic, we get linear demand functions for C^i, Y_t:

$$\begin{aligned} &C^i = \delta^C_i \left(\alpha^C_i, \lambda,\ 1+r\right) H_{t-1} \\ &\frac{Y_t}{1+r} = \delta^Y \left(\alpha^Y_f, \alpha^Y_m, \lambda,\ 1+r\right) H_{t-1}, \end{aligned} \tag{10}$$

for $i = m, f$; δ^C_i, δ^Y represent the fraction of income spent on individual consumption and children, respectively, and are functions of the parameters α^C_i -which measures the preference for own consumption relative to the income of children- and α^Y_i -which measures the preference for child's income relative to own consumption- with $\frac{\partial \delta^Y}{\partial \alpha^Y_i} > 0$.

Substituting (10) into the budget constraint (4) and using the overall budget constraint in (8) we get:

$$I_t = \delta^Y Y_{t-1} - \frac{a_t}{1+r}\left(1 - \delta^Y\right) \tag{11a}$$

$$Y_t = (1+r)\delta^Y Y_{t-1} + \delta^Y a_t + \varepsilon_t . \tag{11b}$$

These simple results have several intuitive implications. First, equation (11b) shows two important sources of earnings correlation. Parental income has a direct effect on child income and also an indirect effect if parental and child ability are correlated across generations as expressed in (6). Holding ability constant, higher-income parents invest more in their children's human and non-human capital. Furthermore, only a fraction δ^{Y} of the (anticipated) child's endowment contributes to increase the expected child's future income, the rest being spent on parental consumption through a reduced investment in the child. In this sense child's ability is an element that parents take into account in determining the amount of effort required to invest and therefore the distribution of resources between the present and the future. Parental investment is increasing in parental altruism $\left(\frac{\partial \delta^{Y}}{\partial \alpha_i^{Y}} > 0\right)$ and in the return to the investment. This means that parents are more willing to invest in children when the payoff is higher. Finally, the collective setting implies that also the distribution of resources within the household affects the amount invested in children and thus their future economic success, since δ^{Y} is a function of λ_{t-1}. This also means that man and woman's earnings have a different impact on child's outcomes. But how does λ_{t-1} affects investments in children? There is a wide perception that, especially in developing countries, an increase in female power has a positive effect on the amount invested in children. If women spend household resources in a manner regarded as socially desirable, policies interventions could have greater success if they are targeted by gender. Thus, understanding how the intrahousehold distribution of power affects children's outcomes is particularly important from the point of view of policies dealing, for example, with child poverty. The next session explores this issue in more details.

3.1 Female Power and Child Welfare

Suppose husband and wife have different preferences over own consumption and child's income as represented by the following utility function:

$$U^{i} = u^{i}\left(C_{t-1}^{i}\right) + \alpha_i v(Y_t) \qquad u' > 0,\ u'' < 0,\ v' > 0,\ v'' < 0, \tag{12}$$

where u, v represents the utility from own consumption and child's income, respectively, α_i measures the degree of altruism toward children and is assumed to differ between the spouses. According to the collective framework, the household maximization process can be written as:

$$\underset{C^m, C^f, Y_t}{Max} \ \lambda_{t-1}\left[u^f\left(C^f\right)+\alpha_f v\left(Y_t\right)\right]+\left(1-\lambda_{t-1}\right)\left[u^m\left(C^m\right)+\alpha_m v\left(Y_t\right)\right] \tag{13}$$

s.t. $C_{t-1}^m + C_{t-1}^f + I_t = y_{mt-1} + y_{ft-1} + y_0$

$Y_t = (1+r)I_t + a_t + \varepsilon_t$.

In this paper we are not concerned about changes in prices and they are treated as fixed. In this framework, the amount invested in the child and own consumption will depend on the decision power of the woman, as stated in the following proposition.

Proposition 1. *Spouses' consumption levels are a monotonic function of female decision power. As* λ_{t-1} *increases female consumption increases and male consumption decreases. The amount invested in children is a non-monotonic function of* λ_{t-1}. *An increase in* λ_{t-1} *has a positive effect on investments in children if the ratio of female to male power is sufficiently high.*

Proof. Rearranging the first order conditions of the household problem we have:

$$\left(1-\lambda_{t-1}\right)u'^m\left(C_{t-1}^m\right)=\lambda_{t-1}\,u'^f\left(C_{t-1}^f\right) \tag{14a}$$

$$\left(1+r\right)\left[\lambda_{t-1}\alpha_f+\left(1-\lambda_{t-1}\right)\alpha_m\right]v'\left(Y_t\right)=\lambda\,u'^f\left(C_{t-1}^f\right) \tag{14b}$$

$$Y_{t-1}=C_{t-1}^f+C_{t-1}^m+I_t\,. \tag{14c}$$

Differentiating (14a) (14b) (14c) with respect to λ_{t-1} and rewriting in matrix form we get:

$$\begin{bmatrix} \lambda_{t-1}u''^{f}\left(C_{t-1}^{f}\right) & -(1-\lambda_{t-1})\,u''^{m}\left(C_{t-1}^{m}\right) & 0 \\ \lambda_{t-1}u''^{f}\left(C_{t-1}^{f}\right) & 0 & -(1+r)^{2}\left[\lambda_{t-1}\alpha_{f}+(1-\lambda_{t-1})\alpha_{m}\right]v''(Y_{t}) \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} \dfrac{\partial \hat{C}_{t-1}^{f}}{\partial \lambda_{t-1}} \\ \dfrac{\partial \hat{C}_{t-1}^{m}}{\partial \lambda_{t-1}} \\ \dfrac{\partial \hat{I}_{t}}{\partial \lambda_{t-1}} \end{bmatrix} =$$

$$= \begin{bmatrix} -u'^{f}\left(C_{t-1}^{f}\right)-u'^{m}\left(C_{t-1}^{m}\right) \\ -u'^{f}\left(C_{t-1}^{f}\right)+(1+r)v'(Y_{t})\left(\alpha_{f}-\alpha_{m}\right) \\ 0 \end{bmatrix}$$

where $\hat{I}_{t-1}, \hat{C}_{t-1}^{i}$ indicate, respectively, the optimal levels of consumption and child's investment . Solving for $\dfrac{\partial \hat{I}_{t}}{\partial \lambda_{t-1}}$ by using Cramer's rule, after some calculations we get:

$$\frac{\partial \hat{I}_{t-1}}{\partial \lambda_{t-1}} = \frac{1}{|D|}\frac{1}{\lambda_{t-1}\alpha_{f}+(1-\lambda_{t-1})\alpha_{m}}\left[\alpha_{m}(1-\lambda_{t-1})u'^{f}\left(C_{t-1}^{f}\right)u''^{m}\left(C_{t-1}^{m}\right)-\alpha_{f}\lambda_{t-1}u'^{m}\left(C_{t-1}^{m}\right)u''^{f}\left(C_{t-1}^{f}\right)\right]$$

where

$$\begin{aligned} |D| = {} & \lambda_{t-1}u''^{f}(1+r)^{2}\left[\lambda_{t-1}\alpha_{f}+(1-\lambda_{t-1})\alpha_{m}\right]v''+(1-\lambda_{t-1})u''^{m}\lambda_{t-1}u''^{f} \\ & +(1-\lambda_{t-1})u''^{m}(1+r)^{2}\left[\lambda_{t-1}\alpha_{f}+(1-\lambda_{t-1})\alpha_{m}\right]v''. \end{aligned}$$

Since $u'', v'' < 0$ we have that $|D| > 0$, and $\left[\lambda_{t-1}\alpha_{f}+(1-\lambda_{t-1})\alpha_{m}\right]$>0. Then, it follows that:

$$\frac{\partial \hat{I}_{t}}{\partial \lambda_{t-1}} > 0 \Leftrightarrow \frac{\lambda_{t-1}}{1-\lambda_{t-1}} > \frac{\alpha_{m}}{\alpha_{f}}\frac{u'^{f}\left(C_{t-1}^{f}\right)u''^{m}\left(C_{t-1}^{m}\right)}{u''^{f}\left(C_{t-1}^{f}\right)u'^{m}\left(C_{t-1}^{m}\right)}. \qquad (15)$$

This means that an increase in the female power has a positive effect on the amount invested in the child if and only if the ratio of female to male power is sufficiently high. This result can be also restated in the following terms[14]. Let $\tilde{\lambda}_{t-1}$ be such that

[14] A similar proof for the case of child labor has been developed for example in Basu (2006), who obtains somewhat opposite predictions since he finds a U-shape pattern for child labor, which can be

$\frac{\tilde{\lambda}_{t-1}}{1-\tilde{\lambda}_{t-1}} - \frac{\alpha_m}{\alpha_f} \frac{u'^f\left(\tilde{C}_{t-1}^f\right) u''^m\left(\tilde{C}_{t-1}^m\right)}{u''^f\left(\tilde{C}_{t-1}^f\right) u'^m\left(\tilde{C}_{t-1}^m\right)} = 0 \quad \left(\Leftrightarrow \frac{\partial \hat{I}_t}{\partial \lambda_{t-1}} = 0\right)$. Then, $\forall \lambda > \tilde{\lambda}$ we have that $\frac{\lambda}{1-\lambda} > \frac{\tilde{\lambda}}{1-\tilde{\lambda}}$ and $\left.\frac{u'^f\left(C_{t-1}^f\right) u''^m\left(C_{t-1}^m\right)}{u''^f\left(C_{t-1}^f\right) u'^m\left(C_{t-1}^m\right)}\right|_{\lambda>\tilde{\lambda}} < \left.\frac{u'^f\left(C_{t-1}^f\right) u''^m\left(C_{t-1}^m\right)}{u''^f\left(C_{t-1}^f\right) u'^m\left(C_{t-1}^m\right)}\right|_{\lambda=\tilde{\lambda}}$. The last inequality follows from the fact that C_{t-1}^f, C_{t-1}^m are increasing and decreasing functions of λ_{t-1}, respectively (see below), and $u' > 0, u'' < 0, u''' > 0$. From this it follows that $\frac{\lambda_{t-1}}{1-\lambda_{t-1}} - \frac{\alpha_m}{\alpha_f} \frac{u'^f\left(C_{t-1}^f\right) u''^m\left(C_{t-1}^m\right)}{u''^f\left(C_{t-1}^f\right) u'^m\left(C_{t-1}^m\right)} > \frac{\tilde{\lambda}_{t-1}}{1-\tilde{\lambda}_{t-1}} - \frac{\alpha_m}{\alpha_f} \frac{u'^f\left(\tilde{C}_{t-1}^f\right) u''^m\left(\tilde{C}_{t-1}^m\right)}{u''^f\left(\tilde{C}_{t-1}^f\right) u'^m\left(\tilde{C}_{t-1}^m\right)} = 0 \quad \forall \lambda > \tilde{\lambda}$, or equivalently $\frac{\partial \hat{I}_t}{\partial \lambda_{t-1}} > 0 \quad \forall \lambda > \tilde{\lambda}$, and the reverse is true for $\lambda < \tilde{\lambda}$. This means that the amount invested first declines and then rise as female power increases, that is there is a U-shape relationship. A similar result can be derived if we relate the amount invested to the male power. Along the same lines it is possible to prove that:

$$\frac{\partial \hat{C}_{t-1}^f}{\partial \lambda_{t-1}} = \frac{1}{|D|} K > 0 \ , \ \frac{\partial \hat{C}_{t-1}^m}{\partial \lambda_{t-1}} = \frac{1}{|D|} H < 0, \tag{16}$$

since $K = \frac{-\alpha_m (1-\lambda_{t-1})}{\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m} u'^f u''^m - (1+r)^2 v''(Y_t) u'^f \frac{\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m}{(1-\lambda_{t-1})} > 0$ and $H = \lambda_{t-1} u''^f\left(C_{t-1}^f\right) + u'^m u''^f + v''(Y_t)(1+r)^2 \left[\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right]\left(u'^m + u'^f\right) < 0$.

Q.E.D.

Another interesting result can be obtained if we differentiate the first order conditions with respect to parents' degree of altruism. The proof of the following proposition is straightforward following the lines of the proof in Proposition 1 and is left to the reader:

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characterized as a public bad. On the same lines see also Felkey (2006) for a similar proof in the case of household public goods that obtains a pattern opposite to us.

Proposition 2. *The amount invested in children and individual consumption are increasing and decreasing functions of the parental degree of altruism, respectively*:
$\frac{\partial \hat{I}_t}{\partial \alpha_i} > 0$, $\frac{\partial C^i_{t-1}}{\partial \alpha_i} < 0$, $\frac{\partial C^i_{t-1}}{\partial \alpha_{-i}} < 0$ for $i = m, f$; $-i = f, m$.

The non-monotonic relationship between female (or male) power might be interesting from a policy point of view. Conventional literature have investigated the relationship between female power and household expenditure patterns, showing how greater female power increases the household budget share devoted to the consumption of goods that are socially desirable (see Hodinottt and Hadda 1995). This literature, however, has investigated linear relationships. An interesting result is obtained by Handa (1996). The author analyses the effect of female headship on household budget shares. On average, the presence of a female decision maker increases the share of the household budget allocated to child and family goods. A section of the paper reports results from a comparison of female headed households with and without a male spouse living in the household. Both types of households are female headed, and thus we could argue that in these households the woman has a relatively high bargaining power, presumably $\lambda > \tilde{\lambda}$ in our model. But we would also expect that the bargaining power is higher if she is un-partnered rather than partnered. According to our model, a comparison of these two types of households would be equivalent to a comparison between two households along the upper tail of the distribution of female power. If it is the case, then the model would predict a greater impact on the amount invested in children in the un-partnered households. The results report significant differences favoring single female in the case of children's wear and no significant difference for education.

More recent literature has tried to explore nonlinearities in the effect of one member's bargaining power on household expenditure patterns. Along these lines, for example, is the recent contribution of Ray et al (2006). Using a collective framework with endogenously determined intrahousehold balance of power, they find that the relative decision power of the adult decision maker significantly affect budget shares following a nonlinear pattern that varies across goods. The results show that there is an inverted U-shaped relationship between the budget share and the male power for goods classified as 'necessary' items like food and fuel and light, and a U-shaped relationship in the case of 'luxury' items, like transport and education. If we interpret education expenditures as a component of our I_t, then this result is predicted by the theory. The authors offer an explanation for these patterns. "Both partners have a preference for luxury items over necessities. Consequently, at the extreme values of λ the dominant partner is able to mould the household preferences towards the particularly luxury items that she/he consumes, leading a rise in its budget share and a fall in that of necessities" (Ray 2006: 455). This explanation might not be that compelling in the case of education, since education is an intergenerational investment decision that shouldn't be viewed as a luxury. However, in developing countries, such as India, it might well be the case that education is a luxury, especially for poorer household. Still, however, it remains open the question remains why an increase in female power has a positive effect on the amount invested in children only if the female male decision power ratio is sufficiently high, or equivalently only if $\lambda > \tilde{\lambda}$. Think about a woman in a traditional family in some developing country, who is likely to live in a status of subjugation in the household. In this case, an increase in her power might be directed toward herself first rather than investing more in children. Positive effects on child's investments display only at the point where the woman has reached a certain threshold reference status level. This interpretation would be consistent with a view of agents that are intrinsically egoistic (as argued, for example, by Mulligan 1997) and who have to make *efforts* to sacrifice own resources to invest in children. Clearly, the amount of effort required might be lower the greater the altruism of the mother, but can be relatively high if the mother is in a condition of subjugation, thereby discouraging investments in children. Certainly, more empirical evidence is needed to examine the relationship between individual decision maker's decision power and children's outcomes and amount spent on children, and this can be a very interesting area of research for future empirical work.

3.2 An Illustration with Cobb-Douglas Preferences

Suppose preferences take the following Cobb-Douglas form. The household maximization problem becomes:

$$\underset{C^m C^f Y}{Max} \quad \lambda_{t-1}\left(\alpha_f \log Y_t + \beta_f \log C_{t-1}^f\right) + \left(1-\lambda_{t-1}\right)\left(\alpha_m \log Y_t + \beta_m \log C_{t-1}^m\right) \qquad (17)$$

$$\text{s.t. } \frac{Y_t}{1+r} + C^m + C^f = Y_{t-1} + \frac{a_t}{1+r} = H_{t-1}.$$

Straightforward calculations show that:

$$Y_t = (1+r)\left[\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right]Y_{t-1} + \left[\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right]a_t + \varepsilon_t \qquad (18)$$

$$I_t = \left[\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right]Y_{t-1} - \left[1-\left(\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right)\right]\frac{a_t}{1+r} \qquad (19)$$

$$C_{t-1}^i = \lambda_{t-1}^i \beta_i \left(Y_{t-1} + \frac{a_t}{1+r}\right) \text{ with } \lambda^i = \lambda,\ 1-\lambda \text{ for } i=f,m. \qquad (20)$$

Note how individual consumption levels are a monotonic functions of own bargaining power, while the amount invested in the child is a non-monotonic function of female power. In particular, by (19) we have that $\frac{\partial I_t}{\partial \lambda_{t-1}} > 0 \Leftrightarrow \frac{\alpha_f}{\alpha_m} > 1$, which is equivalent to condition (15) for the Cobb-Douglas case[15]. This simply means that an increase in a member's decision power increases the amount invested in children if and only if this member's degree of altruism is greater than that of the other member.

From (18) it follows that the impact of parental income on children income depends on λ_{t-1}. In this framework, we are interested in the following structural parameter:

$$\left.\frac{dY_t}{dy_{it-1}}\right|_{da_t=0} = (1+r)\left[\left(\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right) + \left(\alpha_f - \alpha_m\right)\lambda_{y_i}\left(Y_{t-1} + \frac{a_t}{1+r}\right)\right] = \mu_i\left(\lambda_{t-1}, a_t; \alpha_i, r\right),$$

(21)

[15] A very similar result has been derived using a different strategy by Blundell et al. (2005). They show that a change in a member's Pareto weight increases the household expenditure on children if and only if the marginal willingness to pay of this member is more sensitive to changes in his/her share than that of the other member. For the Cobb-Douglas example, this reduces to the condition in the text.

which measures the impact of an increase in male/female earnings on child income keeping ability constant. This structural parameter can be decomposed into two effects, a direct effect and an indirect effect (i.e. through the female bargaining power). Additional comments on these results will be provided later in the paper. For the moment it is worth to emphasize that in addition to the factors already stressed in the literature as potential sources of the differences in intergenerational mobility across countries or across groups, the collective framework allows to emphasize that differences in household structure can affect the degree of intergenerational mobility since the value of the structural parameter varies across the distribution of λ. Furthermore, this framework allows for different impacts of male and female earnings on child permanent income.

As noted in section 2, most empirical estimates of the degree of intergenerational mobility cannot identify the causal effects of parental income. Furthermore, they estimate empirical relationship with a unitary model of the household in mind. Here we show that if accept the idea that the household is better to be treated as a micro society of individuals, then failures to account for this aspect can lead additional sources of bias in the commonly estimated child-parent earnings relationships.

Let's rewrite equation (18) as follows:

$$Y_t = (1+r)\alpha_m Y_{t-1} + (1+r)(\alpha_f - \alpha_m)\lambda_{t-1}Y_{t-1} + \alpha_m a_t + (\alpha_f - \alpha_m)\lambda_{t-1}a_t + \varepsilon_t\,, \qquad (22)$$

where, if $\lambda = 1{,}0$ we are back to the unitary model. Since λ is, by definition, a function of exogenous variables, we could in principle estimate it in a first stage and use it in a second stage to estimate equation (22). Since ability is not observed, however, we should treat as a part of the error term and estimate:

$$Y_t = (1+r)\alpha_m Y_{t-1} + (1+r)(\alpha_f - \alpha_m)\hat{Y}_{t-1} + \xi_t\,,$$

where $\xi_t = \alpha_m a_t + (\alpha_f - \alpha_m)\lambda_{t-1}a_t + \varepsilon_t$ and $\hat{Y} = \lambda Y$. If ξ_t were orthogonal to the regressors, then we could consistently estimate $(1+r)\alpha_m, (1+r)(\alpha_f - \alpha_f)$. Note that $\mu_i(\lambda_{t-1}, a_t; \alpha_i, r)$ is a function of ability (which is unobservable). This is a common problem encountered in some econometric textbooks and in the empirical estimation of earning functions in which education and ability are modeled to have both separate and interactive effects on earnings. In this case we cannot hope to estimate the partial effect across many different values of ability. Usually of more interest is the partial effect averaged across the population distribution of ability:

$$E_{a_t}\mu_i(\lambda_{t-1},a_t;\alpha_i,r)=(1+r)\left[(\lambda_{t-1}(\alpha_f-\alpha_m)+\alpha_m)+(\alpha_f-\alpha_m)\lambda_{yi}\left(Y_t+\frac{\mu_a}{1+r}\right)\right],$$

with $\mu_a = Ea_t$. In this case, omission of λ would produce inconsistent estimates of $(1+r)\alpha_m,(1+r)(\alpha_f-\alpha_f)$ and thus of the average partial effect of interest.

The problem is that ξ_t is likely to be correlated with the regressors since ability is correlated across generations. In this case, unless we have a valid identification strategy, we cannot identify the causal effect of interest, but we would obtain a sort of reduced form estimates that capture also the earning correlation that works through ability. In this case, the omission of λ would add an additional source of bias and we would get an inconsistent estimate of "wrong" structural parameter.

The model developed in this section is simple enough to understand how the intra-household balance of power can potentially affect the degree of intergenerational mobility. However, there are several simplifying assumptions: there is no distinction between investments in human and non-human capital, rates of return on the amount invested are constant, and there are no capital market imperfections. Building on the seminal work of Becker and Tomes (1986), these assumptions are relaxed in the following sections.

4 Human and non-Human Capital

A. Assumptions and Framework

In this model there are two ways parents can transfer resources to the future generation: by investing the amount h_t in their human capital and by leaving bequests in the form of assets, k_t. Thus, the total amount invested in children is given by $I_t = h_t + k_t$. If a constant rate of return is a reasonable assumption for non-human capital investments, it is likely to be unrealistic for the case of investments in human capital[16]. There are different reasons why rates of returns on human capital are a decreasing function of the amount invested. Since human capital is embodied in the person and she has limited mental and physical capacity, after some points diminishing returns set in. As the stock of human capital accumulates it becomes progressively more costly to invest since now the opportunity cost is higher. This means that the marginal rate of return declines even if the dollar value of the investment is the same. Furthermore, since human capital investments spread over an investment period, later investments would be less profitable because the length of time to profit of the investment is lower, determining a reduction in the present value of net benefits and thus of rates of return (Becker 1993).

The amount invested (h_t) in the human capital of children translates into effective units of human capital (H_t) through the following productive process:

$$H_t = f(h_t, a_t) \text{ with } f_h > 0, f_{hh} < 0, f_a > 0, f_{ha} > 0, \tag{23}$$

h_t should be viewed as a general form of human capital investment which can include expenditures on child's education, health, the value of in home training and so on. In equation (23) both the amount invested by parents and own ability positively affect child's human capital, but greater child's ability also allows children to benefit more from parental investments. Child's adult earnings (W_t) then depend on human capital and market luck:

$$W_t = \theta\ H_t + \varepsilon_t, \tag{24}$$

where θ is the earnings of one unit of human capital, or equivalently the earnings return to human capital. From this it follows that the marginal rate of return on the amount invested in human capital is given by:

$$\frac{\partial W_t}{\partial h_t} = \theta\, f_h(h_t, a_t) = R_h > 0 \text{ with } R_{hh} < 0. \tag{25}$$

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[16] Thus, rates of returns on physical assets are treated as constant. It could be the case that returns on portfolio assets depends on individual characteristics. For example, if you have greater human capital you are able to pick up better portfolios, but this effect is likely to be rather weak.

We continue to assume ability transmits across generations according to the following equation:

$$a_t = (1-\eta)\bar{a} + \eta a_{t-1} + \nu_t,$$

where $\bar{a}$ is the average ability in the parents' generation and a_{t-1} is the average parental ability, that is $a_{t-1} = \frac{a_{mt-1} + a_{ft-1}}{2}$. The other source of income for the child when adult is given by the bequests left by the parents, that is $R_k k_t$, where R_k is the constant rate of return on assets. In this setting parents are concerned about total wealth of the child, $W_t + R_k k_t$, and the resolution of the household problem depends on whether capital markets are perfect or imperfect[17].

B. The Household Problem in Perfect Capital Markets

In this version of the model[18], no restrictions are imposed on the values k_t can take, but it is assumed that parents are able to pass amounts of debt to their children. This means that they can borrow against their child's future earnings to finance human capital investments. This form of borrowing would be equivalent to negative values of k_t. For example, parents can borrow from a bank to finance schooling expenditures for the child and that loan be paid back by the child when adult through his/her earnings capacity. In this framework, the household maximization problem takes the following form:

$$\max_{C^m, C^f, Y_t} \quad \lambda_{t-1}\left[u^f\left(C^f\right) + \alpha_f v(W_t + R_k k_t)\right] + (1-\lambda_{t-1})\left[u^m\left(C^m\right) + \alpha_m v(W_t + R_k k_t)\right] \qquad (26)$$

$$\text{s.t.} \quad C^m_{t-1} + C^f_{t-1} + h_t + k_t = y_{mt-1} + y_{ft-1} + y_0$$

[17] Note that the simplified model in section 3 can be considered a special case of this more general model. A general production function of child quality can be written as $W_t = \theta f(i_t, \tilde{a}_t)$ where $i_t, \tilde{a}_t$ represent the input of goods and the endowed inputs, respectively. If time inputs are ignored, and if goods have a constant marginal product (as in the case in section 3 where rates of returns are constant), this function reduces to the additive function $Y_t = \alpha(\tilde{a}_t)i_t + \beta(\tilde{a}_t)\tilde{a}_t = \alpha\ i_t + a_t$ with $\beta(\tilde{a}_t)\tilde{a}_t = a_t$ under the simplifying assumption that α is independent of $\tilde{a}_t$.

[18] The distinction between perfect and imperfect capital markets has been introduced by Becker and Tomes (1986) and further elaborated by Mulligan (1997,1999)

$$W_t = \theta \; H_t + \varepsilon_t$$

$$H_t = f(h_t, a_t).$$

where $Y_t = W_t + R_k k_t$. In this case the following can be proved:

Proposition 3. *If capital markets are perfect, all families can afford the efficient level of human capital investment. In this case, the amount invested in child's human capital is independent of parental resources, members' decision power, degree of altruism, but is an increasing function of child's ability and a decreasing function of asset rates of return.*

Proof. The first order conditions of the household maximization problem can be written as follows:

$$(1-\lambda_{t-1})u'^{m}\left(Y_{t-1} - C_{t-1}^{f} - h_t - k_t\right) = \lambda_{t-1}u'^{f}\left(C_{t-1}^{f}\right) \tag{26a}$$

$$v'(W_t + R_k k_t)R_h\left[\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right] = \lambda_{t-1}u'^{f}\left(C_{t-1}^{f}\right) \tag{26b}$$

$$v'(W_t + R_k k_t)R_k\left[\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right] = \lambda u'^{f}\left(C_{t-1}^{f}\right), \tag{26c}$$

where, as before $Y_{t-1} = y_{mt-1} + y_{ft-1} + y_0$. After differentiating these first order conditions with respect to $y_{it-1,} \lambda_{t-1}, a_t, R_k$, rearranging in matrix form and solving for $\frac{\partial h_t}{\partial j}$ $j = y_{it-1}, \lambda_{t-1}, a_t, R_k$ gives:

$$\frac{\partial \hat{h}_t}{\partial y_{it-1}} = \frac{1}{|A|}(R_h - R_k)\left\{\begin{array}{l} -\gamma_{t-1}v''u''^{f}\left[(1-\lambda_{t-1})u''^{m} - u'^{f}\lambda_{y_i} - u'^{m}\lambda_{y_i}\right]\lambda_{t-1}R_k \\ -\lambda_{t-1}(1-\lambda_{t-1})\,u''^{m}u''^{f}v'\lambda_{y_i}\left(\alpha_f - \alpha_m\right) \\ -\left[(1-\lambda_{t-1})u''^{m} + \lambda_{t-1}u''^{f}\right]\left(u'^{f}\lambda_{y_i}v''\gamma R_k\right) \end{array}\right\} = 0$$

$$\frac{\partial \hat{h}_t}{\partial \lambda_{t-1}} = \frac{1}{|A|}(R_h - R_k)\left\{\begin{array}{l} -\left(u'^{m} + u'^{f}\right)\left(\lambda_{t-1}u''^{f}v''R_k\,\gamma\right) + \lambda_{t-1}(1-\lambda_{t-1})u''^{m}u''^{f}v'\left(\alpha_f - \alpha_m\right) \\ +\left(u'^{f}\,v''\gamma_{t-1}R_k\right)\left[(1-\lambda_{t-1})u''^{m} + \lambda_{t-1}u''^{f}\right] \end{array}\right\} = 0$$

since by (26b) and (26c) in equilibrium all families make the efficient human capital investment, i.e. $R_h = R_k$; note that $\gamma_{t-1} = \lambda\alpha_f + (1-\lambda)\alpha_m$. Along the same lines we get:

$$\frac{\partial \hat{h}_t}{\partial a_t} = \frac{1}{|A|}\left[-\lambda_{t-1}(1-\lambda_{t-1})u''^m u''^f\, v'\theta\gamma_{t-1}f_{ha} - v'\theta\gamma_{t-1}{}^2 f_{ha}v''R_k^2\left(\lambda_{t-1}u''^f + (1-\lambda_{t-1})u''^m\right)\right] > 0$$

$$\frac{\partial \hat{h}_t}{\partial R_k} = \frac{1}{|A|}\left[\gamma_{t-1}v'\lambda_{t-1}(1-\lambda_{t-1})\, u''^m u''^f + \gamma_{t-1}{}^2 R_k^2 v'v''\left(\lambda_{t-1}u''^f + (1-\lambda_{t-1})u''^m\right)\right] < 0$$

since $|A| = \gamma_{t-1}\,\lambda_{t-1}(1-\lambda_{t-1})u''^m u''^f v'R_{hh} + \gamma_{t-1}^2 v''v'R_k^2 R_{hh}\left(\lambda_{t-1}u''^f + (1-\lambda_{t-1})u''^m\right) < 0$

$f_{ha} > 0, u'', v'' < 0, \gamma_{t-1} > 0$. Q.E.D.

From this it follows that the optimal amount invested in child's human capital is given by:

$$\hat{h}_t = g(a_t, R_k),\ g_a > 0, g_{R_k} < 0. \tag{27}$$

Substituting the optimal amount invested in children into the earnings function we get:

$$W_t = \theta f\left(g(a_t, R_k), a_t\right) + \varepsilon_t = \vartheta(a_t, R_k) + \varepsilon_t. \tag{28}$$

In this framework, the structural parameter of interest among non-borrowing constrained families measures the effect of an exogenous change in parental income on the earnings of the adult child keeping ability constant. From equation (28) this parameter is zero. This means that there is no direct relationship between parents and child's incomes. However, if ability is correlated across generations, intergenerational earnings correlation arises due to the correlation of abilities, that is:

$$\left.\frac{dW_t}{dy_{it-1}}\right|_{da_t=0} = 0 \tag{29a}$$

$$\frac{dW_t}{dy_{it-1}} = \frac{\eta}{2}\frac{\vartheta_{a_t}}{\vartheta_{a_i}}. \tag{29b}$$

It is interesting to see that if there is positive assortative mating between parents based on ability, the degree of earnings persistence increases:

$$\frac{dW_t}{dy_{it-1}} = \frac{\eta}{2}\frac{\vartheta_{a_t}}{\vartheta_{a_i}}\left(1+R_a\right), \qquad (30)$$

where R_a represents the degree of positive sorting (Becker 1991). This means that earnings regress to the mean at a rate proportional to the transmission of ability and persistence is higher the greater the degree of assortative mating. If earnings were approximately linearly related to ability, mother and father's ability were equal, and no sorting exists, we would back to the unitary case where $\frac{dW_t}{dy_{it-1}} = \eta$.

These results show that since capital markets are perfects, parents can separate investments in children from their own resources and altruism (as in the unitary model, see Becker and Tomes 1986) and also from the members' bargaining power.

C. The Household Problem in Imperfect Capital Markets

If capital markets are imperfect, parents cannot borrow against the future income of the child. Transfers between generations are only of one-way type, that is from parents to children, but we cannot force children to give parents any asset, i.e. negative values of k_t are not allowed. The main rationale for this argument is that human capital is very poor collateral to lenders. In this framework shutting down this market can lead to inefficiencies since parents do not invest the optimal amount in their kids.

In this case, the household maximization problem becomes:

$$\underset{C^m, C^f, Y_t}{Max}\ \lambda_{t-1}\left[u^f\left(C^f\right)+\alpha_f v\left(W_t+R_k k_t\right)\right]+\left(1-\lambda_{t-1}\right)\left[u^m\left(C^m\right)+\alpha_m v\left(W_t+R_k k_t\right)\right] \quad (31)$$

$$\text{s.t.}\quad C^m_{t-1}+C^f_{t-1}+h_t+k_t = y_{mt-1}+y_{ft-1}+y_0$$

$$W_t = \theta\ H_t+\varepsilon_t$$

$$H_t = f\left(h_t, a_t\right)$$

$$k_t \geq 0.$$

Solving the household problem, it is easy to show that $R_h \geq R_k$. Thus, two cases arise: when the Lagrange multiplier on the borrowing constraint is zero, $k_t > 0$, the borrowing constraint does not bind and we have that $R_h = R_k \Leftrightarrow \theta f_{h_t}\left(h_t^*, a_t\right) = R_k$. In this case the household make the efficient level of human capital investment $\left(h_t^*\right)$. Thus, households leaving positive bequests behave like households that are non-borrowing constrained, and the results of previous section apply. Instead, when the Lagrange multiplier on the borrowing constraint is positive, $k_t = 0$, the borrowing constraints bind and $R_h > R_k$. These households do not make the efficient level of human capital investment but $h_t < h_t^*$. For these households parental income and the distribution of power within the household are important determinants of investments in the future generation, and thus of child's future economic success. Furthermore, since for these households rates of return on human capital investments are higher, redistributive policies can be effective in reducing inequality rising efficiency at the same time.

Proposition 4. *If capital markets are imperfect and borrowing constraints are binding, the amount invested in children is a function of household resources, parents' degree of altruism, child's ability and intra-household balance of power. In particular, an increase in* λ_{t-1} *has a positive effect on investments in children if the ratio of female to male power is sufficiently high.*

Proof. Following the same lines as the proof of Proposition 3, we have that for $k_t = 0$:

$$\frac{\partial \hat{h}_t}{\partial \lambda_{t-1}} = \frac{1}{|B|}\frac{1}{\gamma_{t-1}}\left[\alpha_f \lambda_{t-1} u'^{m}\left(C_{t-1}^m\right) u''^{f}\left(C_{t-1}^f\right) - \alpha_m\left(1-\lambda_{t-1}\right) u'^{f}\left(C_{t-1}^f\right) u''^{m}\left(C_{t-1}^m\right)\right] \tag{32}$$

where $\gamma_{t-1} = \lambda_{t-1}\alpha_f + \left(1-\lambda_{t-1}\right)\alpha_m > 0$, and

$|B| = -\lambda_{t-1} u''^{f}\left(1-\lambda_{t-1}\right) u''^{m} - \left[\lambda_{t-1} u''^{f} + \left(1-\lambda_{t-1}\right) u''^{m}\right]\left[\gamma_{t-1} v'' R_h^2 + v' R_{hh}\right] < 0$.

This means that, as shown in Proposition 1, an increase in female bargaining power has a positive effect on the amount invested in children if and only if the ratio of female to male bargaining power is sufficiently high, i.e. $\frac{\lambda_{t-1}}{1-\lambda_{t-1}} > \frac{\alpha_m}{\alpha_f} \frac{u'^f\left(C_{t-1}^f\right) u''^m\left(C_{t-1}^m\right)}{u''^f\left(C_{t-1}^f\right) u'^m\left(C_{t-1}^m\right)}$, or equivalently $\lambda > \tilde{\lambda}$. From this we have that:

$$\begin{aligned}\frac{\partial \hat{h}_t}{\partial y_{it-1}} &= \frac{1}{|B|}\left[-\lambda_{t-1}\left(1-\lambda_{t-1}\right) u''^f\, u''^m\right] + \\ &\frac{1}{|B|}\frac{1}{\gamma_{t-1}}\left[\alpha_f \lambda_{t-1} u'^m\left(C_{t-1}^m\right) u''^f\left(C_{t-1}^f\right) - \alpha_m\left(1-\lambda_{t-1}\right) u'^f\left(C_{t-1}^f\right) u''^m\left(C_{t-1}^m\right)\right]\lambda_{t-1 y_{it-1}}\end{aligned} \tag{33}$$

Thus, an increase in, say, male earnings has two effects on the amount invested. A direct positive effect, that we define *total resources effect*, and express the idea that investments in children are normal goods. But we have also a bargaining power effect: a change in individual income can affect bargaining power and, in turn, this affects the amount of resources invested in children. We define the latter *bargaining power effect*.

The effect of altruism and ability are given respectively by:

$$\frac{\partial \hat{h}_t}{\partial \alpha_f} = \frac{1}{|B|} v' R_h \lambda_{t-1}\left(\lambda_{t-1} u''^f + \left(1-\lambda_{t-1}\right) u''^m\right) > 0 \tag{34}$$

$$\frac{\partial \hat{h}_t}{\partial \alpha_m} = \frac{1}{|B|} v' R_h \left(1-\lambda_{t-1}\right)\left(\lambda_{t-1} u''^f + \left(1-\lambda_{t-1}\right) u''^m\right) > 0 \tag{35}$$

$$\frac{\partial \hat{h}_{t-1}}{\partial a_t} = \underbrace{\frac{\lambda_{t-1} u''^f + \left(1-\lambda_{t-1}\right) u''^m}{|B|}}_{+} \theta \gamma_{t-1}\left(\underbrace{f_a\, R_h v''}_{-} + \underbrace{v' f_{ha}}_{+}\right). \tag{36}$$

Note that the $sign \frac{\partial \hat{h}_{t-1}}{\partial a_t} = sign\left(\underbrace{f_a R_h v''}_{-} + \underbrace{v' f_{ha}}_{+}\right)$. Ability has now two effects on the amount invested in children: a negative income effect and a positive substitution effect. The negative income effect arises from the fact that children with greater ability are richer, and expenditures of children are discouraged when children are expected to be richer. The positive substitution effect derives from the fact that higher ability increases the marginal rates of return on children encouraging investments $(f_{ha} > 0)$. The total effect is thus ambiguous. However, for usual form assumptions about utilities and human capital production function the substitution effect is likely to dominate the income effect. Note that equation (19) can be viewed as a special case of (36) where the substitution effect is zero. Q.E.D.

From this it follows that we can write $\hat{h}_t = g^*(Y_{t-1}, \lambda_{t-1}, a_t, \alpha_i)$, which, inserted in the child's earning equation gives:

$$W_t = \theta f\left(g^*\left(Y_{t-1}, \lambda_{t-1}, a_t, \alpha_i\right), a_t\right) + \varepsilon_t = \vartheta^*\left(Y_{t-1}, \lambda_{t-1}, a_t, \alpha_i\right) + \varepsilon_t . \tag{37}$$

Child's adult earnings depend now directly on parental resources and also on the distribution of the members' bargaining power. Suppose we are interested in the effect of father earnings on children's earnings, the most commonly estimated empirical relationship. The structural parameter of interest is give by an increase in father earnings keeping ability constant, that is:

$$\left.\frac{dW_t}{dy_{mt-1}}\right|_{da_t=0} = \vartheta^*_{Y_{t-1}} + \vartheta^*_{\lambda}\lambda_{y_m} , \tag{38}$$

which, differently from the unitary models, is the sum of a direct total resources effect and the bargaining power effect. This expression shows an important feature of the model, that is the fact that higher father earnings affect directly and indirectly the amount invested in children and thus children's outcomes. The most basic reason why parental income is a very important determinant of children performance is that if the amount invested in children is a normal good (as the positive total resources effect show), then better off households can buy better food, housing, medical care and we should therefore observe better child's outcomes. This reasoning however would be incomplete if we would not take into account that an increase in father's income affects spouses' bargaining power and thus child's outcomes. If the bargaining power effect is positive we would observe a reinforcement of the total resources effect, and the reverse is true if the bargaining power effect is negative.

The total effect of father earnings on children earning is given by the sum of these two effects and an indirect effect that works through the inheritability of abilities:

$$\frac{dW_t}{dy_{mt-1}} = \vartheta^*_{Y_{t-1}} + \vartheta^*_{\lambda}\lambda_{y_m} + \frac{\eta}{2}\frac{\vartheta^*_{a_t}}{\vartheta^*_{a_m}} . \tag{39}$$

The standard unitary model predicts stronger ties between parents' and child's earnings among families that are borrowing constrained, and this prediction has been object of empirical research with mixed results as reviewed in section 2. This is in fact an important question from a policy point of view. If greater persistence is due to the presence of borrowing constraints then there is a scope for policy interventions aimed at increase social mobility. However, a comparison of equations (38) and (39) suggests that the way we model household decision making has important consequences for the planning of public policies. It is still true that in the perfect capital market case (and in the group of rich household in the borrowing constraint model) earnings regress fast to the mean at a rate proportional to the transmission of abilities, but it would be wrong to assume that borrowing constraints bind in the same manner among households not leaving bequests to their children. The collective model of the household allows us to introduce a very important source of heterogeneity across households. Even for the same level of household income, families can greatly differ in the way resources and bargaining power are distributed across members, and they differ also in the way bargaining power affects child's outcome. The model suggests that borrowing constraints matter for children's future outcome since there are likely limits on educational and other human capital investment choices, but they matter to a different extent across households, since families differ in the way bargaining power is allocated across members and thus in the way resources are invested in children. We would expect borrowing constraints tighten more the link between father and child's earnings in households where the bargaining power effect is positive, that is in households where the lack of resources represents a greater problem because there is a greater willingness to invest in children. Thus, the direct relation between father's and child's earnings does not need to be linear, but it varies across the distribution of λ_{t-1}. Consider, for example, the Cobb Douglas example of section 3. There we have that:

$$\left.\frac{dY_t}{dy_{it-1}}\right|_{da_t=0} = (1+r)\left[\left(\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right) + \left(\alpha_f - \alpha_m\right)\lambda_{yi}\left(Y_{t-1} + \frac{a_t}{1+r}\right)\right],$$

where $(1+r)\left(\lambda_{t-1}\alpha_f + (1-\lambda_{t-1})\alpha_m\right)$ is the positive total resources effect, and $\lambda_{yi}\left(\alpha_f - \alpha_m\right)(1+r)\left(Y_{t-1} + \frac{a_t}{1+r}\right) = \lambda_{yi}\frac{\partial Y_t}{\partial \lambda_{t-1}}$ is the bargaining power effect.

For these reasons, empirical tests of the borrowing constraints model might be misleading if we ignore this important source of household heterogeneity. Alleviation of borrowing constraints might therefore have the greatest impact in families where the household structure is such that there is a great willingness to invest in children. Neglecting of this aspect could reduce the efficacy of policies aiming at the alleviation of borrowing constraints.

4.1 An Extension: Parents and Child's Human Capital

Up to this point we considered households as having the same technology for the production of human capital. One way to relax this assumption and introduce heterogeneity in the production of child's human capital is to expand equation (23) in the following way:

$$H_t = f\left(h_t, a_t, H_{mt-1}, H_{ft-1}\right), \tag{40}$$

with $f_h > 0, f_{hh} < 0, f_a > 0, f_{ha} > 0$, $f_{H_f} > 0, f_{H_m} > 0, f_{hH_f} > 0, f_{hH_m} > 0$. This captures the idea that greater parental human capital positively affects children's human capital as well as the returns to investment. More educated parents are in fact more efficient producers of child human capital. They are likely to get more output from a given amount of inputs because their greater level of education is such that they can get the same task done more efficiently, this is the concept of productive (or worker) efficiency which refers to the marginal product of education $\left(f_H > 0\right)$. But greater parental human capital can also allow parents to select better inputs. For example, they can select better schools, they are more aware of the benefits of a good diet for the child and so on, and this is likely to increase the productivity of the amount invested in children.

We might be interested to see how parental human capital affects child's human capital and thus, the degree of intergenerational mobility. Let's first consider the effect of an increase in, say, female human capital, for the perfect capital market case.

A. Perfect Capital Markets

Differentiating the first order conditions of the household problem with respect to female human capital and following the lines of previous pages, straightforward calculations show that:

$$\frac{\partial \hat{h}_t}{\partial H_f} = \frac{1}{|A|} v' \gamma_{t-1} f_{hH_f} \theta \left[-\lambda_{t-1}(1-\lambda_{t-1}) u''^m u''^f - \gamma_{t-1} v'' R_k^2 \left(\lambda_{t-1} u''^f + (1-\lambda_{t-1}) u''^m \right) \right] > 0, \tag{41}$$

since $|A| < 0, f_{hH_f} > 0$.

From this, we have that:

$$\hat{h}_t = \tilde{g}(a_t, R_k, H_f, H_m) \text{ and } H_t = f(\tilde{g}(a_t, R_k, H_f, H_m), a_t, H_f, H_m), \tag{42}$$

Then, the impact of an increase of mother human capital on child's human capital is given by:

$$\frac{\partial H_t}{\partial H_{ft-1}} = f_{\tilde{g}} \tilde{g}_{H_f} + f_{H_f} > 0, \tag{43}$$

and in the case of positive assortative mating between parents' education levels:

$$\frac{\partial H_t}{\partial H_{ft-1}} = f_{\tilde{g}} \left(\tilde{g}_{H_f} + \tilde{g}_{H_m} \beta_H \right) + f_{H_f} + f_{H_m} \beta_H > 0, \tag{44}$$

where $\beta_H > 0$ measures the positive degree of sorting and derives form the following matching function: $H_{mt-1} = \beta_0 + \beta_H H_{ft-1} + v_{t-1}$. Finally, we have that:

$$W_t = \tilde{\vartheta}\left(a_t, H_{mt-1}, H_{ft-1}, R_k\right) + \varepsilon_t \tag{45}$$

In this case, even in absence of inheritability of abilities, earnings persist across generations because fathers with greater human capital have higher earnings, their children accumulate greater human capital and thus will have greater earnings when adults:

$$\left.\frac{dW_t}{dy_{mt-1}}\right|_{da_t=0} = \tilde{\vartheta}_{H_m} \frac{\partial H_m}{\partial y_{mt-1}} = \frac{1}{\theta}\tilde{\vartheta}_{H_m} . \tag{46}$$

This allows also earnings persistence to differ depending on whether father or mother earnings are measured. If rates of return on human capital were the same for males and females $(\theta_m = \theta_f = \theta)$ but mother human capital is a more important determinant of child's human capital $\tilde{\vartheta}_{H_f} > \tilde{\vartheta}_{H_m}$, then earnings would be more persistent when measured with respect to the mother.

Depending on whether intergenerational earnings correlations are due simply to the correlation of abilities or also of human capital might be important from a policy point of view. Society might not be willing to level the playing field if the only circumstance trough which parents affect children outcome is transmissions of abilities, but it might be willing to level the playing field if parental human capital is the key determinant of children's economic success. In this case, even if capital markets are perfect and families can afford the efficient level of investment, differences in earnings can still arise if there is human capital heterogeneity in the parental generation, since families with greater human capital will invest more in their children. In this case, redistributive policies might well reduce inequality in schooling and earnings, but at the cost of reducing efficiency.

B. Imperfect Capital Markets

The dynamics of human capital transmission across generations are more complicated to analyze in this case, since parents' human capital will have a direct effect on children outcomes as well as an indirect effect through income and members' bargaining power.

In this case, it is possible to show that a compensated increase in female human capital is given by:

$$\frac{\partial \hat{h}_{t-1}}{\partial H_f} = \frac{\partial \hat{h}_{t-1}}{\partial \lambda_{t-1}} \lambda_{H_f} + \frac{\lambda_{t-1} u''^f + (1-\lambda_{t-1}) u''^m}{|B|} \theta \gamma_{t-1} \left(f_h R_h v'' + v' f_{hH_f} \right), \tag{47}$$

which is ambiguous a priori. Nevertheless, we are able to see the different mechanisms by which mother human capital affects children.

The optimal amount invested in children is now a function not only of household resources, female bargaining power and ability, but also of parents' human capital: $\hat{h}_t = \tilde{g}^* (a_t, Y_{t-1}, \lambda_{t-1}, H_m, H_f)$ and $H_t = f\left(\tilde{g}^* (a_t, Y_{t-1}, \lambda_{t-1}, H_f, H_m), a_t, H_f, H_m\right)$ and from this we have that (abstracting from positive assortative mating):

$$\frac{\partial H_t}{\partial H_{ft-1}} = f_{\tilde{g}} \left(\tilde{g}^*_{H_f} + \tilde{g}^*_{\lambda} \lambda_{H_f} + \tilde{g}^*_{\lambda} \lambda_{y_f} \frac{\partial y_f}{\partial H_f} + \tilde{g}^*_{Y_{t-1}} \frac{\partial y_f}{\partial H_f} \right) + f_{H_f} \tag{48}$$

This expression rationalizes the different channels of transmission of human capital from mother to children that most empirical work tried to identify especially with data on developing countries. We have a positive direct effect which captures the productive efficiency story described above, $f_{H_f} > 0$, and a positive income effect $\tilde{g}^*_{Y_{t-1}} \frac{\partial y_f}{\partial H_f}$ since the amount invested in children is a normal good. The term $\tilde{g}^*_{H_f}$ is ambiguous a priori since, as in the case of ability, it captures income and substitution effects working in opposite directions: the negative income effect arises from the fact that children from parents with greater human capital are richer, and expenditures of children are discouraged when children are expected to be richer. The positive substitution effect derives from the fact that greater parental human capital increases the marginal rates of return on children encouraging investments$(f_{hH} > 0)$. If the allocative effect of education is strong, the substitution effect is likely to dominate. Furthermore, we have bargaining power effects. Grater female human capital can improve woman's stand in the household both directly $(\lambda_{H_f})$and indirectly through and increase in her earning power $\left(\lambda_{y_f}\right)$. If greater female power positively affects investments in children, then we would have a potentially other important transmission mechanism through which mother education affects child's human capital. To the best of out knowledge, this pathway of influence has not been explored in empirical work, and could be an interesting area for future research.

Finally, the correlation between parents and children's human capital might add an additional source of earnings correlation across generations, which can weaken or reinforce persistence according to its strength. Letting:

$$W_t = \theta f\left(\tilde{g}^*\left(a_t, Y_{t-1}, \lambda_{t-1}, H_f, H_m\right), a_t, H_f, H_m\right) + \varepsilon_t = \tilde{\vartheta}^*\left(a_t, Y_{t-1}, \lambda_{t-1}, H_{mt-1}, H_{ft-1}\right) + \varepsilon_t$$

we have that our structural parameter of interest is given by:

$$\left.\frac{dW_t}{dy_{it-1}}\right|_{da_t=0} = \tilde{\vartheta}^*_{Y_{t-1}} + \tilde{\vartheta}^*_{\lambda}\lambda_{y_i} + \tilde{\vartheta}_{H_i}\frac{\partial H_i}{\partial y_{it-1}}. \tag{49}$$

5 Intergenerational Consumption Mobility

While earnings are the most widely used measure of economic status in the study of intergenerational mobility, consumption might be more interesting because it is more closely related to welfare. However, except for Mulligan (1997, 1999), a detailed analysis of consumption mobility is scarce. In this section we extend the collective model of the household to study consumption mobility from a theoretical point of view.

To derive analytical solutions for the *collective* consumption expansion path, we follow Mulligan (1997, 1999) in making the following functional form assumptions[19] and we write our collective household problem in terms of woman, man and child's consumption $\left(C_t\right)$:

$$\underset{C_m, C_f, C_t, h_t, k_t}{Max}\ \lambda_{t-1}\left(\frac{C_{ft-1}^{1-\pi}}{1-\pi} + \alpha_f\frac{C_t^{1-\pi}}{1-\pi}\right) + \left(1-\lambda_{t-1}\right)\left(\frac{C_{mt-1}^{1-\pi}}{1-\pi} + \alpha_m\frac{C_t^{1-\pi}}{1-\pi}\right), \tag{50}$$

s.t. $C_t = W_t + R_k k_t = \theta H_t + R_k k_t$

[19] Differently from the author, however, we do not explicitly model uncertainty.

$H_t = f(a_t, h_t) = a_t h_t^{\tau}$

$C_{t-1}^{m} + C_{t-1}^{f} + h_t + k_t = y_{mt-1} + y_{ft-1} + y_0$

$k_t \geq 0.$

The solution set then depends on whether the Lagrange multiplier on the non negativity constraint is positive or zero.

A. Perfect capital markets

If capital markets are perfect, no restrictions are imposed on the values k_t can take. In this case, from the first order conditions of the household maximization problem, we have:

$$\frac{\lambda_{t-1} C_{ft-1}^{-\pi}}{\lambda_{t-1}\alpha_f C_t^{-\pi} + (1-\lambda_{t-1})\alpha_f C_t^{-\pi}} = \frac{(1-\lambda_{t-1}) C_{mt-1}^{-\pi}}{\lambda_{t-1}\alpha_f C_t^{-\pi} + (1-\lambda_{t-1})\alpha_f C_t^{-\pi}} = R_k \, . \qquad (51)$$

From this, several manipulations lead to the following evolution equations for consumption:

$$\ln C_t \cong \ln C_{ft-1} + \frac{1}{\pi}\frac{\alpha_m}{\alpha_f}\frac{1}{\lambda_{t-1}} + \frac{1}{\pi}\ln \alpha_f - \frac{1}{\pi}\frac{\alpha_m}{\alpha_f} + \frac{1}{\pi}\ln R_k \qquad (52)$$

$$\ln C_t \cong \ln C_{mt-1} + \frac{1}{\pi}\frac{\alpha_m}{\alpha_f}\frac{1}{\lambda_{t-1}} + \frac{1}{\pi}\ln\frac{\lambda_{t-1}}{1-\lambda_{t-1}} + \frac{1}{\pi}\ln \alpha_f - \frac{1}{\pi}\frac{\alpha_m}{\alpha_f} + \frac{1}{\pi}\ln R_k \, . \qquad (53)$$

In this case, our structural parameter of interest which measures persistence of log consumption, is given by the effect of an exogenous change in parental consumption, and is equal to one for both male and female consumption. Thus, as in the unitary case, the model would predict that consumption would not regress to the mean across generations. Mulligan (1997 1999) notes that in the unitary case this prediction is counterfactual. In particular, he analyzes how heterogeneity in altruism bias downward estimates of consumption persistence across non-borrowing constrained families. With enough heterogeneity in altruism, estimates of log consumption persistence might give a coefficient less than one. However, if we instrument parental consumption with parental income in order to correct for this source of heterogeneity we should get a coefficient of one. But his estimates do not support this conclusion, and the author suggests that his endogenous altruism model is the only one able to predict regression to the mean in consumption even among non-borrowing constrained families, consistently with the data.

Our model, however, allows us to derive different conclusions. First, it outlines how the relevant consumption measure is an individual one; in fact the model gives two evolution equations for consumption. Second, it is important to note that even in absence of heterogeneity in altruism, household heterogeneity introduced by λ_{t-1} and ignored by (or unobserved to) the econometrician might still lead to a persistence of log consumption less than one. In this case, trying to control for heterogeneity in altruism alone might not be enough to reject the null hypothesis of a coefficient equal to one if we do not control also for heterogeneity in λ_{t-1}. These conclusions can be summarized by the following proposition:

Proposition 5. *When capital markets are perfect, consumption does not regress to the mean across generations (i.e. consumption elasticity is equal to 1). However if there is heterogeneity in female household bargaining power, OLS estimates of the degree of consumption persistence would be inconsistent even in absence of heterogeneous altruism rates.*

Proof. Suppose there is no heterogeneity in altruism rates. We can rewrite equation (52) as:

$$\ln C_t \cong cst + \ln C_{ft-1} + \frac{1}{\pi}\frac{\alpha_m}{\alpha_f}\frac{1}{\lambda_{t-1\ k}} + \xi_t$$

Where $cst = \frac{1}{\pi}\ln\alpha_f - \frac{1}{\pi}\frac{\alpha_m}{\alpha_f} + \frac{1}{\pi}\ln R_k$ and ξ_t captures other exogenous unmeasured factors. Then we have that:

$$p\lim\left(\hat{\beta}_{C_t,C_{ft-1}}\right)=1+\frac{1}{\pi}\frac{\alpha_m}{\alpha_f}\frac{\operatorname{cov}\left(\frac{1}{\lambda_{t-1}},\ln C_f\right)}{\operatorname{var}\left(\ln C_f\right)}<1,$$

since $\frac{1}{\pi}\frac{\alpha_m}{\alpha_f}>0$, $\frac{\partial \ln C_f}{\partial \lambda_{t-1}}>0$. Along the same lines it is possible to prove that $p\lim\left(\hat{\beta}_{C_t,C_{mt-1}}\right)=<1$.

This would add to the source of bias generated by heterogeneous ability and altruism identified in Han and Mulligan (2001). Note that since λ_{t-1} does not affect the amount invested in children in the perfect capital market model, it does not enter the earnings equation. Heterogeneity in λ_{t-1} thus would not add a new source of inconsistency to estimated degree of earnings persistence in the perfect capital market case.

B. Imperfect capital markets

When the Lagrange multiplier is greater than zero, $k_t>0$, and borrowing constraints are not binding. In this case, the evolution equation of consumption is the same as in the perfect capital market case. In this case, however, it is not possible to obtain an analytical expression for the inconsistency due to ignored or unobserved heterogeneity in λ_{t-1}, since we should compute conditional expectations given the selection rule, which is complicated. In this case, estimates of the degree of consumption persistence would suffer from an additional negative omitted variable bias and a selection bias whose sign is ambiguous. Following Han and Mulligan 2001, several calculations allow us to show that the selection rule in our collective framework is given by:

$$k_t>0 \Leftrightarrow \left(Y_{t-1},a_t,\lambda_{t-1}\right)\in\Theta,$$

where

$$\Theta\equiv\left\{\left(Y_{t-1},a_t,\lambda_{t-1}\right):\ln Y_{t-1}-\frac{2-\tau}{1-\tau}\ln a_t-\ln\left(1+\frac{\left(R_k\right)^{1-\frac{1}{\pi}}}{\tau}\left(\lambda_{t-1}\alpha_f+\left(1-\lambda_{t-1}\right)\alpha_m\right)^{-1/\pi}\left(\lambda_{t-1}^{1/\pi}+\left(1-\lambda_{t-1}^{1/\pi}\right)\right)\right)>G\right\},$$

where $G=\frac{2-\tau}{1-\tau}\ln\frac{R_k}{\theta\tau}$. (54)

When borrowing constraints are binding, $k_t = 0$ and we obtain the following evolution equations of consumption:

$$\ln C_t \cong \beta \ln C_{ft-1} + \frac{1}{\pi}\beta\frac{\alpha_m}{\alpha_f}\frac{1}{\lambda_{t-1}} + \frac{1}{\pi}\beta \ln \alpha_f - \frac{1}{\pi}\beta\frac{\alpha_m}{\alpha_f} + \frac{1}{\pi}\beta \ln \theta\tau + \frac{1}{\pi\tau}\ln a_t \tag{55}$$

$$\ln C_t \cong \beta \ln C_{mt-1} + \frac{1}{\pi}\beta\frac{\alpha_m}{\alpha_f}\frac{1}{\lambda_{t-1}} + \frac{1}{\pi}\beta \ln\frac{\lambda_{t-1}}{1-\lambda_{t-1}} + \frac{1}{\pi}\beta \ln \alpha_f - \frac{1}{\pi}\beta\frac{\alpha_m}{\alpha_f} + \frac{1}{\pi}\ln \theta\tau + \frac{1}{\pi\tau}\beta a_t \tag{56}$$

where $\beta = \dfrac{\tau}{1+\frac{1}{\pi}(1-\tau)} < 1$. In this case, the model would predict that consumption regresses to the mean across generations. Also in this case, unaccounted heterogeneity in λ_{t-1} adds an additional negative omitted variable bias and a selection bias whose sign is ambiguous, and the magnitude cannot be computed analytically.

The model in (50) assumes that mother and father have the same degree of relative risk aversion (π), or equivalently the same elasticity of substitution $\left(\frac{1}{\pi}\right)$. A special case is given by $\pi = 1$ with utility functions reducing to a simple log-log functional form. This assumption, however, might be restrictive if we assume that the willingness to trade off consumption at different points in time is an individual rather than household characteristic. We could then reformulate the problem above assuming different degrees of intertemporal substitution between men and women, π_m, π_f . However, the price to pay in this case is that closed form solutions for the evolution equations for consumption cannot be obtained. Several calculations show that we can only derive children consumption as an implicit function of parents' consumption and female bargaining power:

$$\ln C_t = \chi_f\left(\ln C_{ft-1}, \lambda_{t-1}\right) \tag{57a}$$

$$\ln C_t = \chi_m\left(\ln C_{mt-1}, \lambda_{t-1}\right), \tag{57b}$$

whose derivatives can be computed analytically. For the perfect capital market case and for the group of families with $k_t > 0$ in the imperfect capital market case we have that:

$$\frac{\partial \ln C_t}{\partial \ln C_{ft-1}} = \frac{1}{1-\left(1-\frac{\pi_m}{\pi_f}\right)\frac{\rho}{\rho+\lambda_{t-1}\alpha_f}}\text{, and } \frac{\partial \ln C_t}{\partial \ln C_{mt-1}} = \frac{1}{1-\left(1-\frac{\pi_f}{\pi_m}\right)\frac{\delta}{\delta+(1-\lambda_{t-1})\alpha_m}} \tag{58}$$

where $\rho = (1-\lambda_{t-1})\alpha_m C_{t-1}^{\frac{1}{\pi_f}\left(1-\frac{\pi_m}{\pi_f}\right)}$, $\delta = \lambda_{t-1}\alpha_f C_{t-1}^{\frac{1}{\pi_m}\left(1-\frac{\pi_m}{\pi_f}\right)}$. From this, it follows that

$$\frac{\partial \ln C_t}{\partial \ln C_{ft-1}} = \begin{cases} 1 & if \quad \frac{1}{\pi_m} = \frac{1}{\pi_f} \\ >1 & if \quad \frac{1}{\pi_m} > \frac{1}{\pi_f} \\ \in (0,1) & if \quad \frac{1}{\pi_m} < \frac{1}{\pi_f} \end{cases} \qquad \frac{\partial \ln C_t}{\partial \ln C_{mt-1}} = \begin{cases} 1 & if \quad \frac{1}{\pi_m} = \frac{1}{\pi_f} \\ >1 & if \quad \frac{1}{\pi_m} < \frac{1}{\pi_f} \\ \in (0,1) & if \quad \frac{1}{\pi_m} > \frac{1}{\pi_f} \end{cases} \tag{59}$$

In the unitary case, Mulligan (1997) demonstrates that regression to the mean in consumption even among non-borrowing constrained families contradicts the prediction of the Becker's model. However, in our collective setting, we have that even when capital markets are perfect or families leave positive bequests, we could have a value of the consumption elasticity less than one, depending on the relative magnitudes of the intertemporal elasticity of substitution of different members.

Analogously, for the borrowing constrained families it is possible to show that:

$$\ln C_t = \psi_f\left(\beta_f \ln C_{ft-1}, \lambda_{t-1}, a_t\right) \tag{60a}$$

$$\ln C_t = \psi_m\left(\beta_m \ln C_{mt-1}, \lambda_{t-1}, a_t\right), \tag{60b}$$

whose derivatives computed analytically are given by:

$$\frac{\partial \ln C_t}{\partial \ln C_{ft-1}} = \frac{\beta_f}{1-\beta_f\left(1-\frac{\pi_m}{\pi_f}\right)\frac{\rho}{\rho+\lambda_{t-1}\alpha_f}}, \quad \frac{\partial \ln C_t}{\partial \ln C_{mt-1}} = \frac{\beta_m}{1-\beta_m\left(1-\frac{\pi_f}{\pi_m}\right)\frac{\delta}{\delta+(1-\lambda_{t-1})\alpha_m}}$$

where $\beta_i = \dfrac{\tau}{\tau + \dfrac{1}{\pi_i}(1-\tau)} < 1$, for $i = m, f$. From this we have that:

$$\frac{\partial \ln C_t}{\partial \ln C_{ft-1}} = \begin{cases} \beta_f & if \quad \dfrac{1}{\pi_m} = \dfrac{1}{\pi_f} \\ > \beta_f & if \quad \dfrac{1}{\pi_m} > \dfrac{1}{\pi_f} \\ < \beta_f & if \quad \dfrac{1}{\pi_m} < \dfrac{1}{\pi_f} \end{cases} \text{ and } \frac{\partial \ln C_t}{\partial \ln C_{mt-1}} = \begin{cases} \beta_m & if \quad \dfrac{1}{\pi_m} = \dfrac{1}{\pi_f} \\ > \beta_m & if \quad \dfrac{1}{\pi_m} < \dfrac{1}{\pi_f} \\ < \beta_m & if \quad \dfrac{1}{\pi_m} > \dfrac{1}{\pi_f} \end{cases} \tag{61}$$

Thus, for example, in the case female elasticity of substitution is greater than that of the male, the child's consumption elasticity with respect to mother's consumption would be less than one in both the perfect and imperfect capital market model, with a lower absolute value in the latter.

Most of the empirical literature on intergenerational mobility focuses on the analysis of intergenerational earnings mobility. To the best of our knowledge, except for Mulligan (1997, 1999), no contributions have been made to the study of intergenerational consumption mobility from both a theoretical and empirical perspective. Clearly as interesting it might be the estimation of consumption mobility the problem is that the estimation of these relationships might be too demanding for most datasets, since in general there is no information on individual consumption levels. Furthermore, this study highlights the importance of the intergenerational elasticity of substitution, about which empirical knowledge is terribly limited. Nevertheless, if we believe that the household are better to be treated as a collection of individuals and if "who gets what" in the household matters as much previous research indicated, greater efforts are needed to collect information at both household and individual level. In our context, this could be of great help for a deeper understanding of intergenerational consumption mobility which, we believe, constitute an important aspect of a country aspect of welfare inequality.

6 Summary and Conclusions

The transmission of economic status from one generation to the next is a potentially important source of inequality. However, considerably less research has been conducted compared to the analysis of cross sectional inequality, especially from a theoretical point of view.

From a policy point of view it is important to understand the channels of transmission of economic status from one generation to the next. A society might be willing to level the playing field if disparities arise, for example, from the presence of liquidity constraints, discrimination or local segregation, but might be less willing to do so if disparities are the results of different genetic abilities, beliefs and so on. There is substantial evidence that persistence of economic status across generations is quite strong, but what are the sources?

The characteristic of the *economic* approach to the study of intergenerational mobility is that it does not consider the transmission of economic status between generations as the result of a *mechanical* process, but individual choices and behaviors are viewed as its key determinant. Parents' choices about the division of resources between themselves and their children will affect their offspring human capital level and economic success. Standard economic models of intergenerational mobility consider individuals with finite lifetimes who care about their children. In this setting, however, marriage and household structure are ignored, and the household is treated as a single decision unit.

In this paper we study how family's decisions about investments in human and non-human capital of children are an important determinant of adult's earnings and thus of persistence in income differentials. We propose a theoretical model of investments in children that allows parents to have different preferences, and investigate how the intra-household distribution of power affects children's outcomes and thus intergenerational mobility. We find that the distribution of decision power within the household matters for children's outcomes. Interestingly, we find that the effect of an increase in female bargaining power on the amount invested in children is not monotonic, but depends on the level of power the woman start with. The most important result related to the explicit consideration of individual preferences of single family members in the collective framework is that household income dynamics are determined not only by the parents' degree of altruism but also by the distribution of power within the household.

Through the analysis of a centralized collective model in the simplest set-up with no distinction between investments in human and non-human capital, it is shown that the standard unitary model ignores the effect of changes in the relative decision of power on the equilibrium value of the income of the future generations.

When we allow for both human and non-human capital investments and capital markets are perfect, the model shows that the amount invested in children is independent of the level of household resources and parental altruism, as in the standard unitary case, and is also independent of the distribution of the resources within the household. In this case, the absence of borrowing constraints allows parents to separate the amount invested in children not only from total resources and altruism but also from the relative power of single members. Thus, the amount invested in children's human capital is a function only of ability and interest rate. Parental income has therefore no causal effect on children's earnings, and earnings transmit across generations at a rate that is a function of the intergenerational transmission of abilities.

When capital markets are imperfect, the collective model of the household allows us to introduce a very important source of heterogeneity across families. For the same level of household income, families can greatly differ in the way resources and bargaining power are distributed across members, and they differ also in the way bargaining power affects children's outcome. The amount invested in children's human capital is thus function not only of total household resources but also of the distribution of power within the household, as well as of ability and parental altruism. In this setting, higher father earnings affect directly and indirectly the amount invested in children and thus children's outcomes. The most basic reason why parental income is a very important determinant of children's performance is that if the amount invested in children is a normal good, then better off households can buy better food, housing, medical care and we should therefore observe better children's outcomes. This reasoning however would be incomplete if we do not take into account that an increase in father's income affects spouses' bargaining power and thus the amount invested in children. If the bargaining power effect is positive we would observe a reinforcement of the total resources effect, and the reverse is true if the bargaining power effect is negative. The total effect of father's earnings on children's earnings is given by the sum of these two effects and an indirect effect that works through the inheritability of abilities. The same reasoning would apply to the effect of mother's earnings. However, the model would allow for a different impact through a differential effect of mother and father's earnings on the intra-household balance of power.

The model suggests that borrowing constraints matter for children's future outcome since there are likely limits on educational and other human capital investment choices, but they matter to a different extent across households, since families differ in the way bargaining power is allocated across members and thus in the way resources are invested in children. We would expect borrowing constraints tighten more the link between father and child's earnings in households where lack of resources represents a greater problem because there is a greater willingness to invest in children.

The model is extended to allow for heterogeneous production function of child human capital across households allowing parental human capital to affect the accumulation of child human capital. The idea is that greater parental human capital positively affects children's human capital as well as the returns to investment. In the case of perfect capital markets the model shows that even in absence of inheritability of abilities, earnings persist across generations because of the correlation in human capital across generations. In this case, even if all families can afford the efficient level of investment, differences in earnings arise if there is heterogeneity in human capital in the parents' generation. When borrowing constraints are binding, intergenerational dynamics are more complicated to analyze since parents' human capital has a direct effect on children's outcomes as well as an indirect effect through income and household members' decision power. The model allows us to explicitly disentangle the different channels through which parental education affects children's human capital.

The fact that parental and especially maternal education positively affects child health and education is a well known empirical result in the economic literature. However, this issue has been traditionally analyzed in the framework of the unitary model. Our set-up displays another potentially important transmission channel from maternal education to child's health. Maternal education can positively affects the relative status-power of women within the household, thus influencing the allocation of resources invested in children, even for the same level of actual or potential female income and labor force participation. This could also potentially help to understand some of the unexplained part of the effect of mother's education in previous studies about this issue especially in developing countries. Empirical evidence that improvement in mother's education increases her decision power within the household and thereby affects children's outcomes would provide an additional strong rationale for policies aimed at improving children's welfare.

The final part of the paper analyzes intergenerational consumption mobility. While earnings are the most widely used measure of economic status in the study of intergenerational mobility, consumption might be more interesting because it is more closely related to welfare. However, except for Mulligan (1997, 1999), a detailed analysis of consumption mobility is scarce. Thus, we extend Mulligan into a collective framework.

The results show that when capital markets are perfect, consumption does not regress to the mean across generations, analogously to the unitary model. However, the collective model allows us to introduce heterogeneity in female household bargaining power as another potential source of heterogeneity, in addition to heterogeneous altruism rates considered by Hahn and Mulligan (2001), which can potentially affects the degree of consumption persistence. The model also shows that when capital markets are imperfect, unaccounted heterogeneity in λ_{t-1} can affect the degree of consumption persistence.

When we extend the model to allow for different degrees of intertemporal elasticity of substitution between household members we have that –contrary to the unitary model- with perfect capital markets or positive bequests it is possible to have a value of the consumption elasticity less than one, depending on the relative magnitudes of the intertemporal elasticity of substitution of different members. This highlights the important role the intergenerational elasticity of substitution can play in intergenerational consumption mobility, about which empirical knowledge is terribly limited.

These results altogether suggest that failure to account for intrahousehold balance of power as source of household heterogeneity might thus affect the interpretation of the structural parameters of interest and the estimation of both earnings and consumption persistence.

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