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Abstract

This study sheds light on the development of family structures in a polygamous context and offers an explanation for the association between outcomes of children and the status of their mothers among wives, based on observable maternal characteristics. Using a game theoretical approach I show that highly productive wives are more strongly demanded in the marriage market than less productive ones so that a selection into being the first wife with respect to productivity takes place. Furthermore, productivity is positively associated with a woman's bargained share of family income to be spent on consumption and investment, due to greater contributions to family income and larger outside options. The findings are empirically supported by a positive relationship between indicators of female productivity, women's levels of seniority among wives, and their children's educational outcomes in rural Ethiopia.

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JEL classification: D13, J12, O12

1 Introduction

This paper outlines a framework to account for differences in the shares of family income attracted by household members that is based on observable characteristics and complementary to explanations involving bargaining power differentials. In particular, it describes why children of first wives are found to fare better than children of junior wives in polygamous families in previous research (e.g. Gibson and Mace, 2006; Mammen, 2009; Strauss, 1990), based on maternal attributes.[1] I show that both the position among wives as well as incomes when married are determined by a woman's productivity so that the mechanism through which rank affects female returns is grounded on productivity. This limits the role of rank as the source of differences in female shares of family income.

In a simple game theoretical framework with two types of women, I demonstrate that women are selected into rank depending on their productivity: 'High productivity' women are more likely to become first wives than 'low productivity' women in polygamous marriages due to higher utility gains for the husband. Rank relates purely to the sequence of wives entering the household in this study.[2] First (or senior) wives are therefore women who get married to a single man. All women entering the household through marriage to a man who is already married are collectively referred to as 'junior wives'.

Productivity is a measure of the ability to generate income and is positively associated with a wife's contribution to family production through the

[1] To be precise, this paper deals with polygyny, a special form of polygamy in which men are married to more than one woman at a time. Throughout the paper this is the situation the terms 'polygamy' and 'polygamous' refer to. Most of the findings are easily transferable to polyandrous settings in which women have more than one husband.

[2] The same applies when referring to 'seniority among wives'.

provision of labor by herself or her children. Determining shares of family income on the basis of a Nash bargaining solution implies that high productivity wives receive bigger shares, irrespective of rank, due to higher family output and larger outside options. These findings explain why first wives, who are on average relatively more productive, receive larger incomes for their maternal nuclear families than junior wives.[3] It is therefore not merely different levels of bargaining power associated with rank or some form of favoritism originating from the husband towards his first wife that drive differences in the incomes of wives of a given man.

There is evidence for the existence of favoritism in polygynous families, however, as presented by Munro et al. (2010). The authors find that, if the husband allocates the proceeds from an investment in an experimental setting in Northern Nigeria, senior wives receive higher returns than junior wives. Consequently, both of the explanations based on bargaining power and favoritism work in the same direction as the mechanism that is grounded on female productivity and proposed here.

The rationale behind the relationship between a woman's productivity, her share of family income and her children's outcomes is as follows. If parents depend on their children for support at a later age it is reasonable for polygamous wives not to pool resources across all children of the household head but to try and attract the biggest possible share of total family income to invest in their own children (Mammen, 2009). The larger a woman's number of children and the higher their incomes, the higher her future income. Women maximize future income if they behave like rational agents according to the permanent income hypothesis put forward by Friedman (1957). They invest in their children also for selfish motives and not purely for altruistic reasons so that children of mothers with higher incomes have better outcomes. Pitt and Khandker (1998) and Qian (2008) provide empirical ev-

[3]Maternal nuclear family denotes a polygamous mother and her biological children in this study.

idence of the positive relationship between female incomes and educational outcomes of children, especially girls.

I provide empirical support for the theoretical predictions of this study with data on polygamous families in rural Ethiopia, mainly among the ethnic group of the Oromo.[4] While Tertilt (2005) states that less than ten percent of all marriages in Ethiopia are polygamous, approximately one third of married Oromo women are in a marital union with a man who has more than one wife. Polygamy is highly prestigious for men and it is reported that resources are shared among wives in recognition of maternal nuclear family size (Gibson and Mace, 2006).

In the empirical section of this paper, parental wealth and the age of women, both at the time of the wedding, serve as indicators of female productivity. Specifically, I find that first wives have wealthier family backgrounds and that they are younger at the time of the wedding than junior wives. This supports the proposition that 'high productivity' women are more likely to become first wives and that there is a selection effect which leads these women to be successful in the marriage market at an earlier point in life. Furthermore, the maternal nuclear families of first wives attract a bigger share of family income which is reflected by the fact that children of first wives exhibit higher school attendance than those of junior wives. There is no evidence that this finding is driven by children of senior wives being more likely to be enrolled in school, however.

Polygamy is a prominent feature of many societies in the Middle East and in Sub-Saharan Africa and is mostly associated with Muslim ethnic groups (Elbedour et al., 2002).[5] An understanding of the intra-household dynamics

[4]The Oromo are a traditionally semi-nomadic pastoralist ethnic group mostly found in the south of the country and 53% of the polygamous wives in the present sample state *Oromo* as their ethnicity. The remainder are *Gedeo* (18%), *Kembata* (6%), *Gamo* (5%), *Gurage* (4%) and *Other* (14%).

[5]Tertilt (2005) states that more than 10% of marriages in 28 countries of Sub-Saharan Africa are polygamous and that more than half of the male population in Cameroon is married to more than one woman, for example. According to the Koran, a man may have

and resource allocation processes therefore has consequences for development policy and is necessary for effective targeting of educational policies and aid in countries where polygamy is practiced.

While there is some work investigating the incidence of polygamy (e.g. Becker, 1974, 1981), no studies exist on the development of rank order among wives to the best of my knowledge. Furthermore, a strand of the literature looks at the implications of women's productivity on the existence and intensity of polygamous unions (Jacoby, 1995; Gould et al., 2008) but the relationship between productivity and the share of total family income a wife receives appears not to have been addressed so far. Jacoby (1995) links female productivity in agriculture to the incidence of polygamy and finds that men have more wives when women are more productive, controlling for men's wealth, due to lower shadow prices for wives as cheap labor. He assumes, however, that there are no productivity premiums on the share of family income a wife receives. Gould et al. (2008) investigate why developed economies tend to practice monogamy in contrast to developing countries and argue that female inequality increases with development and reduces the incidence of polygamy. Similarly to Jacoby (1995), it is assumed that there are no differences in the returns of wives of a given husband (Gould et al., 2008).

The selection effect proposed in the framework of the present paper is in line with Gibson and Mace (2006) who merely suggest that senior wives may be of 'higher quality' than junior wives, where quality relates to factors such as wealth, family status or attractiveness. Furthermore, empirical evidence shows that differences in the incomes of wives depending on their relative position exist, which is in support of the mechanism formulated in the present paper. Gibson and Mace (2006) find that senior wives tend to have the highest Body Mass Index (BMI) among wives and Kazianga and Klonner (2009) suggest that junior wives are at a significant material disadvantage.

a maximum of four wives who he has to support and to treat equally (Boserup, 1970).

Strassman (1997), on the other hand, shows that first wives among the Dogon in Mali generally have a higher social status but only non-material advantages compared to junior wives.

Mammen (2009) argues that rank itself could be the source of different levels of income by influencing bargaining power among wives when competing for resources, and Kazianga and Klonner (2009) state that junior wives are generally the adults with the least bargaining power in polygamous families. While this concept is difficult to quantify, the present study shows that a woman's high level of productivity both gives her a better chance of becoming a first wife and earns her a higher income within the family, thereby explaining the association between seniority among wives and income, and eroding the effect of rank *per se*. It should be noted that productivity is likely to positively impact on bargaining power but this aspect is beyond the scope of this study. Differences in bargaining power are ignored for the purpose of an analysis of the role of productivity in the determination of income shares attracted within the family.

Gibson and Mace (2006) give an overview of the not entirely conclusive literature on the implications of maternal rank among wives for children. A common finding, however, is that children of first wives have better educational outcomes than children of junior wives (Gibson and Mace, 2006). Mammen (2009) finds that being the child of a senior wife is positively related to school enrollment and expenditure, and to the duration of education. In addition, children of junior wives are found to be more likely to participate in home production (Mammen, 2009). Furthermore, studies by Gibson and Mace (2006), Strauss (1990), and Strauss and Kalpana (1990) present evidence that children of junior wives fare worse with respect to anthropometric conditions and survival probability.

The present study contributes to the existing literature on polygamy by proposing a mechanism through which the position among wives affects female shares of family income. The remainder of the paper is structured as

follows: Section 2 describes the theoretical framework that demonstrates the selection of women into rank on the basis of productivity and the association between productivity and income. Section 3 outlines the empirical application in which the correlates of rank and the allocation of resources among wives in the present sample are examined. Section 4 concludes.

2 The Framework

This section presents an extension to the models of polygamy by Becker (1981) and Jacoby (1995) by allowing for women to differ in productivity and for productivity to influence partner choice. I illustrate the existence of a selection effect of women into rank depending on their productivity and show that productivity is positively related to the shares of family output of wives. This explains the mechanism through which rank affects female shares of family income and, in turn, weakens the association of female income and rank *per se*.

Productivity of individuals relates to the ability to generate income, either directly through employment and insurance possibilities provided by their parents, or indirectly through the provision of a large number of children. The latter support the family by performing agricultural work on the family's land and livestock during childhood and by providing an old age pension equivalent when parents are too old to work. Consequently, highly productive individuals are younger, healthier, better educated and more fertile.

2.1 Setup

Consider an economy in which F women are born per generation of whom a fraction τ are 'high productivity' type $\bar{p}$ women and $(1-\tau)$ are 'low productivity' type $\underline{p}$, all else equal. In addition, there are N identical men in each generation.

Individuals live for two periods and the number of weddings is restricted to one per period and individual. Men may therefore be married to at most two women. Women can only enter marriage with one partner. Furthermore, generations only marry among themselves. All individuals are of reproductive age and single at the beginning of the first period. There is full information, i.e. the productivity of potential spouses is observable and payoffs are common knowledge.[6]

2.1.1 Family output

In order to draw conclusions about the decisions of spouses regarding marriage we need to determine their payoffs from entering a marital union. Co-wives do not pool resources but live autonomously with their children so that the husband's production with each wife is independent.[7] Total family utility U is the sum of the outputs Y produced by a husband with each of his wives as suggested by Becker (1981):

$$\begin{aligned} U =& \bar{w}\bar{Y} + \underline{w}\underline{Y} \\ =& \bar{w}\bar{j}\bar{y}\left(\frac{n(x_N)}{\bar{w}+\underline{w}}, \bar{f}(x_F)\right) + \underline{w}\underline{j}\underline{y}\left(\frac{n(x_N)}{\bar{w}+\underline{w}}, \underline{f}(x_F)\right) \end{aligned} \tag{1}$$

where $\bar{w}$ and $\underline{w}$ denote the number of type $\bar{p}$ and type $\underline{p}$ wives of a husband, respectively.[8] $\bar{Y}$ denotes the production of a husband with a type $\bar{p}$ spouse while $\underline{Y}$ represents his output with a type $\underline{p}$ wife, and $\bar{y}$ and $\underline{y}$ denote the

[6]Productivity may, for example, be observed through a healthy and strong physique that acts as an indicator of the individual's ability to perform agricultural work and reproduce successfully, and through parental wealth that impacts positively on an individual's education and physical health, and, thus, fertility.

[7]Co-wives are reported to live autonomously with little cooperation in many African ethnic groups (Boserup, 1970; Kazianga and Klonner, 2009) including the Oromo in Ethiopia according to Gibson and Mace (2006).

[8]Note that $\bar{w} + \underline{w} \leqslant 2$ in this setup due to the restrictions on marriages per individual and period. Furthermore, for family output U to be positive, $\bar{w} + \underline{w} > 0$.

results of their individual efforts, respectively.[9] Men and women are endowed with x_N and x_F, respectively, and each supply one unit of labor. The production functions n and f describe how the spouses individually convert their endowments into processed resources, e.g. into their own labor force to contribute to joint output, or into individual output. Function f increases with female productivity at a decreasing rate, i.e. $f' > 0$ so that $\bar{f} > \underline{f}$, $f'' < 0$. Note that the resources available to type $\bar{p}$ and type $\underline{p}$ women x_F and the share of processed resources invested by the husband with each wife, $\frac{n(x_N)}{\bar{w}+\underline{w}}$, are identical across types.

Function j describes the joint efforts of a husband-wife match to convert their individually processed resources into joint output Y. The joint production of a husband and a wife exceeds the sum of their individual products, i.e. $Y_j' > 0$, with both types of women. Note that the marginal product of marriages is decreasing, $Y_j'' < 0$, and that the joint production function increases with female productivity at a decreasing rate, i.e. $j' > 0$ so that $\bar{j} > \underline{j}$, $j'' < 0$. Examples of this surplus over the sum of the individual products include procreation for which an investment of both the husband and wife is needed, or the utility gained from labor sharing or specialization of spouses in agricultural work.[10] In rural African settings it is usually the case that some plots of the family are managed and farmed by the male spouse and others by the female one (Udry et al., 1995). In addition, there are gender-specific crops so that a marital union results in the household producing a larger number of crops.[11] This allows risk diversification, especially in the African context where cash crops tend to be male crops while women engage in subsistence farming (Elson, 1995).

[9] Bars and underbars denote the concerned variables and functions for type $\bar{p}$ and type $\underline{p}$ wives, respectively, throughout Section 2.

[10] Please also see Becker (1973) for a thorough discussion of the gain generated by marriage.

[11] Qian (2008) mentions that men and women have comparative advantages in the agricultural production of different crops in China.

2.2 Male income when married

Both men and women have a choice: Marrying or staying single. In both periods they decide to get married if they gain a higher utility from being married than from being single. Returns from marriage depend on the couple's joint production Y. Spouses determine each other's shares Z_{Ni} and Z_{Fi} of joint output Y_i for the husband and wife, respectively, according to a Nash bargaining solution by taking into account their incomes when not entering marriage and their spouse's reaction. Whether it is the first or second marriage of the husband is denoted by $i = 1, 2$. The incomes when not entering marriage are denoted by R_{Ni} and R_F and represent the outside options of the man and woman, i.e. their incomes if they fail to to reach an agreement.[12] Nash bargaining splits the surplus that marriage yields over and above the sum of the outside options $R_{Ni} + R_F$. In case of a marriage between a man and a type $\bar{p}$ woman, for example, the spouses determine the Nash bargaining solution by maximizing the product of excess utilities over the husband's share $\bar{Z}_{Ni}$:

$$g(Z_i, R_i) = \underset{\bar{Z}_{Ni} \in Z}{\arg\max} (\bar{Z}_{Ni} - R_{Ni})^{\frac{1}{2}} (\bar{Z}_{Fi} - \bar{R}_F)^{\frac{1}{2}}, \tag{2}$$

where $\bar{Z}_{Fi} = \bar{Y}_i - \bar{Z}_{Ni}$. Note that all agents have equal bargaining power of $\frac{1}{2}$ so that the gain generated by marriage, i.e. the surplus over the incomes when single, is shared equally. Consider the first marital union of a man, i.e. $i = 1$. Maximization of equation (2) with respect to $\bar{Z}_{N1}$ and subsequently solving for the woman's income when married $\bar{Z}_{F1}$ yields the returns from marriage between a man and a type $\bar{p}$ wife:

$$\bar{Z}_{N1} = \frac{\bar{Y}_1 + R_{N1} - \bar{R}_F}{2} \tag{3}$$

[12] Note that no temporal subscript is necessary on female incomes when single as women can only enter one marriage.

$$\bar{Z}_{F1} = \frac{\bar{Y_1} + \bar{R}_F - R_{N1}}{2}. \tag{4}$$

The payoffs from marriage with a type $\underline{p}$ wife are computed analogously. Equations (3) and (4) show that the share of the couple's output a spouse receives increases with her outside option, $Z'_R > 0$. There are limited opportunities for unmarried women to earn income in Sub-Saharan Africa so that their outside options are smaller than those of men, $\underline{R}_F < \bar{R}_F < R_{Ni}$, and the husband receives a larger share of family income. Furthermore, to ensure that all women have a chance of entering marriage, women's reservation wages are partly determined endogenously.[13] The incomes when single of all agents are bigger than zero, however.

Firstly, it should be noted that both spouses have higher incomes when married than when single. This is due to the complementarities of male and female labor, $Y'_j > 0$, which leads to the couple's output being bigger than the sum of the individual outputs, $Y_1 > R_{N1} + R_F$. Accordingly, all agents strictly prefer marriage over being single. Equations (3) and (4) indicate that each agent receives an equal share of the surplus in addition to her outside option due to equal bargaining power.

The fractions of family income $\bar{z}_{N1} = \frac{\bar{Z}_{N1}}{\bar{Y_1}}$ and $(1 - \bar{z}_{N1}) = \frac{\bar{Z}_{F1}}{\bar{Y_1}}$ corresponding to equations (3) and (4) are given by:

$$\bar{z}_{N1} = \frac{1}{2} + \frac{R_{N1} - \bar{R}_F}{2\bar{Y_1}} \tag{5}$$

$$(1 - \bar{z}_{N1}) = \frac{1}{2} + \frac{\bar{R}_F - R_{N1}}{2\bar{Y_1}} \tag{6}$$

and analogously for marriages involving a type $\underline{p}$ wife. Equations (5) and (6) indicate that the share of each spouse depends on the relative size of her reservation wage. As male outside options are higher than female ones,

[13] This is a reasonable assumption as being an unmarried woman is not accepted or economically sustainable in many African societies, especially among Muslim ethnic groups in which polygamy mostly occurs (Elbedour et al., 2002).

$R_{N1} > \bar{R}_F$, the husband receives more than half of the joint output, i.e. $z_{N1} > \frac{1}{2}$. Furthermore, as high productivity women have higher incomes when single than low productivity ones, $\bar{R}_F > \underline{R}_F$, the husband receives a smaller fraction of joint output with a type $\bar{p}$ than with a $\underline{p}$ wife, i.e. $\bar{z}_{N1} < \underline{z}_{N1}$. However, the relation between the absolute shares he receives, $\bar{Z}_{N1}$ and $\underline{Z}_{N1}$, also depends on the couples's joint output Y_1 as the latter is higher with a type $\bar{p}$ wife than with a type $\underline{p}$ one, $\bar{Y}_1 > \underline{Y}_1$. As the marginal product of marriage is positive, $Y_j' > 0$, and as the joint productivity function increases with female productivity, $\bar{j} > \underline{j}$, the difference in joint output is bigger than the difference in incomes when single when comparing type $\bar{p}$ and $\underline{p}$ wives:

$$\bar{Y}_1 - \underline{Y}_1 > \bar{R}_F - \underline{R}_F. \tag{7}$$

As the male outside option R_{N1} remains unaffected, it follows that a man's payoff from marriage Z_{N1} is higher when married to a 'high productivity' wife as he attracts half of the surplus:

$$\bar{Z}_{N1} > \underline{Z}_{N1}. \tag{8}$$

Due to the positive marginal product from each marriage, $Y_j' > 0$, male income always increases with marriage. However, because male effective resources and individual output invested with each wife $n(x_N)$ are divided by the total number of wives $\bar{w} + \underline{w}$, the marginal product decreases, $Y_j'' < 0$, and men experience diminishing returns to marriages. For the same reason, a first wife's income when married decreases when her husband enters marriage with a second woman so that women prefer monogamy. This does not impact on her decision to get married when men are identical, however, as she is not able to anticipate whether he enters marriage in the second period.[14]

[14]The probability of a husband attracting a second wife is identical among men and considered in detail in Section 2.3. As there are more women than men as assumed in Section 2.3, and as women's returns when single are very low, it is not a profitable strategy for women to remain single and marry a single man in the second period as they

The fact that male reservation wages when already married are equal to the returns from his first marriage and not to his income when single, i.e. $R_{N2} = Z_{N1} > R_{N1}$, influences the returns of each spouse entering his second marriage. It is apparent that he receives a bigger fraction of joint output in his second marriage, $z_{N2} > z_{N1}$, holding the type of wife constant. Women therefore prefer being the first wife if they are in a polygamous union. Furthermore, as $\bar{Z}_{N1} > \underline{Z}_{N1}$, if women only have the option of becoming a second wife, they prefer having a low productivity co-wife. If her co-wife is of type $\underline{p}$ she is able to extract a larger share of the couple's joint output.[15]

Following equation (8), marrying a type $\bar{p}$ woman is preferred over entering marriage with a type $\underline{p}$ woman due to higher male returns, irrespective of which marriage it is for the man.

2.3 The matching process

The matching of spouses is a crucial part of demonstrating the selection of women into rank. In each period there are three potential agents: a man, a type $\bar{p}$ and a type $\underline{p}$ woman. It is not necessarily the case that the husband and wife are the decision-makers with regards to partner choice but rather their families, especially when individuals get married at a very young age (Carmichael, 2011). However, whether it is the spouses themselves or their families that decide on the partner does not alter the behavior in the marriage market if partner choice is based on rational rather than emotional considerations and if parents' utility increases with their child's income.[16]

risk remaining single in the long run. Relaxing the restrictions on the number of periods and the number of wives per husband could make this a profitable strategy but also implies that women cannot anticipate the number of co-wives. Again, waiting is not profitable due to the risk of remaining single.

[15]Note that, if it is not assumed that the fractions of joint output z_{N1} and therefore $(1 - z_{N1})$ are fixed for the second period (even though a second marriage lowers joint output Y_1 due to lower male investment), women entering marriage in the first period also prefer a low productivity co-wife.

[16]Fafchamps and Quisumbing (2005) state that most marriages in Ethiopia are arranged and that economic factors appear to be one of the main determinants of partner choice

To make the model more realistic, I introduce rationing of mates and assume that there are less men than women.[17] In addition, there are not more women than twice the number of men to ensure that all women may get married in either period:

Assumption 1. $N < F \leqslant 2N$.

Furthermore, let us assume for the moment that there are fewer high productivity women than men:[18]

Assumption 2. $\bar{F} < N$.

Preferences for marriage of all agents and male preferences for type $\bar{p}$ wives form the basis of the following proposition:

Proposition 1. *The more productive wives are, the higher their rank.*

As men are identical and as their income when married increases with female productivity, $\bar{Z}_{Ni} > \underline{Z}_{Ni}$, all type $\bar{p}$ women get married in the first period and randomize among potential husbands. Those men that are not matched to a type $\bar{p}$ woman marry a type $\underline{p}$ one due to marriage always being more profitable than remaining single so that all men are in a marital union at the beginning of the second period. As the marginal product of marriage is positive, $Y_j' > 0$, and as the man extracts part of this surplus, all

because of the evidence of assortative matching with respect to wealth and human capital. Note that payments of bride prices are not directly modeled here but could be included in female income. They will not influence the conclusions drawn from the framework, however, if they are smaller than the marginal product of a woman in a marital union so that her income still increases with marriage.

[17] This assumption mirrors reality in this setting due to a history characterized by periods of civil wars in large parts of the African continent in which men constitute the majority of casualties due to their higher exposure to this specific danger. Furthermore, Gibson and Mace (2006) mention that women are often forced into polygamous marriages due to a surplus of women in the marriage market, which is also given as a motivation for polygamous marriage by Becker (1973) besides large inequalities among men (Becker, 1974).

[18] The implications of relaxing Assumption 2 are discussed in Appendix A.

men prefer entering a second marriage over being monogamous. Because of Assumption 2, this setting implies that all type $\bar{p}$ women as well as some type $\underline{p}$ women become first wives and that the remaining type $\underline{p}$ women become second wives, therefore giving substance to Proposition 1.

Specifically, the chance of attracting a type $\bar{p}$ woman in the first round, $\bar{m}_{N1}$, is identical among men. The chance of men to enter marriage in period 1 in this setting is $m_{N1} = 1$ as women prefer marriage over being single and men are identical. The chance of entering marriage can be disaggregated into the chances of attracting a type $\bar{p}$ woman in the first period, $\bar{m}_{N1} = \frac{\bar{F}}{N}$, and of being matched to a type $\underline{p}$ woman, $\underline{m}_{N1} = \frac{N-\bar{F}}{N}$. Male reservation wages when negotiating payoffs of their second marriage are $\bar{Z}_{N1}$ or $\underline{Z}_{N1}$, depending on the type of first wife. For men married to a type $\bar{p}$ first wife to have equally good chances of entering a second marriage m_{N2}, they negotiate with potential wives with the lower male reservation wage $\underline{Z}_{N1}$ so that the type of co-wife is of no importance to a potential second wife. This implies that matching in different periods is independent as the type of a man's first wife has no influence on his marital outcome in the second period. The process therefore exhibits *uniform random matching* as described by La Ferrara (2003) and the remaining type $\underline{p}$ women are matched randomly to their husbands in period 2. Specifically, the chance of male players to enter marriage in period 2 is $m_{N2} = \underline{m}_{N2} = \frac{F-N}{N}$.

2.4 Female income when married

Proposition 2. *The more productive women are, the higher their incomes when married.*

Equation (6) illustrates that the fraction of joint output earned by a type $\bar{p}$ wife is higher than by a type $\underline{p}$ one, $(1 - \bar{z}_{Ni}) > (1 - \underline{z}_{Ni})$. As the man's outside option R_{Ni} does not change with the type of wife for a given i, and

as joint output is higher the higher female productivity, $\bar{Y}_i > \underline{Y}_i$:

$$\bar{Z}_{Fi} > \underline{Z}_{Fi}. \tag{9}$$

Note that the conclusions from equation (9) hold for women of equal rank. As women have a relatively lower threat point relative to the man if he is already married, women of identical productivity but lower rank earn lower incomes from marriage, which means that the direct effect of rank on female income is only weakened and not completely eroded by the present framework. Furthermore, equation (9) shows that female returns are not directly a function of the size of the maternal nuclear family as suggested by Gibson and Mace (2006). However, the number of children positively influences the returns from marriage for both spouses as children are part of joint output Y.

3 Empirical Results

In this section I investigate empirical evidence for Propositions 1 and 2. Specifically, I supply empirical support for the proposed selection effect of women into rank and for the association with the shares of family income polygamous wives receive.

3.1 Data

The data employed in this paper are the first four rounds of the Ethiopian Rural Household Survey conducted by the Economics Department of Addis Ababa University in collaboration with the International Food Policy Research Institute and the Centre for the Study of African Economies at Oxford University. The surveys are representative and have sample sizes of approximately 2000 households per round. The first round of the survey was conducted between January and March 1994, the second one in the months

of August through October of the same year and the third one in the first three months of 1995. The fourth round was conducted in 1997 and three further rounds have been completed since. The main source of data for this piece of research is the fourth round of the survey.[19]

The households surveyed in the different rounds form a panel but only polygamous households are investigated here which results in relatively small sample sizes. However, the questionnaires are very detailed, especially in round 4 regarding the household head's and his spouses' marital history. Furthermore, the information on the marital history of both spouses is unique in African household surveys to the best of my knowledge and essential in order to give empirical evidence in support of the theoretical findings of Section 2. The survey includes questions on the timing of each wedding, on the decision-maker regarding partner choice, on the family background of each spouse, and on the biological parents of each child.[20]

In cases where the data on the timing of the wedding clearly suffer from measurement error, I use the panel structure of the dataset to establish the sequence of wives between rounds 1 and 4.[21] These procedures enable non-ambiguous ranking of 85% of wives in the sample. If the timing of weddings is not clear after these procedures, I apply the method suggested by Mammen (2009) and Elbedour et al. (2002) and proxy rank by the age of wives with rank being positively related to age.[22] This strategy is not ideal as junior

[19]See Fafchamps and Quisumbing (2005) for a detailed description of the study area, the sampling strategy, and the survey design of round 4, particularly regarding the module on the marital history of the household head and his spouse(s).

[20]Unfortunately, the amount of usable data in response to some questions is limited, for example regarding the spouses' educational attainment which would be an ideal proxy for female productivity as introduced in Section 2. One explanation for the fact that there are hardly any usable data on spouses' education besides the low response rate is the rural location of these households in which most adults have not received any formal education.

[21]Measurement error is apparent if the duration of the marriage and the year of the wedding do not add up to either one the years in the Ethiopian calendar in which the interviews for the fourth round of the survey were undertaken.

[22]This means that the oldest woman is regarded as the senior wife, the second oldest as the second wife etc.

wives can be older than senior wives, especially if the age difference is small. In most cases, however, this negative correlation between rank and age holds as verified by those households in the sample for which the sequence of weddings is known. For 83% of the wives for whom the ranking is clear, age proxies marital sequence correctly.

Table 1 presents summary statistics for polygamous wives and t-tests for equality of the means of first (denoted by '*_first*') and second wives (denoted by '*_second*').[23] First wives got married to their current husband at a younger age (*age_wedding*) and have been married considerably longer (*no_years_married*) than junior wives. Both differences are statistically significant. The fact that first wives have been married to their spouse for a longer time is not surprising in this setting as first wives are by definition those wives that got married to a man first. The vast difference in the duration of marriage, especially between first and second wives, is noteworthy, however, and indicates that the decision to move from a monogamous to a polygamous marriage takes longer than from two to three wives, for example. The finding that first wives are considerably younger upon marriage supports Proposition 1: First wives are more productive due to their younger age. They are furthermore highly demanded and exit the marriage market earlier in life.

The variable *wealth_parents* is an ordinal variable ranging from 1 through 5, in which a value of one means that the husband perceived his bride's parents to be 'very poor' and a value of 5 indicates that the husband rated the bride's parents as 'very rich' at the time of the wedding.[24] It is shown that the parents of first wives are perceived to be wealthier by the husband at the time of the wedding even if this difference is not statistically significant.

Table 1 also shows that first wives have a larger number of children

[23]The variables are denoted by '*_third*' and '*_fourth*' for third and fourth wives, respectively. As can be seen in Table 1, the number of more junior wives than of rank two is very small so that the t-tests are only performed between first and second wives.

[24]A value of 2 corresponds to 'poor', a value of 3 to 'average' and a value of 4 to 'rich'.

Table 1: Summary Statistics for polygamous wives

	mean	difference	min	p50	max	sd	N
age_wedding_first	16.0888	-6.0246***	3	16	29	6.2303	46
age_wedding_second	22.1134		8	22	38	6.4958	43
age_wedding_third	23.1905		13	25	33.125	7.8224	7
age_wedding_fourth	30		30	30	30	.	1
no_years_married_first	25.1957	11.5212***	5	25	45	10.6555	46
no_years_married_second	13.6744		1	12	35	10.1271	43
no_years_married_third	10.1429		1	4	25	10.3187	7
no_years_married_fourth	7		7	7	7	.	1
wealth_parents_first	2.8913	0.1239	1	3	4	0.7372	46
wealth_parents_second	2.7674		1	3	5	0.7819	43
wealth_parents_third	3		2	3	4	0.8165	7
wealth_parents_fourth	5		5	5	5	.	1
no_children_union_first	5.7826	1.7128***	0	5	12	3.0471	46
no_children_union_second	4.0698		0	4	11	2.6672	43
no_children_union_third	3		0	2	8	2.9439	7
no_children_union_fourth	3		3	3	3	.	1
no_children_schoolage_first	2.0217	0.6031*	0	2	5	1.8073	46
no_children_schoolage_second	1.4186		0	1	6	1.5921	43
no_children_schoolage_third	1.5714		0	0	4	1.9881	7
no_children_schoolage_fourth	1		1	1	1	.	1
rel_no_children_union_first	0.2978	-0.0825**	0	0.2938	0.6667	0.1498	46
rel_no_children_union_second	0.3803		0	0.3333	1	0.2052	43
rel_no_children_union_third	0.3717		0	0.2609	1	0.3156	7
rel_no_children_union_fourth	0.4286		0.4286	0.4286	0.4286	.	1

Note: Two-sample t-test for equality of the means for unpaired data with unequal variances in all cases.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

from the current union in general (*no_children_union*) and at schooling age (*no_children_schoolage*), i.e. between 6 and 18 years of age, both inclusive. Both differences are statistically significant. When assessing the fertility of wives, however, it should be noted that some women and especially first wives get married at very young ages at which they may not yet be able to conceive.[25] On the other hand, as shown in Table 1, first wives tend to get married at a considerably younger age than junior wives, which also means that they have more reproductive years with their husbands.

To ensure that differences in fertility in relation to the duration of the marriage are not driven by the fact that wives are married at an age at which they may not be able to conceive, the years of marriage in which the wife was not of reproductive age are not taken into account when computing the relative number of children. The variable *rel_no_children_union* therefore denotes the number of children of a wife and her husband divided by the number of years they have been married in which she was of reproductive age.[26] Inclusion of the years in which a wife was not of reproductive age does not qualitatively alter the results as presented in Section 3.2, however. The difference in fertility in relation to the duration of marriage at reproductive age is statistically significant and shows that productivity in terms of fertility is not higher among senior wives, which may appear to be a contrast to the underlying assumption of this paper. However, female productivity as described in Section 2 relates to reproductive potential, not realized fertility, which is subject to other characteristics of the relationship than female reproductive potential.

In summary, it should be noted that the data confirm the prediction

[25] Boserup (1970) mentions that polygamy often leads to high bride prices and therefore to families marrying off their daughters at a young age. Meekers (1992) furthermore describes that marriages are arranged at a very young age to make sure girls have not engaged in extra-marital sexual behavior.

[26] Women are of reproductive age between 15 and 49 years of age as used, for example, by the United Nations (2004) and Yohannes et al. (2011). The latter study specifically investigates Ethiopian data.

regarding the characteristics of wives derived in Section 2 with respect to the age at the time of the wedding, i.e. summary statistics indicate that first wives get married at a younger age than junior wives. However, no conclusive picture to support Proposition 1 emerges when looking at realized fertility or the natal family's background in terms of wealth. Descriptive statistics for the households in which the polygamous wives in this sample live are given in Table B 1 in Appendix B.

Summary statistics for the children of polygamous mothers are given in Table B 2 where '$\_motherfirst$' denotes that the individual is a child of the first wife, '$\_mothersecond$' of the second wife and so on. Firstly, it should be noted that the number of children of first wives versus the number of children of junior wives combined is relatively balanced, which also holds for the gender distributions ($male$). First wives have a lower share of male children than second wives and this difference is statistically significant. This could suggest that men feel the need for a second wife if the first one does not give birth to male heirs. Furthermore, 43 out of the 58 households with polygamous wives (74%) include children at schooling age of the first wife and at least one junior wife. Children are on average 10-12 years of age with the children of the one fourth wife in our sample being slightly younger (age) and children of the first wife being older than those of the second wife in a statistically significant way. The table shows that only a little over 30% of the children aged over 5 and under 19 years of age in the present sample are enrolled in school ($school$), which is possibly due to the rural location of these households. The ratio is slightly lower for children of first wives and slightly higher for children of second wives but the difference in means is not statistically significant. If they are enrolled in school, attendance across all groups is very high with a mean of almost 10 months in which they attend more than half the school days ($school\_attend$). This value is somewhat higher for children of first wives in a statistically significant fashion.

3.2 Correlates of Rank

Supporting Proposition 1 with empirical evidence is difficult as productivity cannot be directly measured, especially in a setting like rural Ethiopia. If women were in paid employment, their earnings could serve as a proxy for human capital. Alternatively, if data were available on the returns to agricultural activity, disaggregated by household member, or if we could measure reproductive potential rather than realized fertility, two central aspects of the concept of female productivity described in Section 2 could be captured empirically. The most accurate and available indicators of a woman's human capital relating to education and health available are her natal family's background and her age at the time of the wedding.

3.2.1 Specification

In order to see whether rank among wives correlates with characteristics that are indicative of a woman's productivity in the present sample, I estimate the following relationship:

$$\begin{aligned} first\_wife_{ih} =& \phi_0 + \phi_1 wealth\_parents_{ih} + \phi_2 age\_wedding_{ih} \\ &+ \phi_3 rel\_no\_children\_union_{ih} + \mathbf{X}_{ih}\boldsymbol{\beta} + \mathbf{H}_h\boldsymbol{\xi} + \epsilon_{ih} \end{aligned} \tag{10}$$

where subscript i denotes the observational unit, i.e. a polygamously married woman, and subscript h denotes the household she lives in. The variable $first\_wife$ is a dummy variable that takes value one if the woman is the senior wife and zero otherwise, i.e. if she is a second or even more junior wife.[27]As the dependent variable is binary, I apply a Probit estimation tech-

[27]Grouping junior wives is necessary here due to the very limited number of third and fourth wives and in accordance with some of the literature (Mammen, 2009; Timæus and Reynar, 1998; Strauss and Kalpana, 1990) but to verify that first wives exhibit different characteristics than second wives at the time of the wedding, Tables 2 and B 3 are replicated with a sub-sample in which wives that are more junior than the second wife are excluded. Results are not presented here but available from the author upon request. The loss of observations puts strain on the sample but the results are robust to using the

nique with robust standard errors.[28]

The ordinal variable *wealth_parents* measures the husband's perception of the wealth of his parents-in-law at the time of his wedding,[29] *age_wedding* measures the age of the wife at the time of the wedding to her current husband, *rel_no_children_union* is the number of children from the union of this wife and her husband divided by the years they have been married at an age that would physically enable her to conceive as explained in Section 3.1.[30] **X** is a vector of individual controls including whether the woman was consulted regarding the choice of her husband (*bride_spousechoice*), how long she has been married to her current husband (*no_years_married*) and the wife's body mass index (*bmi*). In many developing countries, a high body mass index (BMI) is still considered a signaling device for health and material well-being. Unfortunately, a woman's BMI can only be observed at the time of the survey, no data is available for her BMI at the time of the wedding. The BMI at the time of the survey may be correlated with her BMI at the time of the wedding, but it is more likely to be an indication for her consumption and therefore her share of family income.

H is a vector of household controls including the logarithm of the total values of assets (*ln_value_assets*), livestock (*ln_value_livestock*), and of the

sub-sample and even stronger than the main results.

[28]There is reason for concern that the error variances of wives married to the same husband may not be independent from each other. The main results hold if the model is estimated with standard errors clustered at the household level. Even though the number of clusters itself is no reason for concern with 50 to 57 (Angrist and Pischke, 2009), the fact that there are very few observations per cluster is not ideal. Results are presented in Tables B 4 and B 5 in Appendix B.

[29]Substituting this ordinal variable for a binary measure that takes a value of 1 if the husband perceives the parents of his bride to have been 'very poor' or 'poor' and a value of 0 if the perception was that they were 'average', 'rich' or 'very rich' does not qualititatively alter the results in Tables 2 and B 3.

[30]Questions on other characteristics of the spouses measuring human capital like formal education, farming experience, bride prices or the value of assets brought into marriage exhibit drastically low response rates in the present sample and can therefore not be used as explanatory variables.

total size of the household's land holdings (*ln_total_plotarea*).[31] The value of assets and livestock are given in Ethiopian Birr, the size of land holdings is measured in hectares. Another household control is the average quality of the land (*quality_land*), which is measured by the mean of a binary variable taking a value of one if the respondent rates a plot as '*lem*(good)' and a value of zero if it is regarded as '*lem-teuf*(medium)' or '*teuf*(poor)', averaged over all plots of the household.

3.2.2 Results

The marginal effects for the specification outlined in equation (10) are given in Table 2, the estimated coefficients are presented in Table B 3 in Appendix B. The estimation technique is identical in columns 1 through 4 while the control variables differ. The results given in Tables 2 and B 3 suggest that some characteristics of a woman that indicate 'high productivity' are significantly correlated with becoming the senior wife.[32] The coefficient on the variable describing the wealth of a bride's parents at the time of the wedding is positive and statistically significant in three out of four columns, which suggests that if the woman's natal family is relatively wealthy, she is more likely to be a first wife. Specifically, her chance of being a first wife increases by 16.1%–20.8% if the perception of her parents' wealth increases to the next category, depending on the specification and conditional on statistical significance. Wealth is often strongly associated with prestige and respect in a positive way in the developing world. Marrying a woman from such a family could be a desirable strategy in order to enhance one's prestige within the community. Furthermore, women growing up in wealthy families may be of

[31] Inclusion of household fixed effects is not advisable due to the fact that there is often only one wife with usable data for all variables per household. Restricting to households with more than one wife for the purpose of household fixed effects is not possible due to the small sample size.

[32] As the sample exclusively consists of polygamously married women, the results for being a junior wife as the dependent variable are simply the mirror image of the ones presented here.

better nutritional and educational status, which in turn suggests more and possibly healthier offspring. Another explanation for this significant association is an insurance effect: A man would want to marry a woman from a wealthy family first so that a strong family network is present to support in needy times.[33]

The coefficient on the wife's age at the time of the wedding is highly significant and negative which indicates that single older women are less likely to become senior wives. Each additional year of age is associated with a 2.5%–3.8% lower probability of becoming a first wife as presented in Table 2. There are two mechanisms at work here: younger women are considered to be of higher productivity and quality, possibly when thinking of the expected number of children, her attractiveness, or her ability to perform agricultural work, and senior wives are selected for marriage at a younger age than junior wives. The first mechanism supports the idea of a qualitative selection effect in which 'high productivity' women are more likely to become first wives while the latter supports the idea of a temporal selection into marital rank in which 'high productivity' women are demanded more strongly in the marriage market and therefore get married at earlier points in life.

The relative number of children is negatively but insignificantly related to becoming a senior wife. However, this may not necessarily be the result of a wife's reproductive potential but of the amount of time that the husband spends with her. It is reported that pay more attention to junior wives (Gibson and Mace, 2006) which is likely to increase their chances of conceiving. Another explanation is that men often choose to marry another wife

[33]Inclusion of binary variables indicating whether the husband perceived the parents of his spouse to be richer or of equal wealth as his natal family does not qualitatively alter the results. Furthermore, neither variable yields statistically significant coefficients. Results are not presented but available from the author upon request. This is interesting given the findings of Fafchamps and Quisumbing (2005) who find evidence for assortative matching with the same dataset. However, it should be noted that the authors look at assortative matching in the marriage market with respect to physical and human capital of spouses, rather than of their natal families and also do not pay specific attention to polygamous unions.

Table 2: Marginal Effects for being a Senior Wife

	(1)	(2)	(3)	(4)
	first_wife			
wealth_parents	0.122	0.161*	0.177**	0.208**
	[0.0759]	[0.0904]	[0.0899]	[0.0998]
age_wedding	-0.0375***	-0.0257***	-0.0282***	-0.0246**
	[0.00926]	[0.00984]	[0.0103]	[0.0111]
rel_no_children_union	-0.398	0.0178	-0.0361	0.0659
	[0.324]	[0.377]	[0.387]	[0.447]
bride_spousechoice (d)	-0.203*	-0.160	-0.167	-0.209
	[0.109]	[0.117]	[0.122]	[0.130]
bmi		0.0222	0.0189	0.00509
		[0.0271]	[0.0287]	[0.0307]
no_years_married		0.0212***	0.0236***	0.0251***
		[0.00623]	[0.00625]	[0.00657]
ln_value_assets			0.00947	0.0374
			[0.0541]	[0.0628]
quality_land			0.274	0.318
			[0.180]	[0.201]
ln_total_plotarea			-0.0676	-0.0375
			[0.0454]	[0.0499]
ln_value_livestock				-0.0958
				[0.0678]
N	97	90	90	81
Chi-squared	22.73	27.13	34.98	32.72
Pseudo R-squared	0.2029	0.2922	0.3248	0.3073

Note: Robust standard errors in parentheses. Marginal effects; (d) for discrete change of dummy variable from 0 to 1.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

because their first wife's fertility does not meet their expectations (Kazianga and Klonner, 2009). In either case, the number of children in relation to the duration of the union is an *ex post* measure of the couple's reproductive activities as opposed to the *ex ante* measure of female reproductive potential incorporated into the theoretical framework in Section 2 as a central measure of a woman's productivity. It is not possible to measure a woman's fertility at the time of the wedding so that the relative number of children is used as a proxy for fertility.

Whether the wife was consulted regarding the choice of her husband is negatively associated with being the first wife in a statistically significant way only when the duration of the marriage is not controlled for. A woman's current BMI is not significantly related to being a first wife, which is a contrast to the findings of Gibson and Mace (2006) and suggests that first wives do not have nutritional advantages over junior wives. As, by definition, first wives are the wives that have been married to a man longest, the coefficient on the duration of the current marriage is positive and statistically significant. This variable should be viewed as a classical control variable that is included to single out the effect of age at marriage from time effects. If the duration of the marriage were not controlled for, it would not be possible to rule out that first wives are younger at the time of the wedding than junior wives because individuals simply prefer to get married at an older age the further time progresses. The inclusion of further household controls in columns 3 and 4 does not qualitatively alter the results.

3.3 Resource Allocation among Wives

In this section I outline a strategy to empirically support Proposition 2, which suggests a positive effect of female productivity on incomes when married through rank. Besides productivity, female income as described in Section 2, i.e. the share of family income a wife attracts for consumption and investment in her nuclear family, cannot be measured directly. Even though it is

reported that each wife in polygamous families among the Oromo holds an independent household budget (Gibson and Mace, 2006), there is no possibility of quantifying this household budget or the consumption of each household member with the survey data available. However, empirical evidence exists on a positive relationship between maternal income and children's outcomes with respect to health (Duflo, 2003; Qian, 2008) and specifically with respect to educational outcomes (Pitt and Khandker, 1998; Qian, 2008).

Investment in children can be measured by whether the child is enrolled in school and more precisely by effective school attendance so that educational outcomes are used as indicators of female income. Although enrollment is associated with sunk costs for school fees and equipment, attending school exhibits costs for school supplies and considerable opportunity costs. When not attending school a child may be working on the family's land holdings or taking care of the family's livestock, a traditional responsibility of children in rural Ethiopia. Both the direct and opportunity costs of schooling may be 'paid' for with the mother's share of family income.

3.3.1 Specification

Intuitively, the most appropriate empirical strategy to test the theoretical framework laid out in Section 2 would be a two-stage procedure, which would instrument for maternal rank with the proxy variables for female productivity. However, a violation of the exclusion restriction is likely so that I use maternal rank as an indicator of productivity, which is justified given the positive association found in Section 3.2. Consequently, this section is in fact a replication of the existing findings by e.g. Gibson and Mace (2006), Mammen (2009), and Strauss (1990) that demonstrate a relationship between maternal rank among wives and children's educational outcomes.[34]

[34]For example, the exclusion restriction may be violated as the wealth of the mother's parents may directly impact on a child's educational outcomes, especially when they are associated with monetary costs. Furthermore, it may be that also the age of the mother at the time of the wedding has a direct effect on her children's educational outcomes

As a first step, an equation of the form:

$$E_{ih} = \psi_0 + \psi_1 mother\_first_{ih} + \psi_2 male_{ih} + \psi_3 age_{ih} + \mathbf{H}_h \boldsymbol{\eta} + u_{ih} \qquad (11)$$

is estimated on the sample of children living in polygamous households over 5 and under 19 years of age. The model is estimated for two dependent variables, namely for a binary variable denoting school enrollment (*school*) and for effective school attendance (*attendance*), i.e. the number of months in which child i of household h attended school more than half of the school days during the year before the survey. When the dependent variable is school enrollment, the model is estimated using a Probit technique. For school attendance in months, the estimation technique is Ordinary Least Squares (OLS). Both the Probit and OLS specifications are estimated using robust standard errors.[35]

In equation (11), the variable $mother\_first$ is a binary variable to control for whether the mother of the child is the first wife or not. As the sample exclusively consists of children of polygamous women, a child's mother is by definition a junior wife if she is not a first wife. Individual controls include the age of the child in the fourth round of the survey in years and *male*, which is binary and takes value one if the child is male and zero otherwise. **H** denotes a vector of household controls including the logarithm of the total value of the family's assets, of the total area of plots in hectares and of the value of livestock. Furthermore, I control for the average quality of the household's agricultural land, the age of the household head (*age_head*) and the total number of children at schooling age in the household (*no_children*).[36]

rather than solely through the channel of affecting her rank among wives. Women that get married at a younger age may be more traditional and less educated, or more modern, and therefore place less or more emphasis on the education of her children than women who get married at a later age.

[35]Again, clustering the standard errors at the household level may be advisable. The results are relatively robust and available from the author upon request.

[36]Neither birth order, nor being the sibling of the first-born or of the first son within the household exhibits a statistically significant impact on children's educational outcomes.

Table 3: Results for children's education

	(1) school	(2) school	(3) attendance	(4) attendance
mother_first (d)	-0.0664	-0.0863	0.377**	0.311**
	[0.0739]	[0.0739]	[0.158]	[0.146]
male (d)	0.146**	0.144**	0.115	0.0438
	[0.0668]	[0.0665]	[0.175]	[0.210]
age	0.0520***	0.0534***	0.0326	0.0300
	[0.00949]	[0.00942]	[0.0278]	[0.0258]
no_children	0.0286*	0.0227	-0.00748	-0.0329
	[0.0162]	[0.0162]	[0.0436]	[0.0470]
age_head	-0.00226	-0.00380	0.00316	-0.000261
	[0.00332]	[0.00319]	[0.00651]	[0.00748]
ln_total_plotarea	-0.00135	-0.00119	-0.0891	-0.100
	[0.0254]	[0.0258]	[0.0612]	[0.0638]
ln_value_assets	0.0565*	0.0408	-0.108	-0.148
	[0.0298]	[0.0323]	[0.112]	[0.129]
ln_value_livestock	-0.0944***	-0.0714*	0.0238	0.0418
	[0.0332]	[0.0366]	[0.0800]	[0.0904]
quality_land		-0.176*		-0.371
		[0.0904]		[0.344]
N	191	191	58	58
Chi-squared	49.62	55.51		
F-statistic			1.13	1.04
Pseudo R-squared	0.212	0.226		
R-squared			0.230	0.261

Note: Robust standard errors in parentheses. Marginal effects in columns 1 and 2; (d) for discrete change of dummy variable from 0 to 1.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.3.2 Results

The marginal effects from estimating equation (11) for school enrollment as the dependent variable are presented in columns 1 and 2 in Table 3. Columns 3 and 4 present the results of the OLS regression for school attendance. The estimated coefficients of the Probit specification are given in Table B 6 in Appendix B. The coefficient on $mother\_first$ is not statistically significant in columns 1 and 2, i.e. the rank of the mother does not impact on the probability of a child being enrolled in school. However, the results suggest positive and statistically significant relationships between being a male child and school enrollment, and between age and the dependent variable. Specifically, Table 3 indicates that male children are 14.4%–14.6% more likely to be enrolled in school than girls. The value of livestock and the average quality of the family's land appear to be correlated with school enrollment in a negative and statistically significant way, which suggests that children may be more heavily involved in the family's agricultural activities the more labor is needed for farming and the rearing of livestock.

When school attendance is the dependent variable in columns 3 and 4, only $mother\_first$ exhibits a statistically significant coefficient. This suggests that children of first wives attend school more than children of junior wives. Unfortunately, the number of observations is very small for this specification and the model is not well-specified according to the overall test of significance so that these results have to be interpreted with care.

The amount of children formally enrolled in school is approximately 30% as shown in Table B 2 and therefore very small in the present sample. Consequently, a Heckman selection model is used when testing for a relationship between a child's school attendance in the last year and the rank of its mother in order to take into account the underlying selection into school enrollment.[37]

Results including these control variables are not presented but support the main results and are available from the author upon request.

[37]The model is estimated using a basic two-step procedure. The results for the coefficients of interest hold but the model is not well-specified if a two-step consistent estimates

Table 4: Results for the Heckman Selection Model

	(1)		(2)	
	attendance			
mother_first	0.381**	[0.166]	0.309*	[0.167]
male	0.194	[0.260]	0.141	[0.299]
age	0.0579	[0.0529]	0.0660	[0.0667]
no_children	0.00980	[0.0535]	-0.0139	[0.0573]
age_head	0.000453	[0.0103]	-0.00481	[0.0112]
ln_total_plotarea	-0.0846	[0.0724]	-0.0942	[0.0737]
ln_value_assets	-0.0851	[0.0909]	-0.129	[0.0938]
quality_land			-0.519	[0.336]
	school			
male	0.481**	[0.222]	0.480**	[0.223]
age	0.155***	[0.0316]	0.158***	[0.0325]
no_children	0.0910*	[0.0510]	0.0748	[0.0516]
age_head	-0.00421	[0.0101]	-0.00791	[0.0105]
ln_total_plotarea	-0.00847	[0.0894]	-0.00939	[0.0917]
ln_value_assets	0.180*	[0.0965]	0.136	[0.101]
ln_value_livestock	-0.297***	[0.108]	-0.231**	[0.114]
quality_land			-0.516*	[0.292]
mills				
lambda	0.272	[0.507]	0.393	[0.687]
N	190		190	
Chi-squared	15.77		17.12	

Note: Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The regression equation takes the following form:

$$\begin{aligned} attendance_{ih} =& \omega_0 + \omega_1 mother\_first_{ih} + \omega_2 male_{ih} + \omega_3 age_{ih} \\ &+ \mathbf{H}_h \boldsymbol{\sigma} + \nu_{1ih}. \end{aligned} \tag{12}$$

A value for the dependent variable in equation (12) is assumed to be observed for a child only if the predicted value of *attendance* in the selection equation is bigger than zero, i.e. if

$$\zeta_0 + \zeta_1 male_{ih} + \zeta_2 age_{ih} + \mathbf{H}_h \boldsymbol{\gamma} + \nu_{2ih} > 0. \tag{13}$$

The variable *log_value_livestock* serves as the exclusion restriction here and is included in **H** only in equation (13), not in equation (12). If the total value of livestock the family holds is a proxy for their material well-being and the costs associated with schooling are mainly incurred at enrollment or if children are the main care-takers of livestock, this is a sensible strategy. If children are occasionally involved in the rearing of livestock, this is not reasonable as this involvement could limit their effective school attendance besides their probability of being enrolled.[38] It appears likely from the results presented in Table 3, however, that children whose job it is to take care of the family's livestock holdings are involved in this heavily and would therefore not be enrolled in school to begin with, i.e. the family's livestock holdings are negatively related to school enrollment in a statistically significant fashion (columns 1 and 2), while the latter is not the case for school enrollment as the dependent variable (columns 3 and 4).

Table 4 presents the results of this specification with and without the

procedure with bootstrapped standard errors or the maximum likelihood estimation strategy with standard errors clustered at the household level are employed. That is, the test statistic for overall significance is smaller than the critical value.

[38] Using *ln_value_assets* as the exclusion restriction also appears to be a reasonable choice and partly supports the results for the coefficients of interest but does not result in a well-specified model, i.e. the test statistic for overall significance decreases to statistical insignificance.

variable *quality_land*. With respect to the coefficient on $mother\_first$ the results support the basic specification outlined in equation (11) and reported in columns 3 and 4 of Table 3: Being the child of a first wife has positive implications and increases school attendance by approximately one third of a month in comparison to being the child of a junior wife. As *lambda* is not statistically significant in either specification, there is no evidence that controlling for selection into enrollment is necessary.

4 Conclusion

This paper investigates the relationship between a woman's productivity, her rank among wives and her share of total family income in a polygamous society, i.e. in a situation where she may not be the only wife of her husband at a given point in time. Previous research has indicated that first wives may be able to attract a larger proportion of the family's income due to higher levels of bargaining power than junior wives (Mammen, 2009). This paper introduces female productivity to the matching process of spouses and argues that 'high productivity' women are more likely to become first wives. Furthermore, productivity plays a role in determining a spouse's returns from marriage. The larger share of family income attracted by senior wives is therefore not merely determined by higher bargaining power associated with rank but a wife's level of seniority among wives and her returns are jointly determined by her productivity. It is possible, however, that productivity positively influences bargaining power so that the explanations are likely to be complementary.

I use a simple theoretical framework to illustrate that relatively productive women have a higher chance of becoming a first wife, i.e. they select into rank depending on productivity, due to a higher utility gain on the part of the husband if married to a highly productive woman. As 'high productivity' wives contribute more to family production and have higher incomes when

single, they receive a larger share of family income than 'low productivity' wives through Nash bargaining with their husbands. Thus, the mechanism by which rank influences female income is based on productivity.

The empirical analysis reinforces the theoretical predictions by showing that senior wives have a wealthier family background at the time of the wedding and enter marriage at a younger age than junior wives. On one hand, these findings support the proposed qualitative selection effect. Young age may be an indicator of productivity as a woman's reproductive prospects are negatively related to her age. On the other hand, the lower age of senior wives at the time of the wedding also suggests a temporal selection effect: they exit the marriage market first because men prefer marrying a productive over a less productive woman. I empirically support the relationship between a wife's rank and her income by showing that children of senior wives are at an advantage regarding school attendance compared to children of junior wives.

The study therefore suggests that polygamous households should not be treated as a uniform family but as a collection of nuclear families consisting of the household head, a wife and their joint children. Consequently, for aid programs and development policy aiming to increase school attendance in regions that exhibit polygamy, the target unit should be the maternal nuclear family and special attention should be paid to children of junior wives.

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Appendix

A The matching process with more type $\bar{p}$ women than men

As the matching of spouses outlined in Section 2.3 involves a random element, consider the selection effect for different proportions of type $\bar{p}$ and type $\underline{p}$ women in order to show that the conclusions do not depend on the relative populations of men and women.

This section uses the identical setup as before but drops Assumption 2 so that there may be more type $\bar{p}$ women than men. Furthermore, let there be some type $\underline{p}$ women:

Assumption 3. $N < \bar{F} < F$.

As male income is higher when married than single and highest with a type $\bar{p}$ wife, i.e. $\bar{Z}_{Ni} > \underline{Z}_{Ni} > R_{Ni}$, men still aim at having as many wives as possible and ideally all of them of the high productivity type. This results in all first wives being 'high productivity' women while both the remaining type $\bar{p}$ as well as all type $\underline{p}$ women get married in the second period. This section therefore changes the distribution of women of each type among first and second wives but the conclusions remain valid: High productivity women are more likely to become first wives than low productivity ones.

B Tables

Table B 1: Summary Statistics for households with polygamous wives

	mean	min	p50	max	sd	N
total_plotarea	3.9841	0.006	2	66.25	8.9728	58
quality_land	0.6729	0	0.7889	1	0.3782	58
value_assets	696.1781	18.5	291.5	5528.4	1002.257	58
value_livestock	2767.698	0	1765	16750	3382.737	58
age_head	50.0517	27	48	87	14.9013	58
no_children	3.241379	0	3	8	2.536127	58

Table B 2: Summary Statistics for children of polygamous wives

	mean	difference	min	p50	max	sd	N
age	11.3918		5.0833	11.25	18.5	3.8449	191
age_motherfirst	11.99	1.212**	5.3333	11.5	18.5	3.8406	96
age_mothersecond	10.778		5.0833	10.5833	18.5	3.7007	73
age_motherthird	11.5104		6.3333	10.5417	18.5	4.1222	16
age_motherfourth	8.9722		5.8333	7.75	15.5	3.7229	6
male	0.555		0	1	1	0.4983	191
male_motherfirst	0.5	-0.144*	0	0.5	1	0.5026	96
male_mothersecond	0.6438		0	1	1	0.4822	73
male_motherthird	0.5625		0	1	1	0.5123	16
male_motherfourth	0.3333		0	0	1	0.5164	6
school	0.3037			0	1	0.461	191
school_motherfirst	0.2917	-0.064	0	0	1	0.4569	96
school_mothersecond	0.3562		0	0	1	0.4822	73
school_motherthird	0.25		0	0	1	0.4472	16
school_motherfourth	0		0	0	0	0	6
attendance	9.7586		6	10	10	0.6834	58
attendance_motherfirst	9.9643	0.349*	9	10	10	0.189	28
attendance_mothersecond	9.6154		6	10	10	0.8979	26
attendance_motherthird	9.25		8	9.5	10	0.9574	4
attendance_motherfourth	.		.	.	.	.	0

Note: Two-sample t-test for equality of the means for unpaired data with unequal variances in all cases.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B 3: Results for being a Senior Wife

	(1)	(2)	(3)	(4)
	first_wife			
wealth_parents	0.308	0.404*	0.446**	0.523**
	[0.191]	[0.227]	[0.226]	[0.250]
age_wedding	-0.0944***	-0.0646***	-0.0711***	-0.0620**
	[0.0234]	[0.0247]	[0.0259]	[0.0281]
rel_no_children_union	-1.001	0.0447	-0.0909	0.166
	[0.817]	[0.950]	[0.974]	[1.126]
bride_spousechoice	-0.516*	-0.406	-0.423	-0.532
	[0.284]	[0.301]	[0.313]	[0.339]
bmi		0.0560	0.0477	0.0128
		[0.0684]	[0.0725]	[0.0774]
no_years_married		0.0534***	0.0595***	0.0632***
		[0.0157]	[0.0157]	[0.0165]
ln_value_assets			0.0239	0.0941
			[0.136]	[0.159]
quality_land			0.689	0.801
			[0.452]	[0.506]
ln_total_plotarea			-0.170	-0.0944
			[0.114]	[0.126]
ln_value_livestock				-0.241
				[0.171]
N	97	90	90	81
Chi-squared	22.73	27.13	34.98	32.72
Pseudo R-squared	0.2029	0.2922	0.3248	0.3073

Note: Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B 4: Results for being a Senior Wife, clustered standard errors

	(1)	(2)	(3)	(4)
	first_wife			
wealth_parents	0.308*	0.404*	0.446**	0.523**
	[0.167]	[0.219]	[0.221]	[0.251]
age_wedding	-0.0944***	-0.0646***	-0.0711***	-0.0620**
	[0.0204]	[0.0215]	[0.0231]	[0.0245]
rel_no_children_union	-1.001	0.0447	-0.0909	0.166
	[0.858]	[0.988]	[1.024]	[1.197]
bride_spousechoice	-0.516**	-0.406	-0.423	-0.532*
	[0.230]	[0.263]	[0.275]	[0.293]
bmi		0.0560	0.0477	0.0128
		[0.0689]	[0.0735]	[0.0788]
no_years_married		0.0534***	0.0595***	0.0632***
		[0.0143]	[0.0144]	[0.0149]
ln_value_assets			0.0239	0.0941
			[0.118]	[0.139]
quality_land			0.689*	0.801*
			[0.389]	[0.453]
ln_total_plotarea			-0.170*	-0.0944
			[0.0984]	[0.110]
ln_value_livestock				-0.241*
				[0.144]
N	97	90	90	81
Chi-squared	30.25	31.88	42.53	44.02
Pseudo R-squared	0.2029	0.2922	0.3248	0.3073

Note: Standard errors are clustered at the household level and given in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B 5: Marginal Effects for being a Senior Wife, clustered standard errors

	(1)	(2)	(3)	(4)
	first_wife			
wealth_parents	0.122*	0.161*	0.177**	0.208**
	[0.0665]	[0.0872]	[0.0884]	[0.100]
age_wedding	-0.0375***	-0.0257***	-0.0282***	-0.0246**
	[0.00808]	[0.00856]	[0.00917]	[0.00971]
rel_no_children_union	-0.398	0.0178	-0.0361	0.0659
	[0.341]	[0.393]	[0.407]	[0.475]
bride_spousechoice (d)	-0.203**	-0.160	-0.167	-0.209*
	[0.0886]	[0.102]	[0.107]	[0.112]
bmi		0.0222	0.0189	0.00509
		[0.0273]	[0.0292]	[0.0313]
no_years_married		0.0212***	0.0236***	0.0251***
		[0.00567]	[0.00573]	[0.00594]
ln_value_assets			0.00947	0.0374
			[0.0469]	[0.0551]
quality_land			0.274*	0.318*
			[0.155]	[0.180]
ln_total_plotarea			-0.0676*	-0.0375
			[0.0391]	[0.0438]
ln_value_livestock				-0.0958*
				[0.0571]
N	97	90	90	81
Chi-squared	30.25	31.88	42.53	44.02
Pseudo R-squared	0.2029	0.2922	0.3248	0.3073

Note: Standard errors are clustered at the household level and given in parentheses. Marginal effects; (d) for discrete change of dummy variable from 0 to 1.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B 6: Results for children's school enrollment

	(1)	(2)
	school	
mother_first	-0.208	-0.271
	[0.233]	[0.236]
male	0.468**	0.462**
	[0.221]	[0.221]
age	0.163***	0.168***
	[0.0288]	[0.0284]
no_children	0.0895*	0.0714
	[0.0507]	[0.0510]
age_head	-0.00708	-0.0119
	[0.0104]	[0.0101]
ln_total_plotarea	-0.00421	-0.00373
	[0.0794]	[0.0811]
ln_value_assets	0.177*	0.128
	[0.0934]	[0.101]
ln_value_livestock	-0.295***	-0.224**
	[0.102]	[0.113]
quality_land		-0.553*
		[0.284]
N	191	191
Chi-squared	49.62	55.51
Pseudo R-squared	0.212	0.226

Note: Robust standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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