

Share the Love: Parental Bias, Women Empowerment and Intergenerational Mobility

Théophile T. Azomahou^{(a,b)*}, Yoseph Y. Getachew^(c), Eleni A. Yitbarek^(b,c)

^(a) University of Clermont Auvergne and CERDI
65 Boulevard François Mitterrand, Clermont-Ferrand, France

^(b) Maastricht University and UNU-MERIT
Boschstraat 24, 6211 AX Maastricht, The Netherlands

^(c) Department of Economics, University of Pretoria
Private bag X20, Hatfield 0028, South Africa

August 19, 2017

Abstract

This paper introduces a collective household decision-making process into a gender-based overlapping generations model with heterogeneous agents. Gender bias is modeled as part of parents' psychic cost – a reflection of their pessimism, which leads to different mobility thresholds for daughters and sons. In this setting, the degree of women's bargaining power is found to be crucial in defining their psychic cost and hence their children's mobility. The framework is then applied to the Nigerian General Household Survey panel data. We estimate a multinomial logit model with unobserved heterogeneity, to assess the intergenerational mobility across primary, secondary and tertiary sectors. We find that children whose parents work in the secondary and tertiary sectors are more likely to work in the same sector. Greater intra-household female bargaining power leads to greater upward mobility for boys more than girls. Parental gender bias could thus be one of the driving force behind gender-based intergenerational persistence.

Key words: Occupation mobility, gender bias, women bargaining power, sub-Saharan Africa

JEL classification: J16; J62, C35; D10, O55

* *Corresponding author:* Tel: +31 433 884 440, Fax: +31 433 884 499 (E-mail: theophile.azomahou@uca.fr)

1 Introduction

Many parents rightly claim the same degree of love for their children, regardless of their sex. However, it is also evident that there exists some form of gender bias and sex preferences in families. Several studies report that in India, boys fare better than girls (e.g., [Barcellos et al. 2014](#); [Aurino 2016](#)). They receive more child care, are breast-fed longer and even get more dietary supplements. In a recent study, [Jayachandran & Rohini \(2017\)](#) show that, relative to Africa, birth order in India is marked by favoritism towards eldest sons, which affects parents' fertility decisions and the allocation of resources within the family. The authors show that this gradient is more pronounced for the top-son preferences and also varies with sibling gender. This phenomenon is most acute in developing countries where the mortality rates are substantially higher for girls than for boys (e.g., [Chen et al. 1981](#); [Arnold et al. 1998](#); [Sen 1990](#)).¹ Such differential treatments of sons and daughters in intra-household resource allocation, in the form of disproportional parental time spending and investment in children education, could be important to intergenerational mobility of men and women.

The interest in intergenerational persistence is often not merely based on the question of its existence but, more importantly, on whether it is a result of inequality of opportunity. The fact that children naturally inherit at least some of their parents' characteristics could contribute to intergenerational persistence of social and economic outcomes. However, when social mobility varies by class, gender or race, it may be an indication of the existence of a differential access to opportunities, which is determined based on these characteristics. Intergenerational persistence becomes more of a policy concern if it is an outcome of inequality of opportunity rather than differences in ability that are often transmitted from parent to child. The unobservability of the latter, however, makes the task of understanding the underlying causes of the intergenerational correlation quite challenging.

This paper first develops a model of intra-household decision making process, parental gender bias and intergenerational occupational mobility (hereafter IG mobility). It then provides some empirical evidences on the role of gender and women bargaining power in IG mobility, using data from Nigeria, that accounts for *unobserved heterogeneity*. Given that women attach a relatively higher weight to the welfare of their children, the degree of their empowerment in household decision-making process could even be more important. However, in spite of a growing literature on gender and social mobility, the role of women empowerment on IG mobility has received a scant attention ([Currie & Moretti 2003](#); [Behrman & Rosenzweig 2005](#)).

The framework for our theoretical analysis is a gender based overlapping generations model in which married/partnered couples face a trade off between investment in their children education, their consumption and labour force participation. The theory builds on models of altruistic parents that face a warm glow utility and human capital investment threshold (e.g., [Banerjee & Newman](#)

¹In China, institutional factors explain explicit preferences for boys (sex-selective abortion and differential mortality).

1993; Galor & Zeira 1993; Moav 2002; Galor & Moav 2004; Galor & Mountford 2008), which defines individual intergenerational occupational mobility.² We follow Chiappori (1988) and Chiappori (1992) in introducing a collective household decision-making process that considers intra-household bargaining power between couples, which is determined according to the human capital of the couples (as in de la Croix & Donckt 2010).³ Another important motivation comes from the work of Ben-Porath & Welch (1976) and Davies & Zhang (1995) who treated gender inequality a result of parental sex preference, which is a feature of parental utility function.

A novel feature of our model comes with our specification of parental attitude towards different gendered children that determines their children’s human capital development and hence IG mobility. In particular, we treat parental gender bias as part of parental psychic cost, which negatively impacts their marginal benefit of investing in their children’s human capital. This could be a reflection of their pessimistic view of the world, which in turn could be a result of intrinsic values placed by the society in gender roles or gender stereotypes such as “the head of the woman is the man”. Parental bias against a certain gender group is associated to a relatively larger psychic cost attached to the specific gender. For instance, in a society where child marriage is commonly practiced, parents who have fear that their investment in their daughters is little rewarding may end up with a relatively larger psychic cost attached to their daughters’ human capital investment. Differences in psychic cost leads to differences in human capital investment threshold of girls and boys. This, in turn, determines the IG mobility threshold for women and men in the economy.

Using this framework, first, we show that parental gender bias could be a basis of gender-based intergenerational persistence. Second, we find that increased women’s bargaining power leads to higher IG mobility. Given that women attach a relatively high weight to the welfare of their children (Doepke & Tertilt 2009), then the degree of their intra-household bargaining power is important in defining the mobility of their children. Third, we find that sons (daughters) whose mothers work in non-farm sectors are more likely to work in the same sectors than sons (daughters) whose fathers work in non-farm sectors or than sons (daughters) whose two parents work in farm. We also find that between siblings, sons are relatively more mobile than their sisters, given that parents attach a relatively higher psychic cost to their daughters’ education. Fourth, individuals benefit from their opposite sex sibling misfortunes. When parents are biased against a particular gender, then they tend to compensate for it by investing more in the opposite sex. However, the total household education investment tends to be lower than what it would have been without a presence of psychic cost or gender bias, implying that parental gender bias could be a basis for aggregate inefficiency.

Our paper also complements, but differs, to the debate over gender inequality in human capital investment. Prominent examples include the work of Galor & Weil (1996), Echevarria & Merlo (1999), Lagerlof (2003), Iyigun & Walsh (2007) and de la Croix & Donckt (2010). Motivated by Becker (1981), Echevarria & Merlo (1999), Iyigun & Walsh (2007) and de la Croix & Donckt (2010),

²Aiyagari et al. (2000) also apply a gender based overlapping generations model with warm glow utility functions.

³Early work in modelling of intra-household decision making process as a bargaining problem goes back to Manser & Brown (1980) and McElroy & Horney (1981).

for instance, put biological differences between women and men at the centre of gender inequality in human capital accumulation. A restricted time allocation by women, in this literature, due to their biological time commitment to childcare during pregnancy, childbirth and breast-feeding, leads to a systematic gender differences in human capital investment. When women devote lower amount of their time to labor market activities, it negatively impacts their returns to education relative to men. This, in turn, leads to lower parental investment in daughters education. In [Lagerlof \(2003\)](#), gender inequality in human capital arises through a coordination process.⁴ In [Galor & Weil \(1996\)](#), it is rather a result of technological differences related to men’s and women’s types of labor. In contrast, in the current paper, gender inequality in human capital is due to differences in non-pecuniary cost associated to human capital investment of sons and daughters.

We apply the framework to a representative panel data survey from Nigeria while accounting for unobserved heterogeneity. Particularly, we use the Nigerian General Household Survey data that cover over 5,000 households and about 14,000 individuals in the years 2011 and 2013, each. In both waves, we observe the main industry of occupation and the highest level of education for two generations. For children, we observe their most recent job; for parents, the industry of occupation they got engaged into throughout most of their life. We study three economic sectors: primary, secondary and tertiary, in contrast to the (limited) literature in developing countries that merely focuses on two sectors – agriculture and non-agriculture. Using both restricted (sub-sample of adult children who live with their parents) and un-restricted samples of all children, we estimate a multinomial logit model with unobserved heterogeneity using simulated maximum likelihood. Our main empirical findings are twofold: First, children with parents working in the secondary and tertiary sectors are more likely to work in the same sector. Second, a greater intra-household female bargaining power leads to greater upward mobility while it benefits boys more than proportionally. Therefore, parental gender bias could be a driving force behind gender-based intergenerational persistence.

Intergenerational mobility studies in developing countries and, to a lesser extent, in advanced economies focus out of necessity on sons and their fathers. Research on the implications of mother’s occupation in the occupational outcomes of their adult children are in particular quite limited in developing countries despite ample evidences that suggest the importance of maternal background (such as mother’s educational attainment, occupation and income) on children’s adulthood socio-economic outcomes (see, for instance, [Grusky & DiPrete 1990](#); [Chadwick & Solon 2002](#); [Beller 2009](#); [Azomahou & Yitbarek 2016](#)). Some of the few exceptions are work by [Lambert et al. \(2014\)](#) and [Emran & Shilpi \(2011\)](#) that examine the gender effects of IG mobility in developing countries.⁵ However, this literature abstracts from women empowerment issue and merely focuses on two sec-

⁴Families play a coordination game against one another, not only caring about the income of their daughters but also the income of their future spouses. In this case, it may be optimal for an atomistic parent to discriminate when all other families discriminate against their daughters.

⁵[Azomahou & Yitbarek \(2016\)](#), [Emran & Shilpi 2015](#) and [Currie & Moretti \(2003\)](#) study intergenerational *education mobility* from gender perspective in developing countries.

tors (agriculture and non-agriculture). For instance, [Emran & Shilpi \(2011\)](#) study IG mobility from agriculture to the non-farm sectors in Nepal and Vietnam. They document strong intergenerational occupation persistence between mothers and daughters in the non-farm sectors in Nepal but not in Vietnam.⁶ In contrast, our paper brings intra-household bargaining power to the front of gender based IG mobility with a focus on three sectors (namely, primary, secondary and tertiary or service sectors).⁷

The rest of the paper is organized as follows: Section 2 develops the theoretical model and provides the analytical results. Section 3 describes the data. Section 4 presents the econometric framework and estimation strategy. Section 5 discusses the estimation results. Section 6 concludes the study. Proof of propositions and further details on the empirics are provided in the Appendix.

2 The Model

Suppose an overlapping generation of many individuals identified as male and female. Each person lives for two periods as a child and an adult. We assume children do not make decision and all economic decisions are made by adults, as in [de la Croix & Donckt \(2010\)](#). Children either go to school and accumulate human capital, if their parents invest in their education, or do nothing. Their consumption in both cases is set to nil.⁸ Adulthood begins by women and men joining in a partnership. When reaching adulthood, the son and the daughter of a given family simply draw spouses at random from other families and form their own family.⁹ At any point in time, each family, indexed by $i \in (0, 1)$, consists of two opposite-sex young – the offsprings – and two opposite-sex adults – the parents. Therefore, the size of the population is constant.¹⁰ Couples *collectively* decide in working or spending time with their children, in their consumption, and for the level of their children education, subject to the household constraints. The weight of their decision on such household matters depends on their relative bargaining power, which in turn depends on their relative human capital.

2.1 Preferences

The utility function of the i th household is given by

$$(2.1) \quad u_{it}(c_{it}, h_{it+1}) = \theta_{it} u^f(c_{it}, h_{it+1}) + (1 - \theta_{it}) u^m(c_{it}, h_{it+1})$$

⁶[Lambert et al. \(2014\)](#) explore IG mobility from gender point of view in Senegal and they find higher maternal intergenerational occupational persistence and highlight the importance of non-land inheritance and mother’s occupation to children adulthood welfare.

⁷Most of the existing work on the intergenerational aspects of women’s empowerment in developing countries has focused on fertility issues (e.g., [Lloyd 1991](#); [Entwisle & Chen 2002](#); [de la Croix & Donckt 2010](#)) and welfare of young children ([Desai & Jain 1994](#)), with little attention to the effects of women bargaining power on gender based IG mobility.

⁸Alternatively, it could be assumed that their consumption to be included in the consumption of their parents.

⁹For the sake of simplicity, we abstract from the possibility of remaining single, being divorced or being in a same-sex marriage.

¹⁰This is a standard assumption given that we abstract from fertility issues.

where u^f and u^m represent the utility of the female and male adults, respectively; c_{it} and h_{it+1} denote the respective total household consumption and children human capital. θ_{it} represents the bargaining power of the female adult; $1-\theta_{it}$, that of the male adult. Following [de la Croix & Donckt \(2010\)](#), we model θ_{it} as a function of the couple's relative human capital:

$$(2.2) \quad \theta_{it} = (1 - \epsilon) (1 - \bar{\theta}) + \epsilon \frac{h_{it}^f}{h_{it}^f + h_{it}^m}$$

where h_{it}^f and h_{it}^m stand for the human capital of the female and male adults, respectively. The last term captures the effect of relative human capital on the couple's intra-household bargaining power. The parameter $\epsilon \in (0, 1)$ represents the marginal impact of the female's relative human capital in her intra-household bargaining power. If $\epsilon = 0$, then $\theta_{it} = (1 - \bar{\theta})$ and, hence, bargaining power is exogenous and the model belongs to the *unitary* household models.¹¹ $\bar{\theta} \in (0, 1)$ is a parameter that captures the exogenous institutional and social factors that affect intra-household bargaining power. For instance, if $\bar{\theta} > 0.5$, due to some gender stereotypes, the bargaining power of women is less than that of men even if $h_{it}^f = h_{it}^m$.¹²

Let the utility function of the j th gender adult of the i th household is defined as follows:

$$(2.3) \quad u^j(c_{it}, h_{it+1}) = \ln(c_{it}^j - \bar{c}) + \beta^j \ln\left\{\left(h_{it+1}^f + \gamma^f\right)^\sigma \left(h_{it+1}^m + \gamma^m\right)^{1-\sigma}\right\}$$

Individuals thus have “warm glow” preferences, as they care not only for their own consumption but also for the human capital of their children.¹³ $0 < \beta < 1$ is the degree of parental altruism; $j \equiv \{f, m\}$ where f and m stand for female and male offspring or adult (depending on the context), respectively; $-j$ represents the opposite sex. We also assume that

$$(2.4) \quad \beta^f > \beta^m$$

which implies that women attach a relatively higher weight to the human capital of their children. $0 < \sigma < 1$ denotes the weight parents attach to the human capital of their sons and daughters. $\bar{c} \geq 0$ stands for subsistence consumption.

The parameter γ^j determines the marginal utility to investment in the j th gendered child education, and, is of central interest in this paper. If $\gamma^j > 0$, then higher γ^j makes the marginal benefit schedule to shift downward.¹⁴ Such a decrease in marginal benefit to education investment is ascribed to a higher non-pecuniary (psychic) cost. The presence of such a psychic cost in the

¹¹See [Browning et al. \(2006\)](#) for a discussion in the relationship between *unitary* and *collective* models of the household.

¹²This is easily seen from Eq. (2.2) that if $h_{it}^f = h_{it}^m$ then $\theta_{it} = 1 - 0.5\epsilon - (1 - \epsilon)\bar{\theta} < 0.5$ as long as $\bar{\theta} > 0.5$.

¹³The use of such utility function is ubiquitous in the literature (see for instance, [Glomm & Ravikumar 1992](#), [Galor & Zeira 1993](#), [Banerjee & Newman 1993](#), [Galor & Weil 2000](#) and [Benabou 2000](#)). Its main advantage (*vis á vis* other dynastic altruistic models that assume parents derive utility from the utility of their children) is its greater analytical tractability while the qualitative results of the model remains unaffected.

¹⁴In the contrary, if $\gamma^j < 0$, higher $|\gamma^j|$ rather makes the marginal benefit schedule shifts upward.

parent's utility function reduces the total amount of investment in children education, through negatively impacting the marginal benefit of investing in children's education.

Parental bias against the j th gendered child is captured by $\gamma^j > \gamma^{-j}$. Such bias could be a result of psychological factors such as the parents' perception of the world that some of their children may face a relatively tougher time to be successful, due to prevailing institutional, political and social factors. Parents who fear that their boys are more likely to become combatants during a civil conflict, for instance, may rather prefer to send their daughters to schools (Stewart et al. 2001; de Walque 2006; Akresh & de Walque 2008). On the contrary, if parents fear that their daughters are at greater risk of being sexually assaulted and harassed, they may stop sending them to school (Shemyakina 2011). Or, in a society where child marriage is widely practiced, parents may fear that investing in their daughters' education is little rewarding due to a likely school dropout. This, in turn, may lower their relative marginal benefit of investing in their girls' education, which could be captured by $\gamma^f > \gamma^m$.

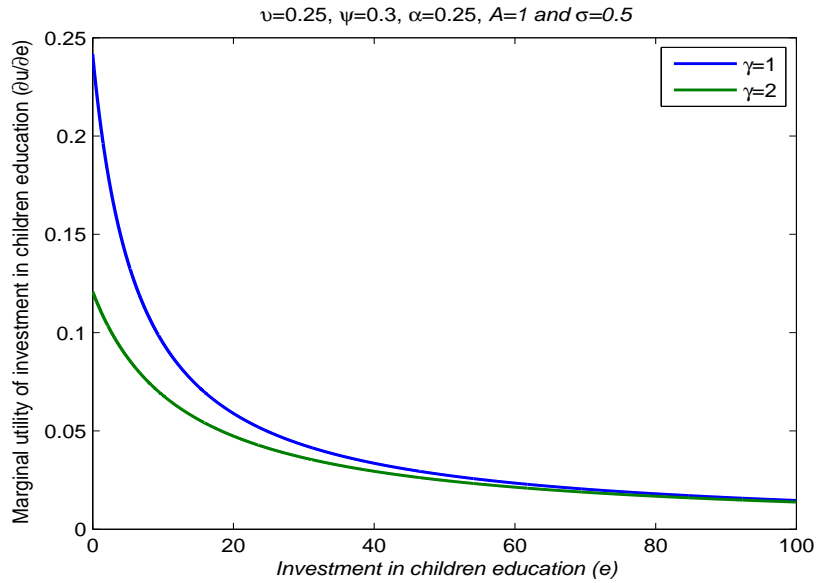


Figure 1 – Effect of a change in γ on the marginal benefit to education investment

Although both σ and γ may reflect parental gender bias, two important distinctions can be made between them. Firstly, γ , in addition to being the basis of parental gender bias, may stand as a *critical* point of children human capital accumulation. Parents may need to overcome their psychological obstacles first and foremost before starting investing in their children human capital. In contrast, σ *merely* reflects parents' sex preference. Secondly, they have different implications in terms of their short- and long-run impacts. For instance, $\gamma^m < \gamma^f$ implies that the marginal benefit of investing in sons' education is higher than that of investing in daughters' education in the short run. In this case, when resources are *meager*, parents may prefer to allocate little resources to their daughters. However, such bias may decline, and eventually disappear, at the later stage

of the development process (see Figure 1). The Figure plots parental marginal utility of children's education investment with respect to investment in children's education.¹⁵ Higher γ makes the marginal utility schedule shift downward with a steeper curvature at lower levels of education investment. Particularly, for similar parental preferences towards sons and daughters, $\sigma = \frac{1}{2}$:

$$\lim_{h_{it+1}^m \rightarrow \infty} u'_{h_{it+1}^m} = \lim_{h_{it+1}^f \rightarrow \infty} u'_{h_{it+1}^f}$$

2.2 Technologies and Constraints

The human capital of the j th gender of the i th household is given by

$$(2.5) \quad h_{it+1}^j = \left(e_{it}^j\right)^v \left(h_t l_{it}^j\right)^\eta$$

where e_{it}^j denotes the couple's spending on the j th child schooling (e.g., tuition fee, books, school uniforms); l_{it}^j represents time allocated for nurturing of this child (e.g., reading bedtime stories, helping with homework). The parameters v and η are elasticities for learning, which reflect the productivity of parental education spending and time allocation on the accumulation of human capital, respectively. We assume constant return to scale: $v + \eta = 1$. h_t is the average human capital of the parent's generation that captures a positive intergenerational spillover in human capital accumulation in the economy. The budget constraint of the i th household is given as follows:

$$(2.6) \quad c_{it}^f + c_{it}^m + e_{it}^f + e_{it}^m = y_{it}$$

where e_{it}^m and e_{it}^f stand for spending in son's and daughter's educations, respectively. y_{it} is the pooled income of the couple, which is defined below.

2.3 Couples' Income and Occupation

We suppose, in every period, that the economy has access to both traditional (farm) and modern technologies (nonfarm). Each adult couple is endowed with a unit of labor. Couples allocate their time between child rearing, l_{it} , and work, $1 - l_{it}$. Only individuals whose parents invest in their human capital have access to non-farm jobs. An individual who has received education during childhood, she/he will have an additional h_{it} units of efficient labor when adult, which immediately qualifies her/him to work in the non-farm sectors.¹⁶ While the wage rate in the farm is ω_t per unit

¹⁵Illustrative calibration is conducted based on $A = 1$, $\sigma = 0.5$, $v = 0.25$ (de la Croix & Donckt 2010), $\psi = 0.3$ (average discount factor following de La Croix & Michel 2002) and $\alpha = 0.75$ (considering a 25% agricultural GDP share in Nigeria). Parental marginal utility of education investment is computed based on Eq. (2.10a) and Eq. (A.4) (the latter terms) and Eq. (A.6) in Appendix A.

¹⁶The outcome will not change if raw labor is assumed to have been upgraded, say, as a result of a universal compulsory primary or secondary education. Then, h_{it} could be interpreted as the special skill required to work in the modern sector.

of labor, the non-farm sectors pay an additional α per unit of human capital. The pooled income of an adult couple, where only one of them works in the non-farm sectors, for instance, is given by $(1 - l_{it})\omega_t + \alpha h_{it}^j$.

One may consider a linear production technology at the aggregate level, without loss of generality, such as

$$(2.7) \quad \omega_t = (1 - \alpha) Ah_t$$

where A is a deterministic total factor productivity (TFP).¹⁷ Therefore, aggregate income in the economy, from the traditional and modern sectors, becomes Ah_t . This also implies that the same type of goods are produced in both sectors.¹⁸

Definition 1 *Suppose there are four types of couples at date t . We refer to group 1 couple, denoted by $i = 1$, when both members of the household work in the non-farm sectors. Group 2, $i = 2$, is when the female works in the non-farm sectors while the male works in the farm sectors. Group 3, $i = 3$, is the opposite of group 2; the male works in non-farm while the female works in the farm sectors. Group 4, $i = 4$, is when both adults work in farm.*

We assume couples are *ex ante* homogeneous within groups. The *pooled* income of the i th couple (y_{it}) is given by

$$(2.8a) \quad y_{it} = (1 - l_{it})\omega_t + b_{it}$$

The first term is the wage income of the couple's whereas b_{it} is income *premium* defined as follows:

$$(2.8b) \quad b_{it} \equiv \begin{cases} \alpha (h_{it}^f + h_{it}^m) & \text{if } i = 1 \\ \alpha h_{it}^f & \text{if } i = 2 \\ \alpha h_{it}^m & \text{if } i = 3 \\ 0 & \text{if } i = 4 \end{cases}$$

The first line captures the pooled income premium of the couple, where both adults work in the non-farm sectors. The second (third) line is the wage premium earned by the female (male) adult member of the household. The wage premium is nil in the last line since there is no one in this household who works in the non-farm sectors.

¹⁷Such an assumption, particularly, could be useful for a future extension of the model to aggregate issues. We merely focus here in mobility, which is mainly an individual matter.

¹⁸Explicit differentiation of the final goods as an agriculture and manufacture goods (as in Galor & Mountford 2008) may lead to a further complication of the model (as it might add another heterogeneity) but with little benefit to our purpose.

2.4 Households Optimal Decisions

2.4.1 Optimal Investment in Education

Households maximize Eqs. (2.1) and (2.3) subject to Eqs. (2.5), (2.6) and (2.8). Solutions for the couple problem consist of optimal education investment in sons and daughters, and, are presented in the following Lemma:

Lemma 2 *The optimization yields*

$$(2.9a) \quad e_{it}^{m*} = \left(y_{it} - 2\bar{c} + z\gamma^f \right) a_{it} (1 - \sigma) - \gamma^m z (1 - a_{it} (1 - \sigma))$$

$$(2.9b) \quad e_{it}^{f*} = \left(y_{it} - 2\bar{c} + z\gamma^m \right) a_{it} \sigma - \gamma^f z (1 - a_{it} \sigma)$$

$$(2.9c) \quad \frac{l_{it}^{j*}}{e_{it}^{j*}} = \frac{\eta}{\omega_t v}$$

where

$$(2.10a) \quad z \equiv \left(\frac{\omega_t v}{h_t \eta} \right)^{1-v} = \left(\frac{v}{\eta} (1 - \alpha) A \right)^{1-v}$$

$$(2.10b) \quad a_{it} \equiv \frac{v \psi_{it}}{2 + v \psi_{it}}$$

$$(2.10c) \quad \psi_{it} \equiv \theta_{it} \beta^f + (1 - \theta_{it}) \beta^m$$

Proof. See Appendix A ■

e_{it}^{j*} and l_{it}^{j*} are the i th couple's optimal spending on education of the j th child, in terms of material resources and time, respectively. ψ_{it} represents the *weighted* intra-household bargaining power of the female. Eqs. (2.9a) and (2.9b), of Lemma 2, show that parental investment in children's education depends on their income, some basic needs (\bar{c}), their sex preference (σ), education technologies (v and η), productivity parameters (A and α), and psychic cost related to ones gender, γ^j , and the opposite sex, γ^{-j} . Eq. (2.9c) captures the trade off between parental time and material resources investment in children education. The ratio $\frac{l_{it}^j}{e_{it}^j}$ decreases in the wage rate ω_t and depends on schooling technologies, v and η . If wages are higher, parents may prefer to allocate more time to work and compensate their children with more of material resources investment. Given Eq. (2.4), the higher women's bargaining power in the household decision-making process (higher ψ_{it}) is, the higher parental investment in children's human capital becomes.

According to Lemma 2, couples with income below their subsistence level $2\bar{c}$ will not invest in the human capital of their children. Furthermore, since the last terms in Eqs. (2.9a) and (2.9b)

are positive, the presence of psychic costs creates additional pressure on parental investment in children's human capital. Effective investments in children's education are thus given by, with respect to parental material resources and time, respectively,

$$(2.11a) \quad e_{it}^j = \max\left(0, e_{it}^{j*}\right)$$

$$(2.11b) \quad l_{it}^j = \max\left(0, l_{it}^{j*}\right)$$

Couples' optimal investment has thus a corner solution where some parents do not invest in their children's education, due to the presence of minimum consumption requirement and non-pecuniary cost. There are in general three types of couples in the economy. The first are those couples whose consumption decisions entail consuming the full amount of their income, and do not invest in their children's human capital due to their failure to meet the minimum consumption requirement ($\bar{c} > 0$) and overcome their psychic cost ($\gamma^j > 0$). The second are those who invest in only one of their children due to the presence of parental gender bias, $\gamma^j > \gamma^{-j}$. The third are those couples who invest in the human capital of both of their children.

Total household education expenditure, $e_{it} = e_{it}^f + e_{it}^m$, is computed by simply adding Eqs. (2.9a) and (2.9b):

$$(2.12) \quad e_{it}^* = (y_{it} - 2\bar{c}) a_{it} - z \left(\gamma^m + \gamma^f \right) (1 - a_{it})$$

We see from Eq. (2.12) that the total education expenditure in the case where $\gamma_i^j \neq 0$ or/and $\gamma_i^{-j} \neq 0$ is smaller than that of the case where $\gamma^j = \gamma^{-j} = 0$. Combining $l_{it} \equiv l_{it}^m + l_{it}^f$ and Lemma 2 gives total time spending in children's education,

$$(2.13) \quad l_{it}^* = \left[(y_{it} - 2\bar{c}) a_{it} - z \left(\gamma^m + \gamma^f \right) (1 - a_{it}) \right] \frac{\eta}{\omega_t \nu}$$

which is also lower than the case where there is no gender bias or psychic cost, $\gamma^j = \gamma^{-j} = 0$. Therefore, the presence of a gender bias (or a psychic cost) could reduce total household investment in children's education and, hence, can be a basis for aggregate inefficiency.

Proposition 3 (i) *The greater γ^{-j} or the lesser γ^j is, the higher e_{it}^{j*} and l_{it}^{j*} become.* (ii) *Given (2.4), an increase in women's bargaining power increases couples' investment in children's education.* (iii) *The presence of a psychic cost or parental gender bias could reduce the total household investment in education.*

Proof. See Appendix A ■

From Proposition 3, it appears that individuals benefit from their opposite-sex sibling misfortunes (higher γ^{-j}). Not only the non-pecuniary cost related to one's gender but also to the opposite sex is important to the person's human capital accumulation. When parents are biased against

a particular gender, then they tend to compensate for it by investing more in the opposite sex. However, the net effect is negative.

After substituting (2.13) into (2.8), and using (2.10b), we can rewrite the i th couple income as follows:

$$(2.14a) \quad y_{it}^* = \xi_{it} + g_{it}b_{it}$$

where

$$(2.14b) \quad \xi_{it} \equiv \left[(2 + v\psi_{it})\omega_t + 2\bar{c}\eta\psi_{it} + \frac{\eta}{v}z(\gamma^m + \gamma^f) \right] \frac{1}{2 + \psi_{it}}$$

$$(2.14c) \quad g_{it} \equiv \frac{2 + v\psi_{it}}{2 + \psi_{it}}$$

Eq. (2.14a) represents the couple's pooled income that consider their optimal allocation of time spending in child rearing and work, given that couples choose to invest in their children's education. Apparently, factors that are important to l_{it}^{j*} are also important to y_{it}^* .

2.5 Optimal Human Capital

By substituting Eqs. (2.9) and (2.10a) into Eq. (2.5), we derive the j th offspring optimal human capital accumulation function, which also determines its mobility:

$$(2.15) \quad h_{it+1}^{j*} = \begin{cases} (y_{it}^* - 2\bar{c} + z\gamma^f) a_{it} (1 - \sigma) z^{-1} - \gamma^m (1 - a_{it} (1 - \sigma)) & \text{if } j = m \\ (y_{it}^* - 2\bar{c} + z\gamma^m) \sigma a z^{-1} - \gamma^f (1 - a_{it}\sigma) & \text{if } j = f \end{cases}$$

where y_{it}^* is defined in Eq. (2.14).

It is straightforward to see that Proposition 3 and the related discussion also apply to individual optimal human capital. It follows that from Eqs. (2.11) and (2.15), an individual's human capital who is born at time t could take a corner solution:

$$(2.16) \quad h_{it+1}^j = \max\left(0, h_{it+1}^{j*}\right)$$

Individuals with $h_{it+1}^j = 0$ are destined to work in farm at $t + 1$ and earn the farm wage rate ω_{t+1} per unit of their labor supply. However, individuals with $h_{it+1}^j = h_{it+1}^{j*} \neq 0$ will work in the non-farm sectors and earn the premium wage rate.

2.6 Intergenerational Linkage

Note that given that there are four groups of households at time t , at time $t + 1$ there could be a maximum of eight groups of heterogenous individuals, categorized based on their gender and family background, who will work in the non-farm sectors. These are four female and four male offsprings

from: (i) non-farmer parents, (ii) farmer father and non-farmer mother, (iii) farmer mother and non-farmer father and (iv) farmer parents.

Formally, this is shown by substituting Eq. (2.14) into Eq. (2.15), and using Eqs. (2.10b) and (2.14c), which give the optimal human capital, for each group, associated to female,

$$(2.17a) \quad h_{it+1}^f = \begin{cases} \chi_{1t}^f \sigma z^{-1} - q_{1t} \gamma^f & \text{if } i = 1 \\ \chi_{2t}^f \sigma z^{-1} - q_{2t} \gamma^f & \text{if } i = 2 \\ \chi_{3t}^f \sigma z^{-1} - q_{3t} \gamma^f & \text{if } i = 3 \\ \chi_{4t}^f \sigma z^{-1} - q_{4t} \gamma^f & \text{if } i = 4 \end{cases}$$

and male offsprings,

$$(2.17b) \quad h_{it+1}^m = \begin{cases} \chi_{1t}^m (1 - \sigma) - p_{1t} \gamma^m & \text{if } i = 1 \\ \chi_{2t}^m (1 - \sigma) - p_{2t} \gamma^m & \text{if } i = 2 \\ \chi_{3t}^m (1 - \sigma) - p_{3t} \gamma^m & \text{if } i = 3 \\ \chi_{4t}^m (1 - \sigma) - p_{4t} \gamma^m & \text{if } i = 4 \end{cases}$$

where

$$\begin{aligned} \chi_{it}^j &\equiv \left(\omega_t + b_{it} - 2\bar{c} + \frac{z}{v} \gamma^{-j} \right) z^{-1} \frac{v \psi_{it}}{2 + \psi_{it}} \\ q_{it} &\equiv 1 - \sigma \frac{\psi_{it}}{2 + \psi_{it}} \\ p_{it} &\equiv 1 - (1 - \sigma) \frac{\psi_{it}}{2 + \psi_{it}} \end{aligned}$$

where χ_{it}^j is the i th couple investment in the j th child education. It consists of a fraction of the couple's pooled income ($\omega_t + b_{it}$) net of total minimum consumption ($2\bar{c}$) plus the psychic cost associated to the opposite-sex sibling (γ^{-j}). $q_{it} > 0$ and $p_{it} > 0$ denote the psychic cost associated to daughters and sons, respectively.

Eqs. (2.17a) and (2.17b) capture the intergenerational linkages between the occupations (and human capital) of children and their parents, for daughters and sons, respectively.¹⁹ In the first lines, offsprings who are working in the modern sectors are linked with parents who worked in the same sectors. In the second (third) lines, only the mothers (fathers) worked in the modern sectors while the fathers (mothers) worked in the agriculture sector. The last lines show the upward mobility of sons and daughters of farmer parents.

Differences between siblings' human capital, in Eqs. (2.17a) and (2.17b), respectively, arise due to differences in parental sex preferences ($\sigma \neq \frac{1}{2}$) and gender bias, $\gamma^m \geq \gamma^f$ whereas differences between human capital of individuals of the same gender comes from heterogeneity in family occupational background.

¹⁹We drop the stars (*) for simplicity.

2.7 Mobility Threshold

Definition 4 *Define*

$$(2.18) \quad h_{it+1}^j \geq 0 \equiv \Omega_i^j \text{ and } h_{it+1}^j = 0 \equiv \bar{\Omega}_i^j$$

where $\bar{\Omega}_i^j$ denotes implicit functions, from Eqs. (2.17a) and (2.17b). i stands for the type of family occupation and j stands for the gender of the particular individual.

Then an individual works in the non-farm sectors iff $\Omega_i^j > \bar{\Omega}_i^j$. The individual works in farm, however, iff $\Omega_i^j = \bar{\Omega}_i^j$. The implicit function $\bar{\Omega}_i^j$ thus defines critical points at which parents do not invest in their children human capital. The higher Ω_i^j becomes the more likely the individual becomes mobile. The mobility of two individuals can thus be compared and contrasted using the associated Ω_i^j . For instance, if $\Omega_2^m > \Omega_3^f$, then sons whose mothers work in the non-farm sectors are more likely to show (upward) mobility than daughters whose fathers work in the same sectors.

Lemma 5 *The mobility threshold, $\bar{\Omega}_i^j$, are given for females and males, respectively, as follows:*

$$(2.19a) \quad \bar{\Omega}_i^f = \begin{cases} \omega + \alpha (h_1^f + h_1^m) - \left(\frac{z}{v} \varrho_1^f + 2\bar{c} \right) & \text{if } i = 1 \\ \omega + \alpha h_2^f - \left(\frac{z}{v} \varrho_2^f + 2\bar{c} \right) & \text{if } i = 2 \\ \omega + \alpha h_3^m - \left(\frac{z}{v} \varrho_3^f + 2\bar{c} \right) & \text{if } i = 3 \\ \omega - \left(\frac{z}{v} \varrho_4^f + 2\bar{c} \right) & \text{if } i = 4 \end{cases}$$

and

$$(2.19b) \quad \bar{\Omega}_i^m = \begin{cases} \omega + \alpha (h_1^f + h_1^m) - \left(\frac{z}{v} \varrho_1^m + 2\bar{c} \right) & \text{if } i = 1 \\ \omega + \alpha h_2^f - \left(\frac{z}{v} \varrho_2^m + 2\bar{c} \right) & \text{if } i = 2 \\ \omega + \alpha h_3^m - \left(\frac{z}{v} \varrho_3^m + 2\bar{c} \right) & \text{if } i = 3 \\ \omega - \left(\frac{z}{v} \varrho_4^m + 2\bar{c} \right) & \text{if } i = 4 \end{cases}$$

where²⁰

$$(2.20a) \quad \varrho_i^f \equiv \gamma^f \left(\frac{1}{\sigma} \frac{2 + \psi_i}{\psi_i} - 1 \right) - \gamma^m$$

$$(2.20b) \quad \varrho_i^m \equiv \gamma^m \left(\frac{1}{1 - \sigma} \frac{2 + \psi_i}{\psi_i} - 1 \right) - \gamma^f$$

Proof. See Appendix A ■

The first and fourth lines in Eqs. (2.19a) and (2.19b) define critical points for individuals whose both parents work in the non-farm and farm sectors, respectively. The second (third) lines are

²⁰We drop the time subscripts as all variables in the functions are in contemporary terms.

related to mobility threshold for individuals only whose mothers (fathers) work in the non-farm sector.

According to Lemma 5, mobility threshold is the difference between the pooled income of a family and its basic needs plus non-pecuniary costs. Once parents are able to meet their basic needs, their children's mobility is determined by their attitude towards different gendered children. Therefore, the presence of mobility threshold largely depends on the presence of parental psychic cost. Given that $\bar{c} > 0$ and $\varrho_i^j > 0$, there will be some parents that fall short of investing in their children education, condemning them to work in the low-paying farm sector.²¹

The composite parameter ϱ_i^j captures *effective* parental gender bias. It consists of the psychic cost related to the j th person, weighted by relative bargaining power of the couples and parental sex preference, net of the psychic cost associated to the opposite-sex sibling. The higher ϱ_i^j becomes, the less mobile the particular child is. The more parents are biased towards the j th child ($\gamma^j < \gamma^{-j}$), the more the individual is favored by his/her parents (as reflected on the value of σ) or the higher the bargaining power of the women (the higher ψ_i), the lesser ϱ_i^j becomes.

2.8 Intergenerational Occupational Mobility

The IG mobility is thus a function of many aggregate and individual factors:

$$(2.21) \quad \Omega_i^j = F \left(A, \bar{c}, \alpha, \eta, v, \sigma, h, \psi_i, h_i^j, h_i^{-j}, \gamma^j, \gamma^{-j} \right)$$

It depends, for instance, on aggregate productivity parameters (A , α and h). It also depends on a parent's education level or occupation type (whether $h_i^j \neq 0$ or not), relative bargaining power of couples (as captured in ψ_i), the psychic costs related to ones gender (γ^j) and the opposite sex (γ^{-j}), parental sex preference (σ), the level of subsistence consumption (\bar{c}) and education technologies (η and v). With respect to our interest variable θ_i , we have the following Proposition:

Proposition 6 *Women's bargaining power is positively associated to IG mobility.*

Proof. See Appendix A ■

This is quite intuitive, given that women are assumed to put relatively more weight in the welfare of their children, Eq. (2.4), they may show more willingness to allocate household resources to their children's education, which in turn determines their mobility.

When comparing the mobility of males and females, and between individuals with different family backgrounds, we consider two cases: i) when parents show no particular sex preference and gender bias, and ii) when parents are gender-biased and favor boys.

²¹On the contrary, if $\bar{c} = \varrho_i^j = 0$, then all parents invest in their children human capital, regardless of their initial endowment or family occupation composition, leading to a complete IG mobility.

In the first case, $\gamma^m = \gamma^f$ and $\sigma = 1/2$, there would be no intrinsic differences between the human capital of men and women, i.e. $h^f = h^m$.²²

Proposition 7 (i) *Children whose parents work in non-farm sectors are more likely to work in the same sectors than those whose two parents work in farm or than those whose fathers work in non-farm sectors. (ii) Children whose mothers work in non-farm sectors are more likely to work in the same sector than those whose fathers work in non-farm sectors or than those whose two parents work in farm.*

Proof. See Appendix A ■

The relations between children from group 1 and 2 households, and between children from group 3 and 4 households are ambiguous. For instance, the bargaining power of the mothers for households in group 2 is higher than that of the mothers in group 1 households ($\psi_2 > \psi_1$), implying a higher IG mobility in the former. But, the fact that both parents of households in group 1 work in the modern sector makes mobility relatively more likely in this group of households. The same analysis applies when comparing individuals in group 3 and 4 households. Although the bargaining power of the mothers is relatively higher in the group 4 households, this would be compromised by the fact that both parents in this group work in the farm.

In the second case where $\gamma^m < \gamma^f$ and $\sigma < 1/2$, boys are favored while parents invest more than proportional in their sons' education. Thus, not only there are mobility differences among individuals with different family backgrounds but also within families themselves (between opposite sex siblings):

Proposition 8 (i) *Between siblings, sons are relatively more mobile than their sisters. (ii) Sons (daughters) whose mothers work in non-farm sectors are more likely to work in non-farm sectors than sons (daughters) whose two parents work in farm. (iii) Sons (daughters) whose two parents work in non-farm sectors are more likely to work in the same sector than sons (daughters) whose fathers work in non-farm sectors.*

Proof. See Appendix A ■

With respect to the relative mobility between individuals of the opposite sex, the corollary below follows from Proposition 8.

Corollary 1 (i) *Sons whose mothers work in non-farm sectors are more likely to work in the same sectors than daughters whose both parents work in farm. (ii) Sons whose both parents work in non-farm sectors are more likely to work in the same sectors than daughters whose fathers work in non-farm sectors.*

²²This can be easily confirmed from Lemma 2. Particularly, if $\gamma^m = \gamma^f$ and $\sigma = 1/2$, then parents invest the same amount of education in their sons and daughters, leading to similarity in human capital between men and women.

The relative mobility of sons (daughters) between group 1 and 2, between group 2 and 3 and between group 1 and 4 households are ambiguous. Although the intra-household bargaining power of the mothers is relatively larger in group 2 households than group 1 and 3 households, the human capital of group 2 of households is relatively smaller compared to the human capital of the households in group 1 and group 3. Similarly, mobility in group 1 households (where both parents work in the non-farm sectors) is not necessarily higher than mobility in group 4 households (where both parents work in farm). Because, even though there is relatively larger human capital in group 1 households, the bargaining power of the mothers is relatively better in group 4 households.

In summary, gender based IG mobility depends on couples' preferences and biases towards certain sex of their children, their relative bargaining powers and their occupational backgrounds.

3 Data and variables

We use the Nigerian General Household Survey (NGHS) data, a two waves (2011 and 2013) panel of 5,000 households with about 14,000 individuals in each wave.²³ NGHS is a nationwide survey that collects detailed information on demographic characteristics, education, health, employment, time use and migration of household head and household members. It is one of the very few national representative panel survey available in developing countries that collects information on adult's parental background.²⁴

3.1 Sample

We consider individuals between the ages of 15 and 65 years who have been active in the labor market in the last 12 months at the time of data collection. We use both *restricted* (sub-sample of adult children who live with their parents) and *un-restricted* sample, each one having its own advantages and disadvantages.²⁵ The un-restricted sample includes all adult individuals for whom we observe the parents' education and occupation status regardless of whether they are alive or reside in the same household while the restricted sample includes only young adults who still live with their parents.

There are two major concerns in using the restricted sample. First, co-residence may lead to a sample selection problem that biases the intergenerational persistence coefficient downward.²⁶ For instance, [Francesconi & Nicoletti \(2006\)](#) and [Azam & Bhatt \(2015\)](#) document a substantial bias in intergenerational educational persistence coefficient when constructing father-son pairs in the UK and India, respectively. Second, co-residence over represents younger adults who are still

²³The data is collected by the National Bureau of Statistics of Nigeria in collaboration with the Bill and Melinda Gates Foundation and the World Bank.

²⁴More statistical addendum of NGHS is available on Living Standards Measurement Study (LSMS) website of the World Bank. See <http://go.worldbank.org/IFS9WG7EO0>.

²⁵See Table [B.1](#) in the Appendix for summary statistics of the restricted sample

²⁶Most of existing intergenerational studies in developing countries rely solely on cohabitation in identifying parent-child pairs (e.g., [Emran & Shilpi 2015](#); [Hnatkovska et al. 2013](#)).

living with their parents, which in turn restricts the analysis to unrepresentative young population (Hnatkowska et al. 2013; Jalan & Murgai 2007). While the un-restricted sample tackles these issues, the restricted sample provides the opportunity to assess the effect of life course variation of parental characteristics on intergenerational occupational mobility. In our case, using the restricted sample enables us to compare the contribution of maternal and paternal occupation observed at different ages to children’s occupational choice.

3.2 Descriptive Statistics

We classify the economy into three sectors: primary (agriculture, forestry, fishing), secondary (manufacturing, construction) and tertiary (service) sectors.²⁷ Our dependent variable is children’s occupation (or sector). Our main control variables include parental background information (education and occupation), women bargaining power, household and individual characteristics, regional and time dummies. NGHS collects parental background information (education and occupation) of all household members, regardless of whether the parent is alive or, resides in the same household. In both waves, we observe the main industry of occupation and the highest level of education for both generations. For children, it is their most recent job; for parents, it is the industry of occupation they got engaged into throughout most of their life.

Women bargaining power variables are based on individual human capital endowments. The literature has used various bargaining power measures such as relative education, employment type and asset ownership among others depending on data availability (see Doss 2013 for a survey of the literature). However, it is generally found that education better explains distribution of bargaining power in a household decision making, especially for women (Lührmann & Maurer 2008; Friedberg & Webb 2006). Others argue a woman’s education positively associates to her fertility decisions, which lowers fertility (e.g., Govindasamy & Malhotra 1996; Breierova & Duflo 2004; Osili & Long 2008; Samarakoon & Parinduri 2015), improves children nutritional outcomes (Handa 1999; Samarakoon & Parinduri 2015) and lowers her tolerance for practices that hurt her wellbeing (Mocan & Cannonier 2012). In addition, there are several pathways through which maternal education affects a woman’s bargaining power. Education may expose a women to new ideas and information, promoting her independence from traditional norms that subjugate her (Malhotra & Mather 1997). Education could also improve a woman’s skills and hence employment opportunity, leading her to equal access to economic opportunity. According to Duflo (2012), education is a paramount means of empowering women by providing them with the knowledge, skills and self-esteem that are necessary to participate fully in the development process.

In the un-restricted and restricted samples, we use two different types of indicators for measuring intra-household bargaining power. In the former, we use a dummy variable of women empowerment whether or not a woman’s educational attainment is higher than that of her partner. Women are expected to have more bargaining power when they attain more education than their partners. On

²⁷In the theoretical framework, secondary and service sectors are identified as a modern sector.

the restricted sample we opt for a different indicator (also, for sake of robustness check) for measuring women empowerment. We aim here to assess the effect of *intensity of women empowerment* on children occupation mobility, by interacting the women’s relative educational attainment with the couples’ age differences.²⁸ This leads to four variables of women empowerment:

- i. older mothers with relatively more years of schooling than fathers,
- ii. younger mothers with relatively more years of schooling than fathers,
- iii. older mothers with relatively less years of schooling than fathers,
- iv. younger mothers with relatively less years of schooling than fathers.

Women are expected to be more empowered when they are younger and have higher educational attainment than their partners. Age is a very important life cycle factor that determines expectation and opportunities of a women and hence her bargaining power within a household. Recent empirical findings show that women who are in the same age or younger than their partners have a higher bargaining power in the family than women who are older than their husband (e.g., [Haque et al. 2011](#)).

Table 3.1 gives summary statistics for the un-restricted sample.²⁹ As mentioned earlier, the data covers a panel sample of 5,000 households and 14,000 individuals in each wave that spread over six zones in rural and urban areas. The majority of children (about 50%) are engaged in agriculture and about 47% of them are male and have 6 years of schooling on average. Nigerian households on average are large, with slightly more than seven members in a household. On average, children have more years of schooling (6.5 years) than their fathers (3 years) and their mother (2 years) regardless of whether parents are alive or, if alive, reside in the same household. About 21% of mothers have more years of schooling than fathers. About 70% and 47% of fathers and mothers are mainly engaged in the primary sector, respectively. More mothers (about 38%) are engaged in the service sector than fathers (about 24%).

Table 3.1 – Descriptive statistics for the un-restricted sample

Variables	Mean	Std. Dev. ^e	Min. ^a	Max. ^b
Dependent: Children’s sector				
Primary (base)	0.506			
Secondary	0.120			
Tertiary	0.374			

Continued on next page...

²⁸Recall that in the un-restricted sample, for children who do not live in the same household with their parents, we only observe their highest educational attainment and their industry of occupation. Therefore, we can only study the *intensity of women empowerment* in the restricted sample.

²⁹See Table .1 in the Appendix for the list and definition of variables.

Table 3.1 – continued

Variables	Mean	Std. Dev. ^e	Min. ^a	Max. ^b
Controls:				
Consumption (10,000)	70.395	95.930	1.516	6,789.529
Age of children	33.300	14.064	15	65
Household size ^c	7.297	3.484	1	31
Years of schooling of children	6.589	5.385	0	18
Father schooling	3.20	4.936	0	18
Mother schooling	2.196	4.036	0	18
Mother more schooling	0.206			
Sex of children	0.527			
Father primary sector	0.696			
Father secondary sector	0.066			
Father tertiary sector	0.238			
Mother primary sector	0.473			
Mother secondary sector	0.147			
Mother tertiary sector	0.380			
Marital status of children ^d	0.558			
North-Central Zone	0.169			
North-East Zone	0.186			
North-West Zone	0.197			
South-East Zone	0.147			
South-South Zone	0.163			
South-West Zone	0.138			
Year 2011	0.504			
Year 2013	0.496			

Note. Number of observations: 28,402 over all waves.

^{a,b} Min. and Max. are not reported for binary variables as per 0 and 1, respectively.

^c The families are multi-generational and they are extended both horizontally and vertically; about 6% of household members in the un-restricted sample are neither the household head nor a spouse or a child.

^d Polygamous unions are also common. About 16% of married individuals are engaged in this type of relationship.

^e Standard Deviation for binary variables can be retrieved using $\sqrt{p(1-p)}$, where p is the probability of the event: here, p denotes the average (proportion) or empirical frequency.

3.3 Sectoral Shift and Occupation Mobility

More recently, most African economies witness a sharp increase in the share of service sector in their economies while entry to non-farm employment is often considered to be an avenue to escape

from extreme poverty (IFAD 2011; World Bank 2005; Lanjouw & Lanjouw 2001).³⁰ In Nigeria, farm jobs as a share of total jobs has also declined recently, suggesting a major structural shift within the economy. Figure 2 plots the proportion of individuals working in each sector across 10 years birth cohorts for both genders. Despite nearly 20 years of growth in Nigeria, agriculture still represents a large share of, though employment. But still, there has been a significant shift of labor force participation from agriculture to the manufacturing and service sectors.

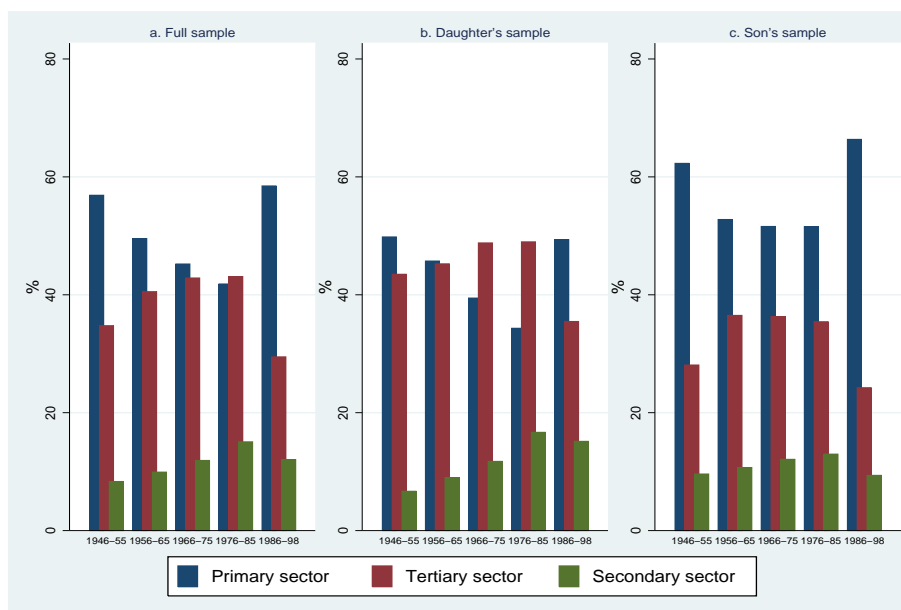


Figure 2 – Proportion of jobs across 10 years birth cohort

In the youngest cohort, there is an increase in the proportion of individuals who are engaged in the agriculture sector. This does not necessarily correspond to the slowdown of structural change however.³¹ It rather corresponds to the age of individuals in the last cohort. Individuals in this cohort are still young (aged between 15 and 27) at the time of the survey whereas entry to non-agriculture sector mostly happens in the later life cycle due to queuing effects (unemployment) in the labor market (Bossuoy & Cogneau 2013). Comparing the first (the oldest) and the fourth (the second youngest) cohorts, the decline in the share of primary sector jobs is about 26% (see Panel A of Figure 2).³² The declining rate varies across gender: comparing the youngest and the oldest cohort, we document about 31% and 17% decline in the proportion of female and male workers in the agriculture sector, respectively (see Panel B and C of Figure 2).

Table 3.2 presents the probability of children participating in the service sector conditional on parents sector, for sons and daughters. Participation in the tertiary sector is persistent across generations. We find that more than half of daughters in the tertiary sector had a mother working

³⁰In general, in most of the developing world non-farm income has been rising. For instance, in Africa income from non-farm employment accounts 34% of rural household income in the 2000s (Haggblade et al. 2010).

³¹Structural change is loosely defined as a decline in the share of primary sector jobs.

³²Note that the proportions of children in primary sector in the 2nd youngest and the oldest cohorts are 41.84% and 56.89%, respectively.

Table 3.2 – Movements in sectors

Panel A. Children’s service sector participation conditional on parents’ sector				
	<u>Mother</u>		<u>Father</u>	
	<u>Daughters</u>	<u>Sons</u>	<u>Daughters</u>	<u>Sons</u>
Primary sector	0.12	0.22	0.09	0.09
Secondary sector	0.40	0.49	0.18	0.27
Tertiary sector	0.57	0.53	0.33	0.42
Panel B. All sectors				
	<u>Gross mobility</u>	<u>Net mobility</u>	<u>Minimum share of movers</u>	<u># Obs.</u>
Daughters	0.54	0.28	0.26	14,976
Sons	0.65	0.39	0.26	13,427

Note: The table reads as follows. In Panel A for instance, 12% of daughters whose mothers were engaged in primary sector are engaged in the service sector, against 57% of children whose mother were in the service sector. In Panel B, 54% of the daughters has a different sector than their parent’s. If all daughters whose mother work in the modern sector would have stayed in the same sector (no downward mobility to primary sector) and only daughters who have a farmer mother transit to secondary or tertiary sectors due to economic structural change, the movement rate would be 26%, pointing out 28% sector mobility unexplained by structural change.

in the same sector while less than 25% of individuals in the service sector declare that either their mother or father were in the agriculture sector. Overall, the probability of being employed in the service and manufacturing sectors is much higher for children if their parents were employed in the same sector. There is a relatively higher intergenerational persistence between mothers’ and daughters’ employment status in the tertiary sector. Sons that have farmer mothers are relatively more mobile; they have a higher chance (about 22%) of joining the service sector than daughters mothers are farmers (about 12%). But note that it is imperative not to take such results at their face value without taking into account the role of sectoral shift. Because, sectoral shift (structural change) is one of the most important determinants of IG mobility. For instance, if there are more jobs created in the non-agricultural sector than it used to be (if there is a significant structural change), the number of individuals who joins the modern sectors (secondary and tertiary) whose parents work in agriculture sector could simply rise, leading to a spurious mobility coefficients to other factors.

Individuals may change occupation for various reasons. They may face either an upward mobility (when joining the modern sectors while their parents engage in the primary sector) or a downward mobility (when remaining in the primary sectors as their parents). Following [Bossuroy & Cogneau \(2013\)](#), we call such mobility as *gross mobility* across generations. Gross mobility simply captures the likelihood of children to have a different occupation than that of their parents. We refer to *net mobility*, gross mobility minus the *minimum movement* across sectors due to structural change. Minimum movement is a situation where children whose parents are engaged in modern sectors remain in the same sector. By comparing gross and net mobility, we identify the effects of structural change on IG mobility. Gross mobility for daughters and sons are 54% and 65% while net mobility are 29% and 39%, respectively. Table 3.2 shows that more than half of

IG mobility is left unexplained by structural change in Nigeria. It also reports a significant difference in IG mobility between men and women. Thus, one of our problems is to determine whether women’s bargaining power explains net IG mobility. This will be dealt in the next section using an econometric model that overcomes the challenges that arise due to unobserved heterogeneity.

4 Estimation Strategy

Our estimation equation is the empirical analogue of Eq. (2.21). Given that the measure of sectoral mobility is ordinal, panel multinomial logit model suits our purpose. Our panel estimation also accounts for unobserved heterogeneity. Intergenerational mobility studies have been fraught with econometric challenges that have been arisen due to unobserved heterogeneity, including the inheritance of genetic endowments such as ability and preference across generations. The partial correlation observed in the data might thus be mainly driven by the transmission of preference and ability between parents and children.³³ However, intergenerational persistence becomes more of a policy concern if it is an outcome of inequality of opportunity rather than differences in ability that are often transmitted from parent to child. The unobservability of the latter makes the task of understanding the underlying causes of the intergenerational correlation quite challenging though. To tackle this challenge, in this study, we use panel multinomial logit model with unobserved heterogeneity.

Let $\mathcal{S}_{it} = s$ denotes the sector in which individual i ($i = 1, \dots, N$) belongs at time t ($t = 1, \dots, T_i$). The probability of making choice s , among S alternatives, in period t , conditional on observed characteristics \mathbf{x}_{it} and unobserved heterogeneity η_i , has the structure:

$$(4.1) \quad \mathbb{P}(\mathcal{S}_{it} = s | \mathbf{x}_{it}, \eta_i) = \frac{\exp(\mathbf{x}_{it}\boldsymbol{\beta}_s + \eta_{is})}{\sum_{l=1}^S \exp(\mathbf{x}_{it}\boldsymbol{\beta}_l + \eta_{il})}$$

For identification, we impose the usual restriction by normalizing $\boldsymbol{\beta}_1 = 0$ and $\eta_1 = 0$ meaning that the primary sector is our base outcome. We assume that the unobserved heterogeneity varies between the two other sectors ($\eta_{i2} \neq \eta_{i3}$) and we allow for correlation between them. Then, their distribution follows a bivariate standard normal distribution with mean $\bar{\boldsymbol{\eta}} = [0, 0]'$ and covariance matrix $\boldsymbol{\Sigma}$ with variances $\sigma_{\eta_{i2}}^2$ and $\sigma_{\eta_{i3}}^2$, and covariance $\sigma_{\eta_{i2}\eta_{i3}}$. Let define $\kappa_{ist} = 1$ if individual i is in sector s at time t and zero otherwise. The likelihood function associated with Eq.(4.1) is

$$(4.2) \quad \mathcal{L} = \prod_{i=1}^N \left(\int_{-\infty}^{+\infty} \prod_{t=1}^{T_i} \prod_{s=1}^S [\mathcal{S}_{it} = s | \mathbf{x}_{it}, \eta_i]^{\kappa_{ist}} \varphi(\eta_i) d\eta_i \right), \quad s = 1, 2, 3$$

³³Previous studies attribute the partial, but high correlations between parents’ and children’s outcomes to *nature* and *nurture inter alia* (Becker & Tomes 1986; Haveman & Wolfe 1995; Black & Devereux 2011; Checchi et al. 2013). Nature refers to a genetic transmission of the ability of a parent to a child: able parents have a higher chance to have more able children that can attain higher levels of education and hence higher income. Nurture pertains to a parent’s time and investment on her child’s human capital.

where $\varphi(\eta)$ denotes the distribution of η . We maximize Eq.(4.2) using simulated maximum likelihood. To maximize the likelihood function, we must integrate over the distribution $\varphi(\eta)$. We use the simulated maximum likelihood method, which is given by:

$$(4.3) \quad \mathcal{L}_{\text{sim}} = \prod_{i=1}^N \frac{1}{R} \sum_{r=1}^R \prod_{t=2}^{T_i} \prod_{s=1}^S \left(\frac{\exp(\mathbf{x}_{it} \boldsymbol{\beta}_s + \eta_s^r)}{\sum_{l=1}^S \exp(\mathbf{x}_{it} \boldsymbol{\beta}_l + \eta_l^r)} \right)^{\kappa_{ist}}$$

where $r = 1, \dots, R$ is the number of draws values from the distribution of the unobserved heterogeneity distribution.³⁴

The coefficients reported are the average marginal effects of the explanatory variables on the log odds ratios $[\mathbb{P}_{is}(t)/\mathbb{P}_{i1}(t)]$ for $s = 1, 2, 3$. For continuous control variables \mathbf{x}^k , the marginal effect computed as:

$$(4.4) \quad \tilde{\beta}_s = \frac{\partial \mathbb{P}_s}{\partial x_s^k} = \mathbb{P}_s \left(\beta_s^k - \sum_{l=1}^S \beta_l^k \mathbb{P}_l \right)$$

Parameters (4.4) are affected by unobserved heterogeneity. In the case of discrete variables, Eq. (4.4) does not apply and the marginal effects are computed as the difference in the predicted probabilities evaluated at alternative values of discrete variables. In the sequel, the marginal effects are computed at means and at zero unobserved heterogeneity. The later choice is consistent with our specification, as expected value of the random heterogeneity effect is null.

5 Empirical Results

In all estimations, we include a number of main and other control variables including parental years of schooling, age, household consumption, household size, sex, marital status, regional and time dummies. Parents' years of schooling is used as a proxy for their human capital. Children education and age are proxies to their human capital, representing the level of their education and work experience, respectively. Household consumption, marital status, and household size are used to control taste, preference and income related heterogeneity between children.

The coefficients for intergenerational persistence may become spurious if parents and children have different labor market opportunities in their respective generation and geographical locations. For instance, the coefficient for IG mobility can be overestimated if there are more jobs available in the modern sector now than it used to be. Similarly, if both parents and children live in an area with limited job opportunities in the manufacturing and service sectors, then occupational persistence in the primary sector may be an artifact of not adequately controlling for heterogeneity in the

³⁴The simulation is based on Halton sequences draws. For each draw, the likelihood is evaluated and averaged over the R draws. We use 50 draws.

availability of non-farm jobs. To account for unobserved location, generation specific heterogeneity and structural change, we control for region and time dummies. These may also help to control peer effects, agglomeration forces and cohort effects.

Table 5.1 summarizes the marginal effects, from estimation of the panel multinomial logit model with unobserved heterogeneity, using the un-restricted sample. Specification tests (likelihood ratio and significance of $\sigma_{\eta_i}^2$) show that the model with unobserved heterogeneity is preferred. Thus, in what follows we present the results of the model that accounts individual heterogeneity for brevity.³⁵ Also note that the marginal effect of gender variable is positive and strongly significant, implying a strong gender effect on IG mobility. This supports our theoretical framework and further provides a rationale to split the data into sub-samples of sons and daughters.

5.1 Intergenerational Occupational Persistence

How likely are children of farmers to work in the non-farm sectors? What is the chance for daughters and sons? How do their parents' characteristics (such as education and occupation) affect their chance of joining the modern sectors or remaining in the primary sector? Table 5.1 presents results that help to answer such questions; columns 2 and 3, for daughters and sons, respectively.

Recall that our model control for unobserved heterogeneity and thus the results reported here are not driven by the unobserved genetic correlations between parents and children. The overall result show that parental characteristics matter. Having a father in primary sector has a significant negative effect to join tertiary sector on sons but not on daughters. On the contrary, having a mother who was a farmer makes it less likely for both sex to work in tertiary. Overall, children whose parents work in the primary sector are less likely to work in the modern sectors (secondary and tertiary sectors). This is true for both sons and daughters; but the effect is larger for daughters than sons. This finding is inline with the results of Lambert et al. (2014) in Senegal and Emran & Shilpi (2011) in Nepal. There is also a strong and positive intergenerational persistence in tertiary sector. Children whose mothers have worked in the tertiary sector are more likely to work in the same sector. The marginal effect is slightly larger for daughters, which is 0.08 compared to 0.07 for sons. The marginal effects of fathers' participation in the service sector on children's engagement in service sector are 0.09 and 0.11 for daughters and sons, respectively. Having either parents (mostly father) in the service sector makes it less likely for one to work in secondary sector.

The effect of parental education on the probability of children being engaged in the modern sectors is weak. However, fathers years of schooling has a positive and significant effect on the probability of sons working in the service sector. We also find having more household resource (proxied by consumption) makes joining the modern sectors more likely whereas such effect is pronounced in the service sector for daughters. Having larger household size reduces the probability of joining the service sector; the effect is again stronger for daughters. Own education plays an

³⁵Results of the model without unobserved heterogeneity using un-restricted sample are available in the Appendix, Table B.2.

important role in joining the service sector for both sons and daughters. We find a strong effect of geography (location of residence) on the probability of joining the tertiary sector. For daughters, there is a significant negative effect of residing in states in which agriculture dominates. For instance, daughters in the North-Eastern part, a region mostly known for the production of crops and livestock, have much lesser chances to join the tertiary sector than their male counterparts. On the other hand, sons living in the South-South Zone where the main economic activity is production of oil have much higher chances of joining the service sector than daughters.

Table 5.1 – Estimation results (average marginal effects) for the un-restricted sample using model with unobserved heterogeneity

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Sector: Secondary						
Consumption (in log)	0.008**	0.003	-0.010	0.006	0.010**	0.005
Age of children	0.0003	0.001	0.001	0.002	2.81e-06	0.001
Age of children squared	-0.00001	0.000	-0.00003	0.00002	-2.95e-06	0.00002
Household size	-0.003***	0.001	0.0009	0.001	-0.005***	0.001
Years of schooling of children	-0.0009*	0.000	-0.003***	0.001	0.0001	0.0006
Father schooling	-0.0005	0.0007	0.0005	0.001	-0.001	0.0008
Mother schooling	0.001*	0.0008	0.003	0.001	0.0003	0.001
Mother more schooling	0.014**	0.006	0.010**	0.010	0.018***	0.008
Sex of children	0.013**	0.005	—	—	—	—
Father in primary sector	-0.217***	0.021	-0.142***	0.022	-0.253***	0.030
Father in tertiary sector	-0.104***	0.008	-0.111***	0.013	-0.126***	0.013
Mother in primary sector	-0.107***	0.010	-0.220***	0.016	-0.022**	0.011
Mother in tertiary sector	-0.050***	0.008	-0.105***	0.013	0.001	0.011
Marital status of children	0.027***	0.006	-0.008	0.011	0.007	0.009
North-Central Zone	-0.024***	0.007	-0.086***	0.010	0.048***	0.017
North-East Zone	0.013	0.009	0.012	0.013	0.022	0.015
South-East Zone	-0.008	0.009	-0.091***	0.011	0.088***	0.024
South-South Zone	0.005	0.009	-0.104***	0.010	0.128***	0.027
South-West Zone	-0.011	0.009	-0.105***	0.010	0.089***	0.024
Year 2013	-0.016***	0.004	-0.009	0.007	-0.016***	0.005
Sector: Tertiary						
Consumption (in log)	0.102***	0.007	0.102***	0.009	0.075***	0.008
Age of children	0.018***	0.002	0.015***	0.003	0.019***	0.002
Age of children squared	-0.0002***	0.00002	-0.0001***	0.00004	-0.0002***	0.00003

Continued on next page...

Table 5.1 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Household size	-0.016***	0.002	-0.015***	0.002	-0.013***	0.002
Years of schooling of children	0.016***	0.001	0.013***	0.002	0.016***	0.001
Father schooling	0.003**	0.001	-0.0003	0.002	0.005***	0.001
Mother schooling	-0.002	0.002	-0.003	0.002	-0.002	0.001
Mother more schooling	0.026**	0.012	0.002	0.016	0.042***	0.014
Sex of children	0.202***	0.009	—	—	—	—
Father in primary sector	-0.125***	0.025	-0.038	0.031	-0.158***	0.034
Father in tertiary sector	0.078***	0.023	0.086***	0.029	0.107***	0.026
Mother in primary sector	-0.215***	0.018	-0.346***	0.028	-0.072***	0.019
Mother in tertiary sector	0.105***	0.017	0.083***	0.022	0.072***	0.019
Marital status of children	0.090***	0.011	0.095***	0.015	0.024	0.016
North-Central Zone	0.021	0.016	-0.024	0.021	0.012	0.021
North-East Zone	-0.079***	0.015	-0.182***	0.021	-0.001	0.019
South-East Zone	-0.007	0.018	-0.123***	0.026	0.067**	0.027
South-South Zone	0.063***	0.018	-0.014	0.024	0.068**	0.027
South-West Zone	0.155***	0.020	0.107***	0.026	0.093***	0.027
Year 2013	-0.064***	0.007	-0.072***	0.010	-0.035***	0.009
$\sigma_{\eta_{i2}}^2$	14.949***	1.228	10.623***	1.427	9.712***	1.244
$\sigma_{\eta_{i3}}^2$	13.162***	0.941	11.801***	1.226	9.086***	0.989
$\sigma_{\eta_{i2}\eta_{i3}}$	0.825***	0.019	0.850***	0.027	0.692***	0.047
Log likelihood	-13413.355		-6655.1016		-6125.258	
Wald χ_2 (d.o.f) ^a	862.38		465.64		480	
d.o.f ^a	20		19		19	
Prob > χ_2	0.000		0.000		0.000	
# Observations	19001		9654		9347	

Notes: ^a dof=degree of freedom of the Wald statistic.

Significance levels: * : 10% ** : 5% *** : 1%

5.2 The Role of Women Bargaining Power in IG mobility

As discussed earlier, we construct measures of women empowerment based on two concepts. The first is mothers education relative to their partners (fathers). Women empowerment measured in such a way is positively related to IG mobility. Particularly, mothers bargaining power increases the likelihood of children being employed in the secondary and tertiary sector by 1.4% and 3%, respectively for the full (un-restricted) sample. However, the effect is much stronger for boys than for girls, especially in the service sector. Increasing women empowerment may barely improve the

mobility of daughters but sons to the service sector. This may imply that either the decisions regarding daughters service sector participation are made by both parents or that mothers attach a greater psychic cost to their daughters' human capital investment (the latter being more likely).³⁶

The second measure of women empowerment (defined as women empowerment intensity) is based on the interaction of couples ages and educations differences, which is applied to the restricted sample of children who are still living with their parents.³⁷ The variable for women empowerment intensity could take one of the following values: older mothers with relatively more years of schooling, younger mothers with relatively more years of schooling, older mothers with relatively less years of schooling, or younger mothers with relatively less years of schooling than fathers (base). To test the effect of women empowerment intensity on children occupation mobility, we repeat our analysis using a sample of children who are still living with their parents (the restricted sample). Table 5.2 presents the results of this exercise. Mothers' empowerment intensity is positively related to children's upward mobility. Having a younger mother with higher years of schooling increases the likelihood of working in the secondary and tertiary sector by 3.1% and 3.6%, respectively. In line with our findings when using the un-restricted sample, the strength of this effect disappears in the daughters sample in the service sector.

Table 5.2 – Estimation results (average marginal effects) for the restricted sample (children living with their parents). Women empowerment: intensity (interaction between age difference and education of mother relative to father)

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Sector: Secondary						
Consumption (in log)	0.006	0.008	-0.007	0.015	0.02	0.013
Age of children	-0.003	0.003	0.02	0.019	-0.007	0.006
Age of children squared	0.00006	0.00007	-0.0005	0.0004	0.0001	0.0001
Household size	-0.0006	0.001	0.002	0.003	-0.002	0.002
Years of schooling of children	0.001	0.001	0.001	0.002	0.0007	0.002
Father schooling	-0.002	0.001	0.001	0.002	-0.005***	0.001
Mother schooling	0.0008	0.001	-0.001	0.002	0.003*	0.002
Mother older educated	-0.016	0.027	-0.053	0.048	-0.017	0.039
Mother younger educated	0.024*	0.012	0.076***	0.026	0.001	0.017

Continued on next page...

³⁶The Chibok schoolgirls kidnapping by Boko Haram Militia best exemplifies the challenges that parents in Nigeria face in sending their daughters to schools.

³⁷Such application is consistent with empirical evidences that suggest that economic conditions of parents are important for early childhood development (Heckman 2008). Parental characteristics also matter more during adolescence; parental social status including their occupation are especially important in early adulthood, at the time of entering labor market (Härkönen & Bihagen 2011).

Table 5.2 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Mother older less educated	-0.015	0.014	-0.031	0.028	-0.014	0.021
Sex of children	0.022***	0.01	—	—	—	—
Father in primary sector	-0.368***	0.032	-0.341***	0.043	-0.367***	0.034
Father in tertiary sector	-0.240***	0.02	-0.239***	0.027	-0.230***	0.021
Mother in primary sector	-0.079***	0.017	-0.158***	0.033	-0.045*	0.025
Mother in tertiary sector	-0.048***	0.016	-0.086***	0.031	-0.031	0.023
Marital status of children	0.046	0.039	0.024	0.073	0.031	0.049
North-Central Zone	0.015	0.019	-0.007	0.035	0.023	0.028
North-East Zone	0.01	0.018	-0.002	0.034	0.005	0.025
South-East Zone	0.019	0.023	-0.016	0.037	0.052	0.037
South-South Zone	0.044*	0.024	0.01	0.039	0.076	0.037
South-West Zone	0.026	0.023	-0.011	0.039	0.06	0.037
Year 2013	-0.060***	0.012	-0.061***	0.023	-0.081***	0.017
Sector: Tertiary						
Consumption (in log)	0.018	0.011	0.060***	0.019	-0.01	0.015
Age of children	0.0003	0.004	-0.014	0.012	-0.003	0.008
Age of children squared	0.00006	0.00008	0.0004	0.0002	0.0001	0.0001
Household size	-0.008***	0.002	-0.012***	0.0041	-0.006**	0.003
Years of schooling of children	0.003**	0.001	0.0009	0.003	0.005**	0.002
Father schooling	0.006***	0.001	0.004	0.002	0.008***	0.002
Mother schooling	-0.001	0.001	0.0007	0.003	-0.003	0.002
Mother older educated	-0.007	0.038	0.041	0.066	-0.049	0.048
Mother younger educated	0.038**	0.016	-0.002	0.028	0.059***	0.021
Mother older less educated	0.036*	0.02	0.052	0.035	0.025	0.026
Sex of children	0.028**	0.012	—	—	—	—
Father in primary sector	-0.136***	0.034	-0.073	0.051	-0.126***	0.036
Father in tertiary sector	0.227***	0.03	0.238***	0.05	0.230***	0.035
Mother in primary sector	-0.100***	0.026	-0.134***	0.046	-0.088***	0.032
Mother in tertiary sector	0.104***	0.023	0.102**	0.041	0.107***	0.029
Marital status of children	-0.018	0.045	0.012	0.081	-0.01	0.056
North-Central Zone	-0.01	0.023	0.026	0.045	-0.028	0.029
North-East Zone	0.019	0.023	0.048	0.045	0.012	0.028
South-East Zone	0.055*	0.028	0.092*	0.05	0.028	0.037
South-South Zone	0.076***	0.028	0.098*	0.051	0.067*	0.036
South-West Zone	0.044	0.028	0.072	0.054	0.017	0.035
Year 2013	0.019	0.015	-0.063**	0.027	0.071***	0.019

Continued on next page...

Table 5.2 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
$\sigma_{\eta_{i2}}^2$	2.971**	1.180	1.043	1.080	3.41e-12	5.34e-09
$\sigma_{\eta_{i3}}^2$	1.128**	0.533	0.305	0.485	1.739***	0.740
$\sigma_{\eta_{i2}\eta_{i3}}$	0.619**	0.248	0.619	0.718	0.744**	0.308
Log likelihood	-2045.503		-831.789		-1175.946	
Wald χ_2 (d.o.f) ^a	143.39		83.14		340.61	
d.o.f ^a	22		21		21	
Prob > χ_2	0.000		0.000		0.000	
# Observations	3803		1435		2368	

Significance levels: * : 10% ** : 5% *** : 1%

5.3 Robustness Check

We showed earlier that a woman’s empowerment has a positive and significant impact on her children IG mobility (more on her sons than on her daughters), when using the un-restricted sample. In this section, we repeat the analysis using the restricted sample. This, in particular, enables us to control different factors that could affect individual IG mobility such as their ages at which their characteristics (including their occupation) is observed and whether or not their parents live in close proximity to them. Empirical evidences show that parents, particularly mothers, favor young children and children who live in close proximity (Aldous et al. 1985; Suito & Pillemer 2000, 2007).³⁸

Our result with the restricted sample holds up reasonably well; mothers bargaining power significantly increases the likelihood of children being employed in the secondary and tertiary sector (see Table 5.3). However, the effect of mother bargaining power on probability to engage in the service sector is not significant for daughters but for sons.

Table 5.3 – Estimation results (average marginal effects) for the restricted sample (children living with their parents). Women empowerment: Mother has more years of schooling than father

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.

Sector: Secondary

Continued on next page. . .

³⁸Note that majority children in the restricted sample are relatively younger than children in the un-restricted sample.

Table 5.3 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Consumption (in log)	0.006	0.008	-0.005	0.016	0.012	0.011
Age of children	-0.003	0.004	0.022	0.019	-0.005	0.005
Age of children squared	0.00003	0.00008	-0.0006	0.0005	0.0001	0.0001
Household size	-0.0006	0.002	0.003	0.003	-0.002	0.002
Years of schooling of children	0.001	0.001	0.0009	0.003	0.001	0.001
Father schooling	-0.001	0.001	0.001	0.002	-0.004**	0.001
Mother schooling	0.0007	0.001	-0.001	0.002	0.002	0.001
Mother more schooling	0.024**	0.012	0.067***	0.024	0.003	0.014
Sex of children	0.024**	0.01	—	—	—	—
Father in primary	-0.349***	0.029	-0.325***	0.041	-0.376***	0.039
Father in tertiary	-0.232***	0.021	-0.237***	0.028	-0.232***	0.025
Mother in primary	-0.072***	0.017	-0.147***	0.033	-0.031	0.022
Mother in tertiary	-0.036**	0.016	-0.071**	0.031	-0.014	0.02
Marital status of children	0.059	0.042	0.041	0.078	0.049	0.049
North-Central Zone	0.007	0.019	-0.022	0.034	0.014	0.024
North-East Zone	0.007	0.018	-0.008	0.033	0.007	0.023
South-East Zone	0.019	0.023	-0.011	0.038	0.039	0.032
South-South Zone	0.041*	0.024	0.011	0.04	0.054*	0.032
South-West Zone	0.023	0.023	-0.018	0.038	0.042	0.032
Year 2013	-0.056***	0.012	-0.056**	0.023	-0.065***	0.015
Sector: Tertiary						
Consumption (in log)	0.022**	0.011	0.061***	0.019	-0.002	0.015
Age of children	-0.0003	0.004	-0.014	0.012	-0.002	0.007
Age of children squared	0.00008	0.00009	0.0004	0.0003	0.0001	0.0001
Household size	-0.009***	0.002	-0.013***	0.004	-0.006**	0.003
Years of schooling of children	0.004**	0.001	0.002	0.003	0.005**	0.002
Father schooling	0.006***	0.001	0.004	0.003	0.008***	0.002
Mother schooling	-0.001	0.001	0.0006	0.003	-0.002	0.002
Mother more schooling	0.025*	0.015	-0.003	0.026	0.038**	0.019
Sex of children	0.027**	0.012	—	—	—	—
Father in primary	-0.133***	0.035	-0.051	0.047	-0.192***	0.043
Father in tertiary	0.217***	0.034	0.252***	0.054	0.193***	0.034
Mother in primary	-0.109***	0.026	-0.134***	0.044	-0.103***	0.033
Mother in tertiary	0.092***	0.023	0.095***	0.041	0.087***	0.028
Marital status of children	-0.026	0.045	0.006	0.081	-0.026	0.057
North-Central Zone	-0.009	0.023	0.025	0.045	-0.022	0.028

Continued on next page...

Table 5.3 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
North-East Zone	0.015	0.023	0.044	0.044	0.008	0.028
South-East Zone	0.051*	0.028	0.08	0.05	0.033	0.036
South-South Zone	0.078	0.028	0.094*	0.051	0.074	0.035
South-West Zone	0.047*	0.028	0.074	0.054	0.025	0.034
Year 2013	0.016	0.015	-0.064**	0.027	0.060***	0.019
$\sigma_{\eta_{i2}}^2$	2.212**	0.971	0.379	0.875	2.610*	1.372
$\sigma_{\eta_{i3}}^2$	0.546	0.434	0.041	0.180	1.409*	0.770
$\sigma_{\eta_{i2}\eta_{i3}}$	0.619	0.520	-0.171	2.678	0.672**	0.320
Log likelihood	-2074.132		-844.806		-1191.013	
Wald χ_2 (d.o.f) ^a	155.35		102.27		91.75	
d.o.f ^a	20		19		19	
Prob > χ_2	0.000		0.000		0.000	
# Observations	3836		1449		2387	

Significance levels: * : 10% ** : 5% *** : 1%

6 Conclusion

Individuals may face various entry costs to access relatively high-paying job markets. Some of these costs are pecuniary and contemporaneous such as immigrating to a city while others are non-pecuniary and dated back to their childhood time such as their parents' negative attitude and belief towards their education and labor market outcome. If the education and training individuals receive during young age are important determinant of the type of occupations they will have when they reach adulthood, the latter may play important role on intergenerational occupational mobility, by influencing parents' investment decision on their children education. If parents attach different non-pecuniary costs to sons and daughters, then this may lead to parental gender bias, as reflected in differential treatment of sons and daughters in intra-household resource allocation, whether in the forms of disproportional parental time spending and/or material investment in education. Parental attitudes toward different gender of their children could then have an important implication to gender based intergenerational occupational mobility.

The model that we have developed here has captured the complex intra-household interactions that affect children's adulthood outcome. In the model, intergenerational occupational mobility is determined by whether an individual receives education during childhood. Such decisions are made collectively by both parents of the individual. Parents have different preferences toward their children human capital. In particular, women are considered to give relatively more weight to the

human capital of their children. There exists parental gender bias, modelled as part of a non-pecuniary psychic cost – a representation of parents’ pessimistic attitude towards their children’s adulthood outcomes –, which negatively related to the marginal benefit of investing in children’s human capital. Parents derive a relatively higher unit of marginal benefit from investing in sons’ human capital due to a relatively larger psychic cost attached to daughters’ human capital investment. Such a bias towards sons could be a result of psychological factors such as parents’ perception of the world that their daughters face a relatively tougher time due to gender discrimination, a reflection of cultural bias such as the stereotypes of the man as the breadwinner of the family or a likely school dropout of women due to early marriage.

In such traditional societies, intergenerational occupational mobility depends on intra-household bargaining power, parents’ occupational background, parental gender bias and sex preferences. Increased women’s bargaining power leads to higher intergenerational occupational mobility, given that they attach a higher weight to their children’s education. Between siblings, sons are relatively more mobile than their sisters. We also found that intergenerational occupational persistence could take *different forms*: For instance, children whose mothers work in modern sector are more likely to work in the same sectors than children whose two parents work in traditional sector. Children whose two parents work in modern sectors are more likely to work in the same sector than children whose fathers only work in modern sector. The relative mobility of children whose both parents work in modern sector and children whose mothers only work in modern sector is ambiguous, however, due to nonlinear differences in income and intra-household bargaining power structure between these families. The same conclusion has been reached with respect to the relative mobility between children whose mothers and fathers work in the modern sector or between children whose both parents work in the modern and traditional sectors.

Applying the framework to a representative panel data survey from Nigeria, we found that children with parents (especially, with mothers) working in the modern sectors are more likely to work in the same sector. A greater intra-household female bargaining power leads to greater upward mobility while it benefits boys more than proportionally. Therefore, parental gender bias could be one of the driving force behind gender-based intergenerational persistence.

A possible extension of the theoretical work could be to fully endogenize couple’s bargaining power in a strategic game setting, in *a la* Mortensen-Pissarides matching model with equilibrium search and matching. Moreover, one could examine aggregate issues such as the stage of development. From empirical perspective, it would definitely be interesting to have a longer panel data with more countries in order to implement a country comparison analysis. Meanwhile, our findings suggest that policies that promote gender based intergenerational occupational mobility in developing countries should base on both, minimizing pecuniary and non-pecuniary costs associated to the human capital accumulation of young girls.

Acknowledgements

We are grateful to Ibrahima Kaba and Moussa Blimpo for extensive comments on a previous draft of the paper. We thank participants to various conferences (2017 ASSA Annual Meeting; the Africa Economics Seminar of the World Bank 2017; the Annual Bank Conference on Africa 2017; the 2017 Asian Meeting of the Econometric Society) for fruitful discussions and suggestions. This work was supported by the FERDI (Fondation pour les Etudes et Recherches sur le Développement International) and the Agence Nationale de la Recherche of the French government through the program “Investissements d’avenir ANR-10-LABX-14-01.” The usual disclaimers apply.

References

- Aiyagari, S. R., Greenwood, J. & Guner, N. (2000), ‘On the state of the union’, *Journal of Political Economy* **108**(2), 213–244.
- Akresh, R. & de Walque, D. (2008), Armed Conflict and Schooling: Evidence from the 1994 Rwandan Genocide, Hien working papers, Households in Conflict Network.
- Aldous, J., Klaus, E. & Klein, D. M. (1985), ‘The understanding heart: Aging parents and their favorite children’, *Child Development* pp. 303–316.
- Arnold, F., Choe, M. K. & Roy, T. K. (1998), ‘Son preference, the family-building process and child mortality in India’, *Population Studies* **52**(3), 301–315.
- Aurino, E. (2016), ‘Do boys eat better than girls in India? longitudinal evidence on dietary diversity and food consumption disparities among children and adolescents’, *Economics and Human Biology* doi.org/10.1016/j.ehb.2016.10.007.
- Azam, M. & Bhatt, V. (2015), ‘Like father, like son? Intergenerational educational mobility in India’, *Demography* **52**(6), 1929–1959.
- Azomahou, T. T. & Yitbarek, E. A. (2016), ‘Intergenerational education mobility in Africa: Has progress been inclusive?’, *Policy Research Working Paper, The World Bank* (7843).
- Banerjee, A. V. & Newman, A. F. (1993), ‘Occupational choice and the process of development’, *Journal of Political Economy* **101**(2), 274–298.
- Barcellos, S. H., Carvalho, L. S. & Lleras-Muney, A. (2014), ‘Child gender and parental investments in India: Are boys and girls treated differently?’, *American Economic Journal: Applied Economics* **6**(1), 157–89.
- Becker, G. (1981), *A Treatise on the Family*, National Bureau of Economic Research, Inc.

- Becker, G. & Tomes, N. (1986), 'Human Capital and the Rise and Fall of Families', *Journal of Labor Economics* **64**, 576–614.
- Behrman, J. R. & Rosenzweig, M. R. (2005), 'Does increasing women's schooling raise the schooling of the next generation? Reply', *American Economic Review* **95**(5), 1745–1751.
- Beller, E. (2009), 'Bringing intergenerational social mobility research into the twenty-first century: Why mothers matter', *American Sociological Review* **74**(4), 507–528.
- Ben-Porath, Y. & Welch, F. (1976), 'Do sex preferences really matter?', *Quarterly Journal of Economics* **90**(2), 285–307.
- Benabou, R. (2000), 'Unequal societies: Income distribution and the social contract', *American Economic Review* **90**(1), 96–129.
- Black, S. E. & Devereux, P. J. (2011), 'Recent developments in intergenerational mobility', *Handbook of Labor Economics* **4**, 1487–1541.
- Bossuroy, T. & Cogneau, D. (2013), 'Social mobility in five African countries', *Review of Income and Wealth* **59**(S1), S84–S110.
- Breierova, L. & Duflo, E. (2004), 'The impact of education on fertility and child mortality: Do fathers really matter less than mothers?', Technical report, National Bureau of Economic Research.
- Browning, M., Chiappori, P.-A. & Lechene, V. (2006), 'Collective and Unitary Models: A Clarification', *Review of Economics of the Household* **4**(1), 5–14.
- Chadwick, L. & Solon, G. (2002), 'Intergenerational income mobility among daughters', *The American Economic Review* **92**(1), 335–344.
- Checchi, D., Fiorio, C. V. & Leonardi, M. (2013), 'Intergenerational persistence of educational attainment in Italy', *Economics Letters* **118**(1), 229–232.
- Chen, L. C., Emdadul, H. & Stan, D. (1981), 'Sex bias in the and health care in rural Bangladesh', *Population and Development Review* **7**(1), 55–70.
- Chiappori, P.-A. (1988), 'Rational household labor supply', *Econometrica* **56**(1), 63–90.
- Chiappori, P.-A. (1992), 'Collective labor supply and welfare', *Journal of Political Economy* **100**(3), 437–67.
- Currie, J. & Moretti, E. (2003), 'Mother's education and the intergenerational transmission of human capital: Evidence from college openings', *Quarterly Journal of Economics* **118**(4), 1495–1532.

- Davies, J. B. & Zhang, J. (1995), ‘Gender bias, investments in children, and bequests’, *International Economic Review* **36**(3), 795–818.
- de la Croix, D. & Donckt, M. V. (2010), ‘Would empowering women initiate the demographic transition in least developed countries?’, *Journal of Human Capital* **4**(2), 85–129.
- de La Croix, D. & Michel, P. (2002), *A Theory of Economic Growth: Dynamics and Policy in Overlapping Generations*, Cambridge University Press.
- de Walque, D. (2006), ‘The socio-demographic legacy of the Khmer Rouge period in Cambodia’, *Popul Stud (Camb)* **60**(2), 223–31.
- Desai, S. & Jain, D. (1994), ‘Maternal employment and changes in family dynamics: The social context of women’s work in rural South India’, *Population and Development Review* pp. 115–136.
- Doepke, M. & Tertilt, M. (2009), ‘Women’s liberation: What’s in it for men?’, *Quarterly Journal of Economics* **124**(4), 1541–1591.
- Doss, C. (2013), ‘Intrahousehold bargaining and resource allocation in developing countries’, *The World Bank Research Observer* **28**(1), 52–78.
- Dufló, E. (2012), ‘Women empowerment and economic development’, *Journal of Economic Literature* **50**(4), 1051–1079.
- Echevarria, C. & Merlo, A. (1999), ‘Gender differences in education in a dynamic household bargaining model’, *International Economic Review* **40**(2), 265–86.
- Emran, M. S. & Shilpi, F. (2011), ‘Intergenerational occupational mobility in rural economy evidence from Nepal and Vietnam’, *Journal of Human Resources* **46**(2), 427–458.
- Emran, M. S. & Shilpi, F. (2015), ‘Gender, geography, and generations: Intergenerational educational mobility in post-reform India’, *World Development* **72**, 362–380.
- Entwisle, B. & Chen, F. (2002), ‘Work patterns following a birth in urban and rural China: A longitudinal study’, *European Journal of Population/Revue Européenne de Démographie* **18**(2), 99–119.
- Francesconi, M. & Nicoletti, C. (2006), ‘Intergenerational mobility and sample selection in short panels’, *Journal of Applied Econometrics* **21**(8), 1265–1293.
- Friedberg, L. & Webb, A. (2006), Determinants and consequences of bargaining power in households, Technical report, National Bureau of Economic Research.
- Galor, O. & Moav, O. (2004), ‘From physical to human capital accumulation: Inequality and the process of development’, *Review of Economic Studies* **71**(4), 1001–1026.

- Galor, O. & Mountford, A. (2008), 'Trading population for productivity: Theory and evidence', *Review of Economic Studies* **75**(4), 1143–1179.
- Galor, O. & Weil, D. (2000), 'Population, technology, and growth: From Malthusian stagnation to the demographic transition and beyond', *American Economic Review* **90**(4), 806–828.
- Galor, O. & Weil, D. N. (1996), 'The gender gap, fertility, and growth', *American Economic Review* **86**(3), 374–87.
- Galor, O. & Zeira, J. (1993), 'Income distribution and macroeconomics', *Review of Economic Studies* **60**(1), 35–52.
- Glomm, G. & Ravikumar, B. (1992), 'Public versus Private Investment in Human Capital Endogenous Growth and Income Inequality', *Journal of Political Economy* **100**(4), 818–834.
- Govindasamy, P. & Malhotra, A. (1996), 'Women's position and family planning in Egypt', *Studies in Family Planning* pp. 328–340.
- Grusky, D. B. & DiPrete, T. A. (1990), 'Recent trends in the process of stratification', *Demography* **27**(4), 617–637.
- Haggblade, S., Hazell, P. & Reardon, T. (2010), 'The rural non-farm economy: Prospects for growth and poverty reduction', *World Development* **38**(10), 1429–1441.
- Handa, S. (1999), 'Maternal education and child height', *Economic Development and Cultural Change* **47**(2), 421–439.
- Haque, M., Islam, T. M., Tareque, M. I., Mostofa, M. et al. (2011), 'Women empowerment or autonomy: A comparative view in bangladesh context', *Bangladesh e-Journal of Sociology* **8**(2), 17–30.
- Härkönen, J. & Bihagen, E. (2011), 'Occupational attainment and career progression in Sweden', *European Societies* **13**(3), 451–479.
- Haveman, R. & Wolfe, B. (1995), 'The determinants of children's attainments: A review of methods and findings', *Journal of Economic Literature* **33**(4), 1829–1878.
- Heckman, J. J. (2008), 'Schools, skills, and synapses', *Economic Inquiry* **46**(3), 289–324.
- Hnatkovska, V., Amartya, L. & Sourabh, P. (2013), 'Breaking the caste barrier intergenerational mobility in India', *Journal of Human Resources* **48**(2), 435–473.
- IFAD (2011), Rural Development Report 2016, Technical report, International Fund for Agricultural Development.
- Iyigun, M. & Walsh, R. P. (2007), 'Endogenous gender power, household labor supply and the demographic transition', *Journal of Development Economics* **82**(1), 138–155.

- Jalan, J. & Murgai, R. (2007), 'Intergenerational mobility in education in India', *Processed. Delhi: the World Bank* .
- Jayachandran, S. & Rohini, P. (2017), 'Why are Indian children so short? The role of birth order and son preference', *The American Economic Review (Forthcoming)* .
- Lagerlof, N.-P. (2003), 'Gender equality and long-run growth', *Journal of Economic Growth* **8**(4), 403–26.
- Lambert, S., Ravallion, M. & Van de Walle, D. (2014), 'Intergenerational mobility and interpersonal inequality in an African economy', *Journal of Development Economics* **110**, 327–344.
- Lanjouw, J. O. & Lanjouw, P. (2001), 'The rural non-farm sector: issues and evidence from developing countries', *Agricultural Economics* **26**(1), 1–23.
- Lloyd, C. B. (1991), 'The contribution of the World Fertility Surveys to an understanding of the relationship between women's work and fertility', *Studies in Family Planning* **22**(3), 144–161.
- Lührmann, M. & Maurer, J. (2008), 'Who wears the trousers? A semiparametric analysis of decision power in couples', *MEA discussion papers* **168**.
- Malhotra, A. & Mather, M. (1997), Do schooling and work empower women in developing countries? Gender and domestic decisions in Sri Lanka, in 'Sociological forum', Vol. 12, Springer, pp. 599–630.
- Manser, M. & Brown, M. (1980), 'Marriage and household decision-making: A bargaining analysis', *International Economic Review* **21**(1), 31–44.
- McElroy, M. B. & Horney, M. J. (1981), 'Nash-bargained household decisions: Toward a generalization of the theory of demand', *International Economic Review* **22**(2), 333–49.
- Moav, O. (2002), 'Income distribution and macroeconomics: the persistence of inequality in a convex technology framework', *Economics Letters* **75**(2), 187–192.
- Mocan, N. H. & Cannonier, C. (2012), Empowering women through education: Evidence from Sierra Leone, Technical report, National Bureau of Economic Research.
- Osili, U. O. & Long, B. T. (2008), 'Does female schooling reduce fertility? Evidence from Nigeria', *Journal of Development Economics* **87**(1), 57–75.
- Samarakoon, S. & Parinduri, R. A. (2015), 'Does education empower women? Evidence from Indonesia', *World Development* **66**, 428–442.
- Sen, A. (1990), *More Than 100 Million Women Are Missing*, New York Review of Books 37.

- Shemyakina, O. (2011), 'The effect of armed conflict on accumulation of schooling: Results from Tajikistan', *Journal of Development Economics* **95**(2), 186–200.
- Stewart, F., Huang, C. & Wang, M. (2001), Internal Wars In Developing Countries: An Empirical Overview of Economic and Social Consequences, *in* F. Stewart & V. Fitzgerald, eds, 'War and Underdevelopment', Oxford University Press.
- Suitor, J. J. & Pillemer, K. (2000), 'Did mom really love you best? exploring the role of within-family differences in developmental histories on parental favoritism', *Motivation and Emotion* **24**, 104–119.
- Suitor, J. J. & Pillemer, K. (2007), 'Mothers' favoritism in later life: The role of children's birth order', *Research on Aging* **29**(1), 32–55.
- World Bank (2005), World Development Report 2006: Equity and Development, Technical report, The World Bank.

Table .1 – List and definitions of variables

Variable name	Definition	Nature
Children's sector, $\mathcal{S}_{i,t} = 1, 2, 3$	1=primary (agriculture:base), 2=secondary (industry), 3=tertiary (service)	discrete
Consumption	Per capita household food and non-food consumption expenditure in regional price	continuous
Age of children	Age of individuals (completed years)	continuous
Household size	Household family size	continuous
Years of schooling of children	Children number of years of schooling associated with the highest grade completed	continuous
Father schooling	Father's number of years of schooling associated with the highest grade completed	continuous
Mother schooling	Mother's number of years of schooling associated with the highest grade completed	continuous
Mother more schooling	Mother has more years of schooling than father's	binary (yes=1)
Mother older educated	Mother is older and has more years of schooling than father's	binary (yes=1)
Mother younger educated	Mother is younger and has more years of schooling than father's	binary (yes=1)
Mother older less educated	Mother is older and has less years of schooling than father's	binary (yes=1)
Mother younger less educated (base)	Mother is younger and has less years of schooling than father's	binary (yes=1)
Sex of children	Gender of children	binary (female=1)
Father in primary sector	Father engaged in agriculture, forestry, fishing and mining for most of his life	binary (yes=1)
Father in secondary sector (base)	Father engaged in manufacturing and construction sector for most of his life	binary (yes=1)
Father in tertiary sector	Fathers engaged in the service sector for most of his life	binary (yes=1)
Mother in primary sector	Mothers engaged in agriculture, forestry, fishing and mining for most of her life	binary (yes=1)
Mother in secondary sector (base)	Mothers engaged in manufacturing and construction sector for most of her life	binary (yes=1)
Mother in tertiary sector	Mothers engaged in the service sector for most of his life	binary (yes=1)
Marital status of children	Married (Monogamous or polygamous)	binary (yes=1)
North-Central Zone	Includes Benue , Kogi, Kwara, Nasarawa, Niger, Plateau and FCT Abuja states	binary (yes=1)
North-East Zone	Includes Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe states	binary (yes=1)
North-West Zone	Includes Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara states	binary (yes=1)
South-East Zone	Includes Abia, Anambra, Ebonyi, Enugu, and Imo states	binary (yes=1)
South-South Zone	Includes Akwa-Ibom, Bayelsa, Cross River, Delta, Edo and Rivers states	binary (yes=1)
South-West Zone	Includes Ekiti, Lagos, Ogun, Ondo, Osun and Oyo states	binary (yes=1)
Time	Structural change indicator: Years 2011 (base) and 2013	binary (yes=1)

A Appendix for the Theory

A.1 Proof for the Lemmas

A.1.1 Proof for Lemma 2

The couples solve the following problem, from Eqs. (2.1) and (2.3),

$$(A.1) \quad \max_{\{c_{it}^m, c_{it}^f, e_{it}^f, e_{it}^m, l_{it}^f, l_{it}^m\}} \left\{ \begin{array}{l} \theta_{it} \ln(c_{it}^f - \bar{c}) + (1 - \theta_{it}) \ln(c_{it}^m - \bar{c}) \\ + \psi_{it} \ln \left[(h_{it+1}^f + \gamma^f)^\sigma + \ln(h_{it+1}^m + \gamma^m)^{1-\sigma} \right] \end{array} \right\}$$

subject to Eqs. (2.5), (2.6) and (2.8a) where ψ_{it} is given by

$$\psi_{it} \equiv \theta_{it} \beta^f + (1 - \theta_{it}) \beta^m$$

From the first order conditions of the problem, we have:

$$(A.3) \quad \frac{c_{it}^m - \bar{c}}{c_{it}^f - \bar{c}} = \frac{1 - \theta_{it}}{\theta_{it}}$$

$$(A.4) \quad \frac{\theta_{it}}{c_{it}^f - \bar{c}} = \frac{1}{2} \frac{h_{it+1}^f \sigma \nu \psi_{it}}{(h_{it+1}^f + \gamma^f) e_{it}^f} = \frac{1}{2} \frac{\psi_{it} (1 - \sigma) \nu h_{it+1}^m}{h_{it+1}^m + \gamma^m} \frac{e_{it}^m}{e_{it}^f}$$

$$(A.5) \quad \frac{\theta_{it}}{c_{it}^f - \bar{c}} \omega_t = \frac{1}{2} \frac{\eta \sigma \psi_{it}}{h_{it+1}^f + \gamma^f} \frac{h_{it+1}^f}{l_{it}^f} = \frac{1}{2} \frac{\psi_{it} (1 - \sigma) \eta h_{it+1}^m}{h_{it+1}^m + \gamma^m} \frac{h_{it+1}^m}{\omega_t l_{it}^m}$$

From Eq. (A.3), the relative consumption of male and female is determined by their relative intra-household bargaining power. Eqs. (A.4) and (A.5) equate the marginal benefits in sons' and daughters' education investment, in terms of material resources and time, respectively. Combing Eqs. (A.4) and (A.5) will lead to

$$(A.6) \quad \frac{e_{it}^f}{l_{it}^f} = \frac{e_{it}^m}{l_{it}^m} = \omega_t \frac{\nu}{\eta}$$

which is similar to Eq. (2.9c). Thus, the ratio of parental investment in material resources and time is the same for both sons and daughters, which is proportional to the wage rate in the agricultural sector.

To derive optimal education investment, first substitute Eqs. (2.5) and (A.6) into the last two

terms of Eq. (A.4) to get³⁹

$$(A.7) \quad e_{it}^f = \frac{\sigma}{1-\sigma} e_{it}^m - \bar{\gamma} z$$

where, z and $\bar{\gamma}$ are defined as follows, considering (2.7),

$$z \equiv \left(\frac{\omega_t v}{h_t \eta} \right)^{1-v} = \left(\frac{v}{\eta} (1-\alpha) A \right)^{1-v}$$

$$\bar{\gamma} \equiv \frac{(1-\sigma) \gamma^f - \sigma \gamma^m}{1-\sigma}$$

Then, from Eqs. (2.5), (A.4) and (A.6), one obtains

$$(A.8) \quad c_{it}^f - \bar{c} = \frac{2\theta_{it}}{(1-\sigma) v \psi_{it}} (e_{it}^m + z \gamma^m)$$

But, we can rewrite Eq. (A.3) as

$$(A.9) \quad c_{it}^m = \varkappa c_{it}^f + b$$

where $\varkappa \equiv \frac{1-\theta_{it}}{\theta_{it}}$ and $b \equiv \bar{c} \frac{2\theta_{it}-1}{\theta_{it}}$. Then substitute Eq. (A.9) into the budget constraint Eq. (2.6) to get

$$(A.10) \quad c_{it}^f - \bar{c} + \theta_{it} (e_{it}^f + e_{it}^m) = \theta_{it} y_{it} - 2\bar{c} \theta_{it}$$

Substituting Eq. (A.8) into (A.10), and using Eq. (A.7), finally, gives (2.9a),

$$e_{it}^{m*} = (y_{it} - 2\bar{c} + z \gamma^f) a_{it} (1-\sigma) - \gamma^m (1 - a_{it} (1-\sigma)) z$$

which is the optimal education investment in sons. In order to get the one for daughters, substitute Eq. (2.9a) into (A.7) and use the definition for $\bar{\gamma}$, which leads to Eq. (2.9b):

$$e_{it}^{f*} = (y_{it} - 2\bar{c} + z \gamma^m) a_{it} \sigma - \gamma^f (1 - a_{it} \sigma) z$$

By combining Eqs. (2.9a), (2.9b) and (2.9c), one could easily solve for optimal time spending in children education, for daughters and sons.

A.1.2 Proof for Lemma 5

Simply apply $h_{it+1}^j = 0 \equiv \bar{\Omega}_i^j$ in Eqs. (2.17a) and (2.17b) to get Eqs. (2.19a) and (2.19b), respectively.

³⁹We consider first degree homogeneity in Eq. (2.5), $v + \eta = 1$.

A.2 Proofs for the Propositions

A.2.1 Proposition 3

Proof. (i) It is straightforward to see, from the Lemma 2, e_{it}^{j*} and l_{it}^{j*} increase in γ^{-j} . (ii) Also, given Eq. (2.4), we see from Lemma 2 that $\partial e_{it}^{j*}/\partial \theta_{it} > 0$ and $\partial l_{it}^{j*}/\partial \theta_{it} > 0$. (iii) From Eqs. (2.12) and (2.13), both e_{it}^{j*} and l_{it}^{j*} will reach their maximum at the boundary $\gamma^j = \gamma^{-j} = 0$. ■

A.2.2 Proposition 6

Proof. Note first that the higher Ω_i^j becomes the more likely the j th individual becomes mobile (see Definition (4)). Then, given $\beta^f > \beta^m$, Ω_i^j increases in θ_i . ■

A.2.3 Proposition 7

Proof. (i) First note that, from Definition (4) and Lemma (5), mobility between different groups of households is determined by the degree of intra-household bargaining power (ψ_i) and parental occupational background (or human capital). Then, the bargaining power of the females in group 1 households is the same as that of group 4 households ($\psi_1 = \psi_4$)⁴⁰ but higher than that of group 3 households ($\psi_1 > \psi_3$) where only the male works in the non-farm sectors. There is also relatively larger human capital in group 1 households (where both parents work in the non-farm sectors) than in group 3 or in group 4 households. Therefore, mobility in group 1 households is higher than mobility in group 3 or group 4 households ($\Omega_1 > \{\Omega_3, \Omega_4\}$). (ii) The females in group 2 households are more empowered than the ones in group 3 or in group 4 households ($\psi_2 > \psi_4 > \psi_3$). Therefore, given $h_i^m = h_i^f$, it follows that children from group 2 households are more mobile than those children from group 3 or group 4 households $\Omega_2 > \{\Omega_3, \Omega_4\}$. ■

A.2.4 Proposition 8

Proof. (i) Given, $\gamma^m > \gamma^f$ and $\sigma < 1/2$, and considering Lemma (5) and Definition (4), it is straightforward that $\Omega_i^m > \Omega_i^f$. (ii) The females are relatively empowered in group 2 households compared to group 4 households ($\psi_2 > \psi_4$). Parental occupational background is also relatively better in group 2 households, since at least one of the parents work in the modern sectors. Therefore, offspring mobility is relatively higher in group 2 households, $\Omega_2^j > \Omega_4^j$. (iii) Comparing mobility between group 1 and 3 households, we see the former are better both in terms of relative female bargaining power ($\psi_1 > \psi_3$) and parental occupational background, which translates to higher relative mobility, $\Omega_1^j > \Omega_3^j$. ■

⁴⁰This can be confirmed by applying L'Hôpital's rule in Eq. (2.2). That is, given $h_1^m = h_1^f$ and $h_4^m = h_4^f = 0$, it follows that $\theta_1 = \theta_4 \Rightarrow \psi_1 = \psi_4$.

B Appendix for the Empirics

Table B.1 – Descriptive statistics for the restricted sample

Group (Variable)	Mean	Std. Dev. ^c	Min. ^a	Max. ^b
Dependent: Children's sector				
Primary (base)	0.644			
Secondary	0.094			
Tertiary	0.262			
Controls:				
Consumption (10,000)	13.353	0.746	9.626	16.481
Age of children	20.469	5.469	15	65
Household size	7.30	3.48	1	31
Years of schooling of children	8.697	3.506	3	31
Father schooling	5.567	5.585	0	18
Mother schooling	4.202	4.882	0	18
Mother more schooling	0.256			
Mother older educated	0.040			
Mother younger educated	0.215			
Mother older less educated	0.151			
Mother younger less educated	0.592			
Sex of children	0.381			
Father primary sector	0.586			
Father secondary sector	0.087			
Father tertiary sector	0.328			
Mother primary sector	0.434			
Mother secondary sector	0.104			
Mother tertiary sector	0.461			
Marital status of children	0.026			
North-Central Zone	0.172			
North-East Zone	0.192			
North-West Zone	0.196			
South-East Zone	0.151			
South-South Zone	0.168			
South-West Zone	0.121			
Year 2011	0.477			
Year 2013	0.523			

Note. Number of observations: 7,160 over all waves.

^{a,b} Min. and Max. are not reported for binary variables as per 0 and 1 respectively.

Continued on next page...

Table B.1 – continued

Group (Variable)	Mean	Std. Dev. ^c	Min. ^a	Max. ^b
------------------	------	------------------------	-------------------	-------------------

^c Standard Deviation for binary variables can be retrieved using $\sqrt{p(1-p)}$
where p is the probability of the event.

Table B.2 – Estimation results (average marginal effects) model without heterogeneity for un-restricted sample

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Sector: Primary (base)						
Sector: Secondary						
Consumption (in log)	0.013***	0.004	-0.008	0.009	0.025***	0.009
Age of children	0.0004	0.001	0.003	0.003	.002	.003
Age of children squared	-0.00002	0.00003	-0.00005	0.00004	-0.00002	0.000
Household size	-0.003***	0.0009	0.0009	0.002	-0.009***	0.002
Years of schooling of children	-0.001*	0.0005	-0.003*	0.002	0.001	0.001
Father schooling	-0.0003	0.0008	0.0004	0.002	-0.001	0.001
Mother schooling	0.002*	0.001	0.004	0.002	0.0002	0.002
Mother more schooling	0.017***	0.007	0.011	0.016	0.026*	0.014
Sex of children	0.022***	0.005	—	—	—	—
Father in primary sector	-0.169***	0.016	-0.126***	0.037	-0.203***	0.032
Father in tertiary sector	-0.104***	0.009	-0.099***	0.023	-0.110***	0.015
Mother in primary sector	-0.119***	0.008	-0.190***	0.018	-0.029	0.025
Mother in tertiary sector	-0.049***	0.007	-0.084***	0.015	0.004	0.024
Marital status of children	0.036***	0.007	-0.002	0.018	0.008	0.022
North-Central Zone	-0.026***	0.008	-0.083***	0.014	0.057*	0.031
North-East Zone	0.023***	0.009	0.008	0.017	0.026	0.036
South-East Zone	-0.003	0.011	-0.088***	0.018	0.104***	0.038
South-South South-South	0.015	0.011	-0.100***	0.017	0.147***	0.040
South-West Zone	-0.009	0.009	-0.103***	0.016	0.101***	0.036
Year 2013	-0.026***	0.006	-0.016	0.012	-0.029**	0.013
Sector: Tertiary						
Consumption (in log)	0.105***	0.007	0.113***	0.013	0.085***	0.013

Continued on next page...

Table B.2 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Age of children	0.014***	0.002	0.013***	0.004	0.016***	0.004
Age of children squared	-0.0001***	0.000	-0.0001**	0.000	-0.0002***	0.000
Household size	-0.015***	0.001	-0.016***	0.003	-0.012***	0.003
Years of schooling of children	0.014***	0.001	0.012***	0.002	0.015***	0.001
Father schooling	0.001	0.001	-0.001	0.003	0.003	0.002
Mother schooling	-0.002	0.002	-0.003	0.004	-0.002	0.003
Mother more schooling	0.013	0.009	-0.004	0.021	0.034*	0.019
Sex of children	0.154***	0.008	—	—	—	—
Father in primary sector	-0.057*	0.022	-0.026	0.052	-0.094**	0.040
Father in tertiary sector	0.077***	0.028	0.055	0.064	0.077*	0.043
Mother in primary sector	-0.115***	0.013	-0.207***	0.042	-0.073***	0.024
Mother in tertiary sector	0.079***	0.013	0.058	0.041	0.040*	0.024
Marital status of children	0.059***	0.010	0.073***	0.021	0.013	0.033
North-Central Zone	0.025***	0.012	-0.021	0.034	-0.0005	0.028
North-East Zone	-0.068***	0.012	-0.164***	0.032	-0.011	0.028
South-East Zone	-0.012	0.015	-0.111***	0.038	0.042	0.034
South-South Zone	0.043***	0.015	-0.017	0.039	0.040	0.033
South-West Zone	0.106***	0.016	0.081*	0.046	0.053	0.033
Year 2013	-0.064***	0.009	-0.078***	0.018	-0.038**	0.017
Log likelihood	-14501.006		-7078.503		-6555.901	
Wald χ_2 (d.o.f) ^a	4593.91		3317.47		2354.96	
d.o.f ^a	40		38		38	
Prob > χ_2	0.000		0.000		0.000	
# Observations	19001		9654		9347	

Notes: ^a d.o.f=degree of freedom of the Wald statistic.

Significance levels: *: 10% **: 5% ***: 1%

Table B.3 – Estimation results (average marginal effects) for the restricted sample (children living with their parents) model without heterogeneity. Women empowerment: intensity (interaction between age difference and education of mother relative to father)

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Sector: Secondary						

Continued on next page...

Table B.3 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Consumption (in log)	0.01	0.012	-0.006	0.033	0.019	0.022
Age of children	-0.004	0.004	0.023	0.108	-0.007	0.011
Age of children squared	0.00006	0.00007	-0.0006	0.002	0.0001	0.0002
Household size	-0.0005	0.002	0.003	0.006	-0.002	0.0043
Years of schooling of children	0.001	0.001	0.0009	0.006	0.001	0.002
Father schooling	-0.002	0.001	0.001	0.004	-0.005*	0.002
Mother schooling	0.0009	0.001	-0.002	0.005	0.003	0.003
Mother older educated	-0.023	0.033	-0.059	0.102	-0.018	0.056
Mother younger educated	0.031*	0.018	0.08	0.056	0.002	0.031
Mother older less educated	-0.017	0.02	-0.029	0.057	-0.014	0.032
Sex of children	0.030**	0.014	—	—	—	—
Father in primary sector	-0.335***	0.05	-0.331***	0.135	-0.351***	0.085
Father in tertiary sector	-0.212***	0.025	-0.232***	0.071	-0.205***	0.043
Mother in primary sector	-0.096***	0.022	-0.166**	0.066	-0.051	0.041
Mother in tertiary sector	-0.052**	0.021	-0.087	0.064	-0.027	0.036
Marital status of children	0.067	0.048	0.042	0.168	0.047	0.078
North-Central Zone	0.018	0.025	-0.006	0.076	0.019	0.042
North-East Zone	0.008	0.022	-0.003	0.07	0.007	0.037
South-East Zone	0.026	0.031	-0.014	0.083	0.051	0.059
South-South Zone	0.059*	0.035	0.016	0.091	0.075	0.062**
South-West Zone	0.034	0.036	-0.012	0.092	0.054	0.065
Year 2013	-0.073***	0.021	0.066	0.062	-0.081**	0.036

Sector: Tertiary

Consumption (in log)	0.019	0.015	0.06	0.044	-0.006	0.025
Age of children	0.0009	0.005	-0.015	0.06	-0.003	0.017
Age of children squared	0.00005	0.00008	0.0004	0.001	0.0001	0.0003
Household size	-0.008***	0.002	-0.012	0.009	-0.006	0.004
Years of schooling of children	0.003	0.002	0.0009	0.007	0.004	0.003
Father schooling	0.006***	0.002	0.004	0.006	0.007**	0.003
Mother schooling	-0.002	0.002	0.0004	0.007	-0.003	0.003
Mother older educated	-0.001	0.047	0.046	0.144	-0.043	0.081
Mother younger educated	0.036*	0.022	-0.003	0.063	0.058*	0.035
Mother older less educated	0.036	0.027	0.052	0.079	0.024	0.043
Sex of children	0.026	0.017	—	—	—	—
Father in primary sector	-0.115***	0.044	-0.072	0.125	-0.140**	0.069
Father in tertiary sector	0.200***	0.04	0.225*	0.129	0.183***	0.059

Continued on next page...

Table B.3 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Mother in primary sector	-0.097***	0.028	-0.13	0.09	-0.087**	0.045
Mother in tertiary sector	0.102***	0.026	0.101	0.085	0.102**	0.04
Marital status of children	-0.03	0.052	0.004	0.172	-0.026	0.089
North-Central Zone	-0.012	0.027	0.027	0.11	-0.028	0.04
North-East Zone	0.022	0.026	0.051	0.103	0.01	0.039
South-East Zone	0.054	0.036	0.093	0.123	0.033	0.059
South-South Zone	0.081**	0.036	0.103	0.13	0.075	0.056
South-West Zone	0.043	0.041	0.073	0.152	0.022	0.058
Year 2013	0.021	0.028	-0.061	0.087	0.069*	0.041
Log likelihood	-2075.492		-833.105		-1181.941	
Wald χ_2 (d.o.f) ^a	1429.88		583.28		933.54	
d.o.f ^a	44		42		42	
Prob > χ_2	0.000		0.000		0.000	
# Observations	3803		1435		2368	

Significance levels: * : 10% ** : 5% *** : 1%

Table B.4 – Estimation results (average marginal effects) for the restricted sample (children living with their parents) model without heterogeneity. Women empowerment: Mother has more years of schooling than father

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Sector: Secondary						
Consumption (in log)	0.009	0.012	-0.004	0.032	0.016	0.021
Age of children	-0.005	0.005	0.024	0.112	-0.007	0.011
Age of children squared	0.00007	0.00008	-0.0006	0.002	0.0001	0.0002
Household size	-0.0004	0.002	0.003	0.005	-0.003	0.004
Years of schooling of children	0.002	0.002	0.0008	0.005	0.002	0.003
Father schooling	-0.002	0.002	0.001	0.004	-0.005*	0.002
Mother schooling	0.0007	0.002	-0.001	0.005	0.003	0.003
Mother more schooling	0.029*	0.016	0.068	0.05	0.006	0.027
Sex of children	0.030**	0.014	—	—	—	—
Father in primary	-0.326***	0.046	-0.318**	0.126	-0.344***	0.079

Continued on next page...

Table B.4 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Father in tertiary	-0.212***	0.024	-0.230***	0.068	-0.206***	0.041
Mother in primary	-0.087***	0.022	-0.153**	0.061	-0.04	0.042
Mother in tertiary	-0.042**	0.021	-0.073	0.062	-0.016	0.037
Marital status of children	0.072	0.049	0.047	0.176	0.053	0.08
North-Central Zone	0.01	0.024	-0.021	0.07	0.017	0.04
North-East Zone	0.008	0.022	-0.008	0.066	0.008	0.037
South-East Zone	0.026	0.029	-0.008	0.079	0.044	0.055
South-South Zone	0.057*	0.033	0.015	0.088	0.071	0.059
South-West Zone	0.029	0.034	-0.019	0.086	0.051	0.063
Year 2013	-0.066***	0.02	-0.059	0.06	-0.072**	0.034
Sector: Tertiary						
Consumption (in log)	0.022	0.015	0.059	0.044	-0.0007	0.024
Age of children	0.0006	0.005	-0.015	0.062	-0.002	0.016
Age of children squared	0.00007	0.00009	0.0004	0.001	0.0001	0.0003
Household size	-0.009***	0.003	-0.013	0.008	-0.006	0.004
Years of schooling of children	0.004	0.002	0.001	0.007	0.005	0.003
Father schooling	0.006***	0.002	0.004	0.006	0.007**	0.003
Mother schooling	-0.001	0.002	0.0005	0.007	-0.002	0.003
Mother more schooling	0.024	0.02	-0.003	0.06	0.037	0.032
Sex of children	0.026	0.017	—	—	—	—
Father in primary	-0.117***	0.041	-0.058	0.112	-0.155**	0.066
Father in tertiary	0.198***	0.037	0.239	0.122	0.173***	0.054
Mother in primary	-0.104***	0.028	-0.133	0.089	-0.100**	0.046
Mother in tertiary	0.093***	0.026	0.093	0.083	0.088**	0.04
Marital status of children	-0.029	0.052	0.004	0.174	-0.027	0.091
North-Central Zone	-0.01	0.027	0.025	0.108	-0.026	0.04
North-East Zone	0.016	0.026	0.045	0.101	0.006	0.039
South-East Zone	0.049	0.035	0.079	0.12	0.034	0.058
South-South Zone	0.079**	0.035***	0.093	0.128	0.077	0.056**
South-West Zone	0.046	0.041	0.074	0.151	0.025	0.059
Year 2013	0.017	0.028	-0.063	0.088	0.061	0.041
Log likelihood	-2080.314		-845.038		-1197.799	
Wald χ_2 (d.o.f) ^a	1454.01		591.53		940.19	
d.o.f ^a	40		38		38	
Prob > χ_2	0.000		0.000		0.000	

Continued on next page...

Table B.4 – continued

Variable	Full sample		Daughters		Sons	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
# Observations	3836		1449		2387	
Significance levels:	*: 10%	** : 5%	***: 1%			