Economics of the Family: Theory and Applications in Developing Countries

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Declaration

I declare that this thesis has not been submitted as an exercise for a degree at this or any other university and is entirely my own work. All research contained herein that is not entirely my own but is based on research that has been carried out jointly with others is duly acknowledged in the text wherever included.

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Summary

This thesis is a collection of three research papers on different aspects of the economics of the family in developing countries. The aim of this thesis is to investigate the power structures and bargaining processes between spouses in the developing world by examining the formation of polygamous family structures, the motivation for intra-ethnicity marriage, and the effect of laws reinforcing jointly assigned rights to land.

Chapter 1 outlines the context and background of the research and provides an overview of the thesis.

Chapter 2 explores the formation of polygamous family structures in rural Sub-Saharan Africa as a means to explaining why children of first wives fare better than children of junior wives. Using a game theoretical approach, I propose that a selection of women into their position among co-wives exists on the basis of individual productivity, due to the higher demand for highly productive wives. The latter control a higher share of family income to be spent on consumption and investment due to greater contributions to family production and larger outside options. The mechanism through which rank affects female shares of family income is therefore based on productivity: It determines both the position among wives and the attracted share of family income. 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.

Chapter 3 adds microeconomic evidence at the household level to the discussion on the implications of ethnic diversity on economic performance in de-

veloping countries. Specifically, the tradition of marriage within ethnic groups is investigated from an economic perspective. It is proposed here that ethnic similarity in married couples in Sub-Saharan Africa enhances economic outcomes through a more efficient joint agricultural production technology. Furthermore, the framework suggests that the probability of intra-ethnicity marriage is positively related to the size of the ethnic group due to frictions in the marriage market. An analysis of Ethiopian rural household data yields empirical support for the theoretical framework by demonstrating that inter-ethnicity marriage of the household head is negatively related to family income. The effect is robust to controlling for lagged income and initial conditions, and comparable for ethnic majority and minority groups.

Chapter 4 explores the relationship between laws strengthening women's rights and children's outcomes, namely child labor and educational attainment. Specifically, a land reform introduced in Vietnam in 2003, that had the objective of reinforcing women's land rights within households, is investigated, which allows an analysis of how legal reforms are transformed and adopted by social norms. The implications of being part of the population of households targeted by the land law are investigated with the help of a household survey that permits detailed investigation of property rights at the plot level. There is consistent evidence that the land reform contributed to reducing the likelihood of participating in agricultural household production and some evidence that it had a positive impact on educational attainment. Both of these effects are found for girls only.

Chapter 5 gives conclusions on the thesis as a whole and presents avenues for future research.

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Chapter 1

Introduction to the Thesis

1.1 Context and Background

The setting of this thesis are households in the rural developing world, more specifically in East Asia and Sub-Saharan Africa. Despite improvements, women are still in a disadvantaged position in most developing economies and do not have the opportunity to exercise equal rights as their husbands. Furthermore, family structures and traditions regarding marriage are highly diverse and very different from those in developed countries, where most of the research and aid flows originate from. The aim of this thesis is to enhance the understanding of family structures, bargaining processes and the control over family income among married couples in the developing world in order to enable more informed and targeted research and interventions.

Chapters 2 and 3 are set in Sub-Saharan Africa, use Ethiopian data, and aim to shed more light on two types of marriage formation: polygamy and the tradition of marriage involving co-ethnics. In particular, chapter 2 proposes a selection effect of women into rank during the formation of polygamous family structures and its impact on the relative shares of family income as a complementary explanation to bargaining power differentials. Chapter 3 focuses on the role of ethnic diversity between spouses during partner choice and its implications for family income. Chapter 4, on the other hand, investigates the effect of a law stipulating completely equal joint land titling in Vietnam on the bargaining positions of women relative to their husbands.

It should be noted that economic research in the field of family structures is difficult

due to their formation being a choice, due to most factors likely being endogenous and due to the difficulty in measuring many individual characteristics empirically. This thesis is an attempt to shed more light on the formation and implications of family structures from an economic perspective but the results should be interpreted with the caution necessary in this field.

1.2 Overview of the Thesis

Chapter 2 begins by outlining existing related research, for example evidence for a positive association between the outcomes of children growing up in polygamous families and the level of seniority of their mothers among wives. By focusing on observable maternal characteristics, a selection into rank among wives depending on female productivity is subsequently demonstrated in a game theoretical framework. Furthermore, it is shown that the attracted share of family income is higher, the more productive wives are, due to higher contributions to family production and larger outside options when bargaining with their husbands. Empirical support is laid out with the help of Ethiopian rural household survey data for which a positive association between indicators of female productivity and the likelihood of being a first wife is presented. Furthermore, the data support existing findings by exhibiting a significant positive effect of maternal seniority among wives on the educational outcomes of children.

Chapter 3 first describes previous research on the relationship between ethnic diversity and economic outcomes, starting from a macro level and moving towards smaller entities. At the household level, previous research on the motivations for intra-ethnicity marriage exists mainly for developed economies. The paper explains the tradition of intra-ethnicity (ethnically homogamous) marriage in Sub-Saharan Africa with purely economic considerations. Family output is defined and a possible effect of ethnic diversity among household members is proposed in which ethnic similarity increases efficiency in agricultural co-operation and thereby family income. Thus, all agents prefer co-ethnic spouses. Furthermore, the theoretical framework shows that

the likelihood of intra-ethnicity marriage is positively related to the relative size of the ethnic group. An analysis of Ethiopian rural household data confirms the negative association between ethnically heterogamous marriage and family income. The effect is robust to controlling for lagged income and initial conditions, and comparable for members of ethnic minority and majority groups.

Chapter 4 is developed from a working paper that is co-authored with Gaia Narciso and Carol Newman. It begins with a summary of the relevant literature and the Vietnamese history regarding land rights. We especially explain the 2003 Land Law, which states that the names of both spouses should be stated on the certificate listing all plots which the family has use rights to, in case the certificate is (re)issued because an additional plot is registered. Implementation of the law, i.e. having both names on the certificate, is likely to be endogenous so we focus on the effect of being among the households that should have implemented the law on children's outcomes, thereby analyzing how laws can shape the custom, even if not fully implemented. Specifically, detailed household survey data from rural Vietnam yields consistent evidence that the law lowers the likelihood of girls to participate in child work and some evidence that it increases their educational attainment. No comparable effect is found for boys. Several robustness checks confirm the main findings by ruling out that other concurrent factors like plot acquisition or registration *per se* may be driving the results.

Chapter 5 concludes the thesis as a whole and presents policy implications and possible directions for future research.

Appendices to all chapters are jointly presented at the end of the thesis.

Chapter 2

Productivity, Rank, and Returns in Polygamy

The research paper forming this chapter was my job market paper and, furthermore, presented at the annual conference of the Irish Society of New Economists (2010) in Dublin, Ireland, the GREP QSS Conference (2010) in Dublin, Ireland, the Centre for the Study of African Economies 25th Anniversary Conference (2011) in Oxford, England, the Spring Meeting of Young Economists (2011) in Groningen, the Netherlands, the Nordic Conference in Development Economics (2011) in Copenhagen, Denmark, the AEL Conference of the German Economic Association, Research Committee on Development Economics (2011) in Berlin, Germany, the annual conference of the European Economic Association (2012) in Málaga, Spain, and in the ZEFa Research Colloquium (2013) of the University of Bonn, Germany. I would particularly like to thank Gaia Narciso for her invaluable and continuous support. Furthermore, I am grateful to Gani Aldashev, Tekie Alemu, Kelly de Bruin, Christian Danne, Benjamin Elsner, Robert Gillanders, Worku Heyru, Matthias Kalkuhl, Eoin McGuirk, Carol Newman, Zeratzion Woldelul and participants of various seminars and workshops at Trinity College Dublin for helpful comments.

2.1 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, 2007; 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 the mechanism through which rank affects female returns is based 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 general measure of the ability to generate income and is positively associated with a wife's contribution to family production through the 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 contributions to family output and larger outside options. These findings explain why first wives, who are on average relatively

[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'.

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 or 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 children of mothers with higher incomes have better outcomes. Pitt and Khandker (1998) and Qian (2008) provide empirical evidence 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

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

[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%).

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, 2007).

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 and resource allocation processes therefore has consequences for development policy and is necessary for effective targeting of educational policies and of 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

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

(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 inequality in female human capital increases with development and reduces the incidence of polygamy. Similarly to Jacoby (1995), the authors assume 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 this paper is in line with Gibson and Mace (2007) 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 (2007) 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. 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 (2007) 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, 2007). 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 (2007), 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 2.2 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 2.3 outlines the empirical application in which the correlates of rank and the allocation of resources among wives in the present sample are examined. Section 2.4 concludes.

2.2 The Framework

This section presents an extension to the model of polygamy by Becker (1981) 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 wives control. This presents a structured description of the mechanism through which rank influences female shares of family income and, in turn, weakens the relationship between 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.

2.2.1 Model 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, which is assumed in order to focus the analysis on the implications of differences in female productivity.

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]

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

[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 (Gibson and Mace, 2007).

produced by a husband with each of his wives as suggested by Becker (1981):

$$\begin{aligned} U =& \bar{w}\bar{Y} + \underline{w}\underline{Y} \\ =& \bar{w}\bar{j}\left(\frac{n(x_N)}{\bar{w}+\underline{w}}, \bar{f}(x_F)\right) + \underline{w}\underline{j}\left(\frac{n(x_N)}{\bar{w}+\underline{w}}, \underline{f}(x_F)\right) \end{aligned} \tag{2.1}$$

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.[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 $\bar{f}(x_F) > \underline{f}(x_F)$, $f'' < 0$. 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 wife exceeds the sum of their individual products, i.e. $Y_j' > 0$, with both types of women, but at a decreasing rate, $Y_j'' < 0$. The joint production function increases with female productivity at a decreasing rate, i.e. $j' > 0$ so $\bar{j} > \underline{j}$ for equal endowments and productivity in individual production, $j'' < 0$. This implies that the excess product of the spouses is larger with a high productivity wife than with a low productivity one. 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

[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, $\bar{w} + \underline{w} > 0$.

[9] Bars and underbars denote the concerned variables and functions for type $\bar{p}$ and type $\underline{p}$ wives, respectively, throughout Section 2.2.

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

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, which is also the case in Ethiopia (Aregu et al., 2011).[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).

2.2.2 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 more 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 $\bar{Z}_{Ni}$:

$$g(Z_i, R_i) = \underset{\bar{Z}_{Ni} \in Z}{\arg\max} (\bar{Z}_{Ni} - R_{Ni})^{\frac{1}{2}} (\bar{Z}_{Fi} - \bar{R}_F)^{\frac{1}{2}}, \tag{2.2}$$

where $\bar{Z}_{Fi} = \bar{Y}_i - \bar{Z}_{Ni}$.[13] 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

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

[12] Note that no temporal subscript is necessary on female incomes when single as women can only enter one marriage and that R_N and R_F are positive functions of x_N and x_F, respectively.

[13] Z is the set of possible payoffs from marriage.

equation (2.2) 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:

$$\bar{Z}_{N1} = \frac{\bar{Y}_1 + R_{N1} - \bar{R}_F}{2} \tag{2.3}$$

$$\bar{Z}_{F1} = \frac{\bar{Y}_1 + \bar{R}_F - R_{N1}}{2}. \tag{2.4}$$

The payoffs from marriage with a type $\underline{p}$ wife are computed analogously. Equations (2.3) and (2.4) 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.[14] 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, i.e. $Y_1 > R_{N1} + R_F$. Accordingly, all agents strictly prefer marriage over being single. Equations (2.3) and (2.4) 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 (2.3) and (2.4) are given by:

$$\bar{z}_{N1} = \frac{1}{2} + \frac{R_{N1} - \bar{R}_F}{2\bar{Y}_1} \tag{2.5}$$

$$(1 - \bar{z}_{N1}) = \frac{1}{2} + \frac{\bar{R}_F - R_{N1}}{2\bar{Y}_1} \tag{2.6}$$

[14]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).

and analogously for marriages involving a type $\underline{p}$ wife. Equations (2.5) and (2.6) 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, $R_{N1} > \bar{R}_F$, 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 when married to a type $\bar{p}$ than to 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, i.e. $\bar{Y}_1 > \underline{Y}_1$. As the marginal product of marriage is positive, $Y_j' > 0$, and as the joint productivity function increases with female productivity, the difference in joint output is bigger than the difference in incomes when single when comparing type $\bar{p}$ and $\underline{p}$ wives:

$$\bar{Y}_1 - \underline{Y}_1 > \bar{R}_F - \underline{R}_F. \tag{2.7}$$

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:

$$\bar{Z}_{N1} > \underline{Z}_{N1}. \tag{2.8}$$

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.[15]

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.[16]

Following equation (2.8), marrying a 'high productivity' woman is preferred over entering marriage with a 'low productivity' one due to higher male returns, irrespective of which marriage it is for the man.

2.2.3 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). This is especially true for first marriages, i.e. the marriage of the senior wife.[17] However, whether it is the spouses

[15]The probability of a husband attracting a second wife is identical among men and considered in detail in Section 2.2.3. As there are more women than men as assumed in Section 2.2.3, 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 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.

[16]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.

[17]Note that, while the first marriage is often arranged by parents, the second one often occurs as a 'love marriage'. This should not play a critical role for the conclusions derived from this section, however. If the second wife were highly productive, she is likely to have become a first wife of another man, rather than being available as a second wife. Furthermore, if love played a role in granting her a privileged status within the family with respect to the allocation of the family's resources, the empirical finding motivating this study would not exist.

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 considerations and if parents' utility increases with their child's income.[18]

To make the model more realistic, I introduce rationing of mates and assume that there are less men than women.[19] In addition, there are not more women than twice the number of men to ensure that all women may get married:

Assumption 2.1. $N < F \leqslant 2N$.

Furthermore, let us assume for the moment that there are fewer high productivity women than men:[20]

Assumption 2.2. $\bar{F} < N$.

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

Proposition 2.1. *The more productive wives are, the higher their rank.*

As men are assumed to be identical and as their income when married increases with female productivity, i.e. $\bar{Z}_{Ni} > \underline{Z}_{Ni}$, all type $\bar{p}$ women get married in the first period and randomize among potential husbands. Those men that are not matched

[18]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 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 as a separate payment in addition to female income. Bride prices should reflect female productivity only, due to men being identical here, and therefore be higher for high productivity than low productivity women. 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 the incomes of both spouses still increase with marriage and if the difference in bride prices between different types of women does not exceed the difference in utility derived by the man from marriage, which would be contrary to the motivation of bride prices to begin with. If it were true that the difference in bride prices were higher than the difference in male payoffs from marriage, men would prefer a low productivity wife as they would derive more net utility from them, which would be a contrast to the definition of the two types of women employed here.

[19]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 (2007) 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).

[20]The implications of relaxing Assumption 2.2 are discussed in Appendix A.

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 men prefer entering a second marriage over being monogamous. Because of Assumption 2.2, all type $\bar{p}$ women as well as some type $\underline{p}$ women become first wives and the remaining type $\underline{p}$ women become second wives, therefore giving substance to Proposition 2.1.

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 as 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 $m_{N2} = \underline{m}_{N2} = \frac{F-N}{N}$.

2.2.4 Female income when married

Proposition 2.2. *The more productive women are, the higher their incomes when married.*

Equation (2.6) 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, $\bar{Y}_i > \underline{Y}_i$, 'high productivity' wives have more of family income to control than 'low productivity' ones:

$$\bar{Z}_{Fi} > \underline{Z}_{Fi}. \tag{2.9}$$

Note that the conclusions from equation (2.9) 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 (2.9) shows that female returns are not explicitly a function of the size of the maternal nuclear family as suggested by Gibson and Mace (2007). However, the number of children positively influences the returns from marriage for both spouses as children are part of joint output Y.

2.3 Empirical Evidence

In this section I investigate empirical evidence for Propositions 2.1 and 2.2. Specifically, I supply empirical results to yield statistical support to the proposed selection effect of women into rank and for the association with the shares of family income polygamous wives receive. The results should be interpreted with care and not seen in isolation from the theoretical framework in Section 2.2 due to a limited sample size and the difficulty of measuring key concepts of the framework such as female productivity in a setting like rural Ethiopia.

2.3.1 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.[21]

The households surveyed in the different rounds form a panel but only polygamous households are investigated here which results in relatively small sample sizes. The questionnaires are very detailed, especially in round 4 regarding the household head's and his spouses' marital history. Furthermore, the information about both spouses and the circumstances at the time of the wedding 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 2.2. 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.[22]

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.[23] 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

[21] 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).

[22] 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 2.2. One explanation for the fact that there are hardly any usable data on spouses' education besides a low response rate is the rural location of these households in which most adults have not received any formal education.

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

rank by the age of wives with rank being positively related to age.[24] This strategy is not ideal as junior 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 predicts marital sequence correctly.

Table 2.1 presents summary statistics for polygamous wives and mean-comparison tests between first (denoted by '$\_first$') and second wives (denoted by '$\_second$').[25] 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 2.1: Young age is associated with higher productivity and first wives are 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.[26] It is shown that the parents of first wives are perceived to be wealthier by the husband at the time of the wedding, which is to be expected following Section 2.2. This difference is not statistically significant, however.

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

[25] The variables are denoted by '$\_third$' and '$\_fourth$' for third and fourth wives, respectively. As can be seen in Table 2.1, the number of more junior wives than of rank two is very small so that the mean-comparison tests are only performed between first and second wives.

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

Table 2.1: 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.

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

Table 2.1 also shows that first wives have a larger total number of children from the current union (*no_children_union*) and at schooling age (*no_children_schoolage*), i.e. between 6 and 18 years of age, both inclusive, which is to be expected as fertility is part of the general concept of female productivity discussed in Section 2.2. Both differences are statistically significant. When assessing 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.[27] On the other hand, as shown in Table 2.1, 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 yet or anymore, 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.[28] Inclusion of the years in which a wife was not of reproductive age does not qualitatively alter the results as presented in Section 2.3.2, 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 mechanism proposed in this paper. However, female productivity as described in Section 2.2 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 regarding the characteristics of wives derived in Section 2.2 with respect to the age at the time of the

[27] 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.

[28] 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.

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 2.1 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 B1 in Appendix B.

Summary statistics for the children of polygamous women are presented in Table B2, where '$\_motherfirst$' denotes that the individual's mother is the first wife of the household head, '$\_mothersecond$' 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. Following Section 2.2, the prior is that children of first wives should exhibit better outcomes due to larger maternal returns from marriage, which is not supported here. 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, which is in line with the expectation derived from Section 2.2: First wives attract a higher share of family income and, therefore, are able

to invest more in their children.

2.3.2 Correlates of rank

Supporting Proposition 2.1 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 2.2 could be captured empirically. The most accurate indicators of a woman's human capital available here are her natal family's background and her age at the time of the wedding. These measures are not ideal but proxy female productivity for the following reasons: A wealthy family background should lead to relatively good education, a strong and healthy physique enabling a large number of healthy children and relatively high contributions in the generation of family income. These last two would also be fostered by young age.

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:

$$\begin{aligned} first\_wife_{ih} =& \phi_0 + \phi_1 wealth\_parents_{ih} + \phi_2 age\_wedding_{ih} \\ &+ \phi_3 rel\_no\_children\_union_{ih} + \mathbf{X}_{ih}\boldsymbol{\beta} + \mathbf{H}_h\boldsymbol{\xi} + \epsilon_{ih} \end{aligned} \tag{2.10}$$

where subscript i denotes the observational unit, i.e. a polygamously married woman, living in household h. The variable $first\_wife$ is a dummy variable that takes a value of one if the woman is the senior wife and zero otherwise, i.e. if she is a second or even

more junior wife.[29] As the dependent variable is binary, I apply a Probit estimation technique with robust standard errors.[30]

The ordinal variable $wealth\_parents$ measures the household head's perception of the wealth of his parents-in-law at the time of his wedding,[31] $age\_wedding$ measures the wife's age 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 2.3.1.[32] $\mathbf{X}$ 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.

$\mathbf{H}$ 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 total size of the house-

[29] 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 2.2 and B3 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 sub-sample and even stronger than the main results.

[30] 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, 2008), the fact that there are very few observations per cluster is not ideal. Results are presented in Tables B4 and B5 in Appendix B.

[31] 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 qualitatively alter the results in Tables 2.2 and B3. Results are not presented but available from the author upon request.

[32] 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.

hold's land holdings (*ln_total_plotarea*).[33] The values 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.

Results

The marginal effects for the specification outlined in equation (2.10) are given in Table 2.2, the estimated coefficients are presented in Table B3 in Appendix B. The estimation technique is identical in columns 1 through 4 while the control variables differ. The results given in Tables 2.2 and B3 suggest that some characteristics of a woman that indicate 'high productivity' are significantly correlated with becoming the senior wife.[34] 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 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

[33]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.

[34]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.

that a strong family network is present to support in needy times.[35]

The coefficient on the wife's age at the time of the wedding is highly statistically 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 2.2. 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 men pay more attention to junior wives (Gibson and Mace, 2007) which is likely to increase their chances of conceiving. Another explanation is that men often choose to marry another wife 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 2.2 as a central aspect of a woman's productivity. It is not possible to determine a woman's fertility at the time of the wedding so the relative

[35]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 2.2: 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.

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

number of children is used as a proxy for fertility.

Whether a woman 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. This is in line with the possible different motivations for first and second marriages from the husband's point of view mentioned in Section 2.2: First marriages are often arranged by the spouses' parents. 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 (2007) 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.

2.3.3 Resource allocation among wives

In this section I outline a strategy to empirically support Proposition 2.2, which suggests a positive effect of female productivity on incomes when married through rank. Besides productivity, female income as described in Section 2.2, 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, 2007), 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.

Specification

Intuitively, the most appropriate empirical strategy to test the theoretical framework laid out in Section 2.2 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 2.3.2.[36] Consequently, this section is in fact a replication of the existing findings by e.g. Gibson and Mace (2007), Mammen (2009), and Strauss (1990) that demonstrate a relationship between maternal rank among wives and children's educational outcomes.

As a first step, an equation of the form:

$$E_{ih} = \psi_0 + \psi_1 mother\_first_{ih} + \psi_2 male_{ih} + \psi_3 age_{ih} + \mathbf{H}_h \boldsymbol{\eta} + u_{ih} \tag{2.11}$$

is estimated on the sample of children living in polygamous households over 5 and

[36]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 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 their children than women who get married at a later age.

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.[37]

In equation (2.11), 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 ($no\_children$).[38]

Results

The marginal effects from estimating equation (2.11) for school enrollment as the dependent variable are presented in columns 1 and 2 in Table 2.3. 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 B6 in Appendix B. The coefficient on $mother\_first$ is not statistically significant in columns 1 and 2, i.e. the rank of the

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

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

Table 2.3: Results for children's education

	(1)	(2)	(3)	(4)
	school		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.

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

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 2.3 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, the only statistically significant coefficient is found for $mother\_first$. 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 these results need to be interpreted with care.

The amount of children formally enrolled in school is approximately 30% as shown in Table B2 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.[39]

The regression equation takes the following form:

$$\begin{aligned} attendance_{ih} =& \omega_0 + \omega_1 mother\_first_{ih} + \omega_2 male_{ih} + \omega_3 age_{ih} \\ &+ \mathbf{H}_h \boldsymbol{\sigma} + \nu_{1ih}. \end{aligned} \tag{2.12}$$

A value for the dependent variable in equation (2.12) is assumed to be observed for a

[39]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 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.

Table 2.4: 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.

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

child only if the predicted value of *attendance* in the selection equation is bigger than zero, i.e. if

$$\zeta_0 + \zeta_1 male_{ih} + \zeta_2 age_{ih} + \mathbf{H}_h\gamma + \nu_{2ih} > 0. \tag{2.13}$$

The variable *ln_value_livestock* serves as the exclusion restriction here and is included in **H** only in equation (2.13), not in equation (2.12). 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.[40] It appears likely from the results presented in Table 2.3, 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 attendance as the dependent variable (columns 3 and 4).

Table 2.4 presents the results of this specification with and without the variable *quality_land*. With respect to the coefficient on *mother_first* the results support the basic specification outlined in equation (2.11) and reported in columns 3 and 4 of Table 2.3: 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. It is important to note that these results should not be seen as hard evidence in favor of Proposition 2.2 due to the necessity of using maternal rank as an indicator of her productivity. As stated in the beginning of this section, the results with respect to the outcomes of chil-

[40] 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.

dren presented here are merely support for the findings by Gibson and Mace (2007), Mammen (2009), and Strauss (1990) on the relationship between maternal rank and children's outcomes.

2.4 Conclusions

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 or favoritism 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 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 through 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 mar-

riage 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 highly 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.

Chapter 3

Ethnicity, Marriage, and Family Income

The research paper forming this chapter was presented at the annual conference of the Irish Society of New Economists (2011) in Dublin, Ireland, the AEL Conference of the German Economic Association, Research Committee on Development Economics (2012) in Bonn, Germany, and in the ZEFb staff seminar (2013) of the University of Bonn, Germany. I would particularly like to thank Gaia Narciso for her invaluable and continuous support. Furthermore, I am grateful to Gani Aldashev, Silvia Caló, Christian Danne, Benjamin Elsner, Ivar Kolstad, Jann Lay, Karen Mayor, Tara McIndoe, Mariapia Mendola, Corina Miller, Carol Newman, and participants of various seminars and workshops at Trinity College Dublin for helpful comments.

3.1 Introduction

This paper investigates the relationship between ethnic diversity and economic outcomes at the household level, thereby providing an economic rationale for a tradition that is in place particularly in rural areas in many countries in Sub-Saharan Africa. Specifically, tradition stipulates that marriage should be ethnically homogamous, i.e. involving co-ethnics (Cazes, 1990; Nave, 2000). It is argued here that there is an economic basis to this tradition as shared ethnicity leads to more efficient co-operation between husband and wife in agricultural production and therefore higher utility gains for both spouses.

The present study proposes in a theoretical framework that marriage between individuals of the same ethnic group is preferred because of shared norms and facilitated co-operation among co-ethnics. This more efficient combining of efforts increases family income through enhanced agricultural output and therefore raises the income of all agents. In addition, there is a negative association between the relative size of an ethnic group and the probability of its members being in ethnically heterogamous marriages, that is, married to non-co-ethnics, due to unequal spouse search costs across ethnic groups.[1]

I argue that the gains from more efficient co-operation between co-ethnics are larger than from skill complementarities between non-co-ethnics. Thus, family output is higher if spouses are from the same ethnic group. Spouses allocate family income according to a Nash bargaining solution so all agents prefer homogamous marriage. This does not imply, however, that all individuals enter a homogamous union. Even if there is no shortage of potential spouses among the co-ethnic population according to gender distributions, an inefficient marriage market results in inter-ethnicity marriage being more prevalent among ethnic minority groups. The market is inefficient as the difficulties of finding a co-ethnic spouse are larger, i.e. the search costs are higher, the smaller the ethnic group.

[1]Note that, for the remainder of this study, 'homogamy' and 'heterogamy' exclusively refer to ethnicity.

I provide empirical support for these predictions using Ethiopian rural household panel data. The survey contains an extensive section on the characteristics of the household head and his spouse before marriage and of some circumstances of the wedding. The findings support the notion that economic outcomes of a family are better if the household head is married to a spouse from the same ethnic group. Specifically, ethnic diversity between spouses is negatively related to a household's ownership of durable assets, whose total value serves as a proxy for long-term family income. Concerns about a selection into homogamous marriage and the possibility of differences in initial economic conditions are addressed with the help of the panel structure of the dataset. The findings are robust to controlling for lagged income and parental wealth at the time of the wedding, and to using the change in asset holdings as the outcome variable. Furthermore, the results are supported in sub-samples of ethnic majority and minority groups.

The remainder of the paper is structured as follows: Section 3.2 provides the motivation for this study and reviews relevant research. A simple framework outlining the effect of ethnic diversity between spouses on family output and the implications of ethnicity for partner choice is developed in Section 3.3. Data and summary statistics are presented in Section 3.4. Section 3.5 outlines the empirical strategy and contains a discussion of the empirical findings on the association between heterogamous marriage and family income. Finally, Section 3.6 concludes.

3.2 Motivation and Literature

Marriage in rural Sub-Saharan Africa is typically clan exogamous, i.e. individuals marry spouses that do not belong to their own or a related clan (Luke and Munshi, 2006), to reduce the risk of marrying within too close blood relationships and to create an insurance network against location-specific income shocks (Rosenzweig and Stark, 1989). This results in vast spatial networks of families that are connected through marital ties (Lévi-Strauss, 1969; Luke and Munshi, 2006; Rosenzweig and Stark, 1989). Even

though clan exogamy leads to a spatial spreading of family members, individuals usually get married within the same ethnic group (Lévi-Strauss, 1969). Unlike the motivation for clan exogamy, the choice of a partner within the same ethnic group has not been investigated on purely economic grounds so far to the best of my knowledge.

The implications of ethnic diversity for economic outcomes are of great interest to development economics, specifically the effect of ethnic diversity on civil wars and on the provision of public goods. The literature proposes that different measures of ethnic diversity (fractionalization, polarization) hamper economic development at a country-level (e.g. Alesina et al., 2003; Easterly and Levine, 1997; Montalvo and Reynal-Querol, 2005) and have negative influences on the provision of public goods at a community-level (Miguel and Gugerty, 2005; Habyarimana et al., 2007).

With respect to the specific association between ethnic diversity and economic outcomes, Alesina and La Ferrara (2005) provide an overview of the literature and argue that diversity may have positive as well as negative consequences. While the provision of public goods is lower in ethnically diverse settings due to differences in preferences and norms, heterogeneity may have positive impacts on the production of private goods, especially in rich economies, due to complementary skills across ethnic groups and a larger potential for innovation (Alesina and La Ferrara, 2005). Despite the large literature on the implications of ethnic diversity, there appears to be a gap in the development literature in this area with respect to the smallest possible community of agents: marriage.

The effect of ethnicity on spouse choice is a well-studied phenomenon in the context of developed economies, on the other hand. The preference for homogamous marriage is generally explained by the desire to marry someone who is similar to oneself (Becker, 1973, 1981). DiMaggio and Mohr (1985) argue that spouses match on the basis of shared culture and Bisin and Verdier (2000) show that the frequency of inter-ethnicity or -religion marriage depends on the prevalence of the group in the population. The authors demonstrate theoretically that minority groups are more likely to

focus on homogamous marriage due to the difficulties of transmitting cultural values to their children if married to a partner from the group forming the majority in the population. As a basis, the authors argue that homogamous couples enjoy "a more efficient socialization technology" when transmitting their cultural values to children (Bisin and Verdier, 2000, p. 957), which is similar to the hypothesis underlying the present study. One of the innovations in the present paper that lead to the different conclusions is that the payoffs from homogamous and heterogamous marriage are assumed not to depend on the ethnic affiliation *per se* of the individuals. Furthermore, the size of the ethnic group plays a direct role in determining the probability of meeting potential co-ethnic spouses, i.e. spouse search costs are not equal across groups.

When looking specifically at immigrants in a developed economy, Furtado (2012) shows that education is positively related to the likelihood of marrying a native due to stronger assimilation and a larger willingness to match assortatively on the basis of education rather than ethnicity in the case of well-educated immigrants. Similarly, Furtado and Trejo (2012) argue that heterogamous marriage may be a sign of strong assimilation and is therefore found to be positively related to economic outcomes measured by individual wages. These findings may appear to be contrary to those of the current study. It should be noted, however, that heterogamy involving a native and an immigrant to a developed economy constitutes a different situation than two natives from different ethnic groups but the same developing country.

Banerjee et al. (2012), on the other hand, investigate preferences for in-caste marriage in India, which is comparable to a preference for ethnic homogamy in Sub-Saharan Africa. They find a strong preference for in-caste marriage in their sample of matrimonial newspaper advertisements and responses but do not investigate possible reasons for this preference, which is the aim of this study. The authors focus on the implications for matching in the marriage market and, interestingly, the preference for in-caste marriage does not override matching on the basis of other attributes. This suggests low marginal costs of focusing on potential spouses of the same caste (Banerjee

et al., 2012).

The underlying hypothesis of the present paper that co-ethnics are jointly more productive than non-co-ethnics is related to the study of Habyarimana et al. (2007) who investigate the reason for the lower supply of public goods in ethnically heterogeneous groups of individuals with the help of games. Among other mechanisms, they propose that co-operation may be facilitated within ethnic groups due to an efficacy mechanism grounded on shared technology (Habyarimana et al., 2007). Specifically, communication and co-operation among members of homogeneous groups may be enhanced due to common cultural backgrounds, i.e. language, experience and norms (Hardin, 1995). It appears likely that co-operation, for example regarding agricultural production, depends on common standards or technology among participating agents, which are shared more strongly the higher the degree of ethnic similarity between spouses. This in turn leads to less need for explanations, for example of production practices, so co-operation is facilitated and more efficient among co-ethnics. In a similar fashion but as part of the literature on ethnicity and firm-behavior, Lazear (1999a) argues that "Common culture and common language facilitate trade between individuals" (Lazear, 1999a, p. S95).

On the other hand, Lazear (1999b) shows that, while multinational firms incur costs by having a diversified workforce in terms of language or culture, these may be offset by complementary skills. With respect to marriages and especially in rural settings, however, it may be that the couple's labor force is sufficiently diversified by gender and that shared culture increases their output due to more efficient co-operation. In rural Africa it is usually the case that some plots are farmed by the household head and others by his spouse (Udry et al., 1995) and that there are gender-specific crops, also in Ethiopia (Aregu et al., 2011). In general, men grow cash crops while women are involved in subsistence farming (Elson, 1995). The current study does therefore not contrast Lazear (1999b) and Alesina and La Ferrara (2005) who mention the positive effect that ethnic diversity may have on output through the complementarity in skills.

Rather, skills of spouses may already exhibit sufficient complementarity due to their different gender and the existence of gender-specific tasks.[2]

3.3 The Framework

This section presents a simple theoretical framework that proposes an economic rationale for the tradition of intra-ethnicity marriage in many developing countries and, thereby, presents a structured description of the mechanism proposed in this study. I argue that marriage within the same ethnic group is associated with higher family income so homogamous marriage is a strictly preferred strategy. Due to frictions in the marriage market, however, heterogamous marriage occurs and is more prevalent in ethnic minority groups.

3.3.1 Model setup

Consider an economy in which N men and F women are born in each generation and in which there are two ethnic groups A and B. Individuals are identical within gender and differ only with respect to their ethnic background. A proportion δ_A of both women and men belong to group A, while $\delta_B = (1 - \delta_A)$ of N and F are of ethnicity B, with $0 < \delta_A < 1$. In addition, $N = F$ so a shortage of co-ethnics of the opposite sex is not a reason for marriage to a non-co-ethnic if the marriage market is efficient. Let A form the majority, while B constitutes the minority ethnic group, i.e. $\delta_A > 0.5$. Ethnicity of all agents is observable and payoffs common knowledge. Individuals live for two periods and marry only within generations, heterosexually and monogamously.[3]

[2]Homosexuality is illegal in Ethiopia (Blackburn and Matthews, 2011) so the present paper only looks at heterosexual unions.

[3]It is possible to extend the model to an infinite horizon under the following assumptions: All couples have two children, one boy and one girl. Unequal sex ratios at birth are no issue in Sub-Saharan Africa so the assumption of gender-balanced offspring is reasonable in this setting. If children are born into a homogamous marriage, they have the same ethnicity as their parents. If they are born into a heterogamous marriage, they, randomly and at an equal probability, adopt one parent's ethnicity. These assumptions ensure that the distributions of gender and ethnicity as well as the findings are constant across time. In reality, offspring of heterogamously married parents are considered 'mixed' ('Mixed' is a possible ethnic

3.3.2 Incomes when married

All agents can choose whether to remain single or whether to get married.[4] If they choose the latter, they may marry a co-ethnic or a non-co-ethnic. The decisions are made depending on the returns from marriage. Family output U is divided between spouses on the basis of a Nash bargaining solution, taking into account their incomes when single, i.e. their outside options R_N and R_F, and the partner's reaction. R_N and R_F represent the income of a man and a woman, respectively, if they fail to reach an agreement.

Nash bargaining divides the excess product that married spouses generate over and above their incomes when single by maximizing the product of excess utilities over the husband's share Z_N:

$$k(Z,R) = \arg\max_{Z_N \in Z} (Z_N - R_N)^{\frac{1}{2}} (Z_F - R_F)^{\frac{1}{2}}, \tag{3.1}$$

where $Z_F = U - Z_N$.[5] Bargaining power is identical among spouses with $\frac{1}{2}$. Maximizing equation (3.1) with respect to Z_N and solving for the wife's income Z_F yields the shares of family income of both agents:

$$Z_N = \frac{U + R_N - R_F}{2} \tag{3.2}$$

$$Z_F = \frac{U + R_F - R_N}{2}. \tag{3.3}$$

Family output U of a married couple is a function of the individual and joint efforts that convert the available crude resources and defined in a similar fashion as in

affiliation in the household survey used in the empirical part of this study) or as belonging to both ethnicities. However, the former would introduce a third group and the latter would complicate the analysis. Furthermore, Nave (2000) describes that, in Mauritius, children from heterogamous marriages tend to completely adopt one parent's ethnicity as a means to fully belonging to one ethnic group.

[4] Following Becker (1973), marriage is defined as co-habiting, not necessarily as being legally married.

[5] Z is the set of possible payoffs from marriage.

Chapter 2 and based on Becker (1981):

$$U_{hw} = j_{hw}(n_h(x_N), f_w(x_F)) \tag{3.4}$$

where subscripts h and w respectively denote the ethnicities of the husband and wife, i.e. $h = A, B$ and $w = A, B$.

Both spouses supply one unit of labor and are endowed with either x_N, the crude resources available to the husband, or with x_F, those available to the wife.[6] Functions n and f describe how husbands and wives, respectively, convert their endowments individually into output or into their labor force. Note that U is concave, i.e. $U'_n > 0$, $U''_n < 0, U'_f > 0, U''_f < 0$.

Assumption 3.1. *Individuals of the same gender are equally productive across ethnicity,*

so $U'_{fA} = U'_{fB}, U'_{nA} = U'_{nB}, U''_{fA} = U''_{fB}$, and $U''_{nA} = U''_{nB}$.[7]

Besides their individual efforts, spouses generate part of U together through co-operative or joint efforts with the help of function j. The latter transforms the result of their individual efforts into U and generates some positive excess product so $U'_j > 0$, but at a decreasing rate, $U''_j < 0$. It follows that the output of a married couple is larger than the sum of their individual productions. Examples of this excess over and above the products that are generated individually are the procreation of children, agricultural specialization, or risk diversification due to the farming of different crops. Thus, it is reasonable to stipulate that this surplus is greater than zero. Furthermore, the surplus is shared equally between spouses due to equal bargaining power. If the surplus were not strictly positive and shared between spouses, individuals would at best be indifferent between marriage and being single.[8] Consequently, income is larger when married than when single, i.e. $Z_N > R_N$ and $Z_F > R_F$ and it follows that:

[6]Note that the male and female crude resources x_N and x_F are identical across ethnicity and that R_N and R_F are positive functions of x_N and x_F, respectively.

[7]Note that Assumption 3.1 also implies that incomes when single R_N and R_F are identical across ethnic groups.

[8]See Becker (1973) and Chapter 2 for a more thorough discussion of the excess product generated by marriage.

Assumption 3.2. *All individuals prefer homogamous marriage due to higher incomes.*

Whether incomes when married are higher in homogamous or heterogamous marriage depends on the relative sizes of U. The degree of ethnic similarity between spouses may only impact on U through their mode of co-operation j as members of both ethnicities are individually equally productive.

Assumption 3.3. *The efficiency of co-operation only depends on the degree of ethnic similarity of spouses and not on whether they are from the majority or minority.*

This implies that the output of co-ethnic couples is identical, irrespective of whether both spouses belong to A or B, but also that the output of non-co-ethnic couples is identical:[9]

$$U^* = U_{AA} = U_{BB} \quad \text{and} \quad U^{\#} = U_{AB} = U_{BA} \tag{3.5}$$

where U^* denotes the output if the spouses are co-ethnics, i.e. if $h = w$, and $U^{\#}$ is the output of a heterogamous couple, i.e. if $h \neq w$.[10]

Assumption 3.2 only holds under the assumption that complementarity is observed between married individuals of shared ethnicity:

Assumption 3.4. *The gains from more efficient co-operation between co-ethnics outweigh the gains from the complementarity in skills between non-co-ethnics,*

which means that $j^* > j^{\#}$ for equal endowments and individual productivity. Assumption 3.4 implies that spouses are assumed to be jointly more productive if they are from the same ethnic group. Consequently, family output is higher if spouses are co-ethnics than if they are from different ethnic groups:

$$U^* > U^{\#}, \tag{3.6}$$

[9]It is possible that co-ethnic minority couples are less productive than co-ethnic majority couples or that the productivity of heterogamous couples depends on which group the head belongs to, e.g. because of facilitated access to production inputs like fertilizers or education for members of the majority. However, this is beyond the scope of this study, which aims at isolating the effect of spouses being co-ethnics, irrespective of which ethnic group they belong to.

[10]Note that variables are denoted by superscripts $*$ and $\#$ for homogamous and heterogamous couples, respectively, throughout the paper.

i.e. the output produced by homogamous couples is larger than that of heterogamous ones. It follows from equation (3.6) that the returns from marriage presented in equations (3.2) and (3.3) are higher if married to a co-ethnic as opposed to being married to a non-co-ethnic:

$$Z_N^* > Z_N^\# \quad \text{and} \quad Z_F^* > Z_F^\#. \tag{3.7}$$

Following equations (3.7), all individuals prefer assortative matching with respect to ethnicity if complementarities exist in the skills of co-ethnic spouses and if Assumption 3.4 holds. This is in line with Becker (1981), who argues that individuals prefer marriage to a partner who is similar to themselves, and with empirical evidence. Firstly, the large majority of marriages in rural areas of Sub-Saharan Africa are homogamous (Cazes, 1990; Nave, 2000).[11] Secondly, the negative association between heterogamous marriage and family income is demonstrated in Section 3.5. These empirical observations therefore yield support for Assumption 3.4, i.e. for higher utility gains from efficiency between co-ethnics than from innovativeness or variety of skills between non-co-ethnics, and, thus, in favor of Assumption 3.2.

3.3.3 Spouse choice

Following equations (3.7) and with balanced sex ratios within ethnic groups and generations, all individuals would enter homogamous unions in the absence of search costs, i.e. if the marriage market were efficient as, for example, assumed in Becker (1981). There may, however, also be a motivation for heterogamous unions if there are frictions in the marriage market that lead to inefficient matching of spouses, especially if the associated search costs differ across ethnic groups.

Furtado and Trejo (2012) and Stier and Shavit (1994) suggest that the incentive for marrying a non-co-ethnic may be a shortage of potential spouses among the co-ethnic population. This section demonstrates that, even in the absence of a shortage of po-

[11] In the sample used in the empirical part of this study only 10.7% of households are headed by an individual who is married to a non-co-ethnic.

tential co-ethnic spouses and given that payoffs are identical across ethnic groups and do not depend on the group's share of the population, heterogamous marriage is relatively more prevalent in ethnic minority groups. This is grounded on larger difficulties of finding a co-ethnic spouse.

The basic set-up closely follows Furtado (2012): There are two periods in both of which each non-married individual is randomly matched to one potential spouse. All individuals are single at the beginning of the first period. It is a one-sided game in which the man choses to propose marriage in either round after being matched to a potential wife and women always accept a proposal. Individuals who enter marriage in the first period exit the marriage market and are not part of the game in period 2.[12] Men, who do not propose in period 1 due to a larger expected payoff from delaying marriage until the second period, are matched to a potential spouse in period 2 and, again, face the decision of whether or not to propose (Furtado, 2012). As being single for life is a dominated strategy due to the positive excess product generated by marriage, men who decide not to propose in the first period always propose in the second one. The interesting decision therefore occurs in period 1.

Proposition 3.1. *The probability of heterogamous marriage is larger, the smaller the relative size of the ethnic group.*

The probability of a man of group i to be matched to a co-ethnic woman in period 1 δ_i is the share of co-ethnics in the female population, where $i = A, B$. Similarly, δ_{i2} is the probability of being matched to a co-ethnic in the second period. Men propose marriage in period 1 if the utility from marriage in period 1 Z_N is at least as high as the expected utility from delaying marriage until period 2. That is, men propose marriage in period 1 if:

$$Z_N \geqslant \delta_{i2} Z_N^* + (1 - \delta_{i2}) Z_N^{\#} - D, \tag{3.8}$$

where D is the total cost of delaying marriage that occurs due to time preferences for

[12] Re-entering the marriage market in period 2 due to divorce or death of the spouse is not possible.

early marriage.[13] Even though individuals do not know who their match in round 2 is, they know the matching probabilities and their incomes from all types of matches. Equation (3.8) implies that all individuals propose marriage if $Z_N = Z_N^*$, i.e. if they are matched to a co-ethnic, as long as there is a non-negative cost to delaying marriage, i.e. as long as $D \geqslant 0$.

The interesting case with respect to equation (3.8) arises when a man is matched to a non-co-ethnic, i.e. if $Z_N = Z_N^{\#}$. Whether the individual now choses to propose depends on the difference between incomes when married, i.e. the relative sizes of Z_N^* and $Z_N^{\#}$, and the likelihood of being matched to a co-ethnic in the second round δ_{i2}. The probability δ_{A2} of being matched to a co-ethnic woman in period 2 for a man of group A depends on the number of individuals of both ethnic groups leaving the marriage market in round 1:[14]

$$\delta_{A2} = \frac{(1-\delta_A)E_A - M_B E_B}{(1-\delta_A)E_A - M_B E_B + (1-\delta_B)E_B - M_A E_A}, \tag{3.9}$$

where M_i is the fraction of men of group i that enter a heterogamous union in period 1 and E_i denotes the size of group i. The numerator of equation (3.9) describes the number of co-ethnic women that are still available in the second period for a man of group A. It is the total number of co-ethnic women (E_A) minus those that enter marriage with a co-ethnic ($\delta_A E_A$) minus those that enter marriage with a non-co-ethnic in period 1. The latter is equal to the number of non-co-ethnic men that decide to enter a heterogamous union ($M_B E_B$). The denominator denotes the total number of single women in the second period. The fraction of non-co-ethnic men that enter a heterogamous union M_i is difficult to measure directly. However, as all agents behave

[13]Note that D is positive, identical across groups and includes the loss due to foregone income by remaining single in period 1. If D were to differ across groups, members of group A would incur a higher loss from postponing marriage as their reservation wages and payoffs from each type of marriage are identical to those of group B, but their chance of marrying a co-ethnic are higher in the first period than the chances of homogamous marriage for members of group B. This would, therefore, reinforce the findings but make the model more complicated. D incorporates the total utility loss of delaying marriage so temporal subscripts on Z_N^* and $Z_N^{\#}$ can be suppressed.

[14]δ_{B2} can be calculated analogously.

identically in equilibrium, M_i is equal to the probability of entering a heterogamous marriage in period 1, m_i. The latter can be disaggregated into the probabilities of being matched to a non-co-ethnic $(1 - \delta_i)$ and into the probability of proposing marriage if matched to a non-co-ethnic:

$$m_i = (1 - \delta_i) Pr(Z_N^{\#} \geqslant \delta_{i2} Z_N^{*} + (1 - \delta_{i2}) Z_N^{\#} - D) \tag{3.10}$$

For heterogamous marriage to occur in period 1, the probabilities that the payoff from heterogamy is at least as big as the expected second-period payoff have to be larger than zero. Furthermore, for the game to continue beyond the first period, these probabilities have to be smaller than one:[15]

Assumption 3.5. $0 < Pr(Z_N^{\#} \geqslant \delta_{i2} Z_N^{*} + (1 - \delta_{i2}) Z_N^{\#} - D) < 1.$

Equations (3.9) and (3.10) show that δ_{A2}, m_A, and m_B mutually depend on each other so drawing conclusions is impossible without making additional assumptions. Furtado (2012) assumes that the matching probabilities are identical in rounds 1 and 2. For the present framework it suffices to assume that the relationship between the matching probabilities is not reversed compared to the first round, i.e. that members of the majority A are not less likely to be matched to co-ethnic potential spouses in period 2 than members of the minority B:

Assumption 3.6. $\delta_{A2} \geqslant \delta_{B2}$.

This entails that:[16]

$$\begin{aligned} (1 - \delta_A) E_A - m_B E_B &> (1 - \delta_B) E_B - m_A E_A \\ \frac{m_B}{m_A} &< \frac{\delta_A}{\delta_B}. \end{aligned} \tag{3.11}$$

By definition, members of group A are less likely to be matched to a non-co-ethnic in round 1 than members of group B as $\delta_A > \delta_B$ and, as a result of Assumption 3.6,

[15] The implications of relaxing Assumption 3.5 are considered in Appendix C.

[16] The denominators are identical so investigating the numerators is sufficient to compare δ_{A2} and δ_{B2}.

they also have a higher chance of homogamous marriage in the second period. This means that members of the minority face greater difficulties of entering marriage with a co-ethnic spouse than members of the majority, i.e. co-ethnic spouse search costs are higher the smaller the ethnic group.

Assumption 3.6 implies that members of the minority have a larger probability of entering a heterogamous marriage in the first period than members of the majority:

$$m_A < m_B \tag{3.12}$$

as the threshold in equation (3.10) at which heterogamous marriage in period 1 becomes profitable, is lower for members of the minority. Thus, Assumption 3.6 and equation (3.11) are most likely to hold if the population of the majority ethnic group is much larger than of the minority group, i.e. if δ_A is significantly bigger than δ_B.

The interesting question is the effect of group size on the overall probabilities of heterogamous marriage of men over both periods, i.e. the relative sizes of $m_i + (1 - \delta_{i2})$. It follows from Assumption 3.6 and equation (3.12) that:

$$m_A + (1 - \delta_{A2}) < m_B + (1 - \delta_{B2}), \tag{3.13}$$

which means that the sum of the incidence of heterogamous marriage in period 1 m_i and the probability of being matched to a non-co-ethnic in the second period $(1 - \delta_{i2})$ is smaller for men belonging to group A than B. Inefficiencies in the marriage market exist as the probability of being matched to a co-ethnic is negatively related to the relative size of the ethnic group, i.e. search costs are higher the smaller the group's share of the total population. Consequently, minority members experience a relatively higher overall probability of entering a heterogamous union than members of the majority group due to larger difficulties of finding a co-ethnic spouse.

In summary, this section proposes how less efficient co-operation between individuals from different ethnic groups translates into lower family income and thereby

encourages intra-ethnicity marriage. As search costs decrease with an increase in the relative size of the ethnic group, the probability of heterogamous marriage is higher in ethnic minority groups.

3.4 Data

Next, I test the theoretical predictions using Ethiopian rural household data. Ethiopia is a highly diverse country in terms of ethnicity with a large number of small groups and three main ones: the *Amhara*, the *Oromo* and the *Tigray*, which makes it an ideal setting for this study. The *Amhara* are mainly found in the center of the country, the *Oromo* in the South and the *Tigray* in the border region to Eritrea. The main source of data is the fourth round of the Ethiopian Rural Household Survey (ERHS) used in Chapter 2.

The present study augments the data of the fourth round, collected in 1997, with selected variables from the first round, which was undertaken in 1994. This study investigates households with a married household head who forms the observational unit together with his wife.[17] Polygamous households are excluded from the analysis as economic outcomes are not separable by couple.[18]

3.4.1 Variables of ethnicity and religion

The key explanatory variable in identifying the relationship between heterogamous marriage and family output is binary and takes a value of one if the household head and his spouse do not share ethnic backgrounds and zero if they do (*eth_diff*). Following Section 3.3, ethnic diversity between spouses is expected to be negatively related to family income. Ethnic backgrounds are determined by answers to the question "Ethnic group" that, if possible, each spouse and otherwise the household head answers for

[17] Throughout the paper I refer to the household head and *his* spouse as 96.9% of the households in the sample are headed by a man.

[18] More precisely, polygynous households, i.e. consisting of a male household head being married to more than one wife, are excluded. Polygyny is not very common in Ethiopia (less than 10% of all marriages in Ethiopia are polygynous according to Tertilt (2005)), however, so this does not put too much strain on the sample size available for the analysis.

himself and his spouse. In the present sample 10.7% of the household heads are married to a spouse from a different ethnic group. Table 3.1 displays summary statistics and mean-comparison tests of the distribution of ethnicity and religion of the household head and his spouse in relation to the ethnic status of the marriage, i.e. whether it is homogamous or heterogamous.

It is shown in the top panel of the table that, if the household head is married homogamously, he is more likely to be of one of the majority ethnic groups *Amhara*, *Oromo* or *Tigray* than if he were married to a non-co-ethnic (except for *Oromo* household heads who present nearly the same share of household heads in heterogamous and homogamous marriages). The difference in means is only statistically significant for *Tigray* household heads, however. If he is married to a non-co-ethnic, a household head is statistically significantly more likely to be of one of the ethnicities with less than 10% prevalence in the sample (grouped in $other\_eth$) than if he were married to a co-ethnic.[19] Furthermore, members of the minority group are more likely to be married heterogamously than members of the majority groups.[20] The data therefore support Proposition 3.1, which states that the prevalence of heterogamous marriages is inversely related to the relative size of the ethnic group.

The picture is not as clear-cut with respect to the spouse's ethnicity in the middle panel of Table 3.1: The only statistically significant difference is found for spouses of $Tigray$ origin, whose share is lower among heterogamous than homogamous marriages. While it is also the case that women in inter-ethnicity marriages are more likely than women in intra-ethnicity marriages to be of an ethnic minority, the difference is not significant. Summary statistics for religious affiliation of the household head are

[19]The ethnicities grouped in $other\_eth$ due to less than 10% prevalence in the sample are $Afar$, $Gurage$, $Gedeo$, $Gamo$, $Kembata$, $Wolaita$, and $Others$. Furthermore, $Adere$ and $Somali$ are given as possible options in the survey but not present in the data. It should be noted that the variable *eth_diff* is determined on the basis of these sub-categories. Furthermore, there is only one household in the sample in which both spouses answer $Others$, which means that they may or may not be of the same minority ethnic group. Exclusion of this household does not qualitatively alter the results. The results of this exclusion are not presented but available from the author upon request.

[20]The difference in means of *eth_diff* between ethnic minorities and majorities in a two-sample t-test for unpaired data with unequal variances is statistically significant at the 5%-level.

Table 3.1: Summary statistics of ethnicity and religion

	mean	difference	min	p50	max	sd	N
Ethnicity of head							
amhara*	0.346	0.080	0	0	1	0.476	659
amhara#	0.266		0	0	1	0.445	79
oromo*	0.229	-0.011	0	0	1	0.421	659
oromo#	0.241		0	0	1	0.430	79
tigray*	0.112	0.062**	0	0	1	0.316	659
tigray#	0.051		0	0	1	0.221	79
other*	0.313	-0.13**	0	0	1	0.464	659
other#	0.443		0	0	1	0.500	79
Ethnicity of spouse							
amhara_sp*	0.346	0.004	0	0	1	0.476	659
amhara_sp#	0.342		0	0	1	0.477	79
oromo_sp*	0.229	-0.011	0	0	1	0.421	659
oromo_sp#	0.241		0	0	1	0.43	79
tigray_sp*	0.112	0.087***	0	0	1	0.316	659
tigray_sp#	0.025		0	0	1	0.158	79
other_eth_sp*	0.313	-0.080	0	0	1	0.464	659
other_eth_sp#	0.392		0	0	1	0.491	79
Religion of head							
orthodox*	0.577	-0.006	0	1	1	0.494	659
orthodox#	0.582		0	1	1	0.496	79
muslim*	0.228	0.088**	0	0	1	0.42	659
muslim#	0.139		0	0	1	0.348	79
protestant*	0.126	-0.077	0	0	1	0.332	659
protestant#	0.203		0	0	1	0.404	79
other_rel*	0.07	-0.006	0	0	1	0.255	659
other_rel#	0.076		0	0	1	0.267	79

Note: As in Section 3.3, superscripts $*$ and $\#$ denote the concerned variable for homogamous and heterogamous couples, respectively. Two-sample t-test for equality of the means for unpaired data with unequal variances in all cases.

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

presented in the bottom panel of Table 3.1. They indicate that there is a statistically significantly lower share of Muslim household heads among heterogamous than homogamous marriages.[21] No statistically significant differences are found for Orthodox Christian and Protestant household heads or for any of the religions with less than 10% prevalence in the sample (*other_rel*).[22] The fact that being affiliated with a religious minority has no significant effect on the ethnic status of the marriage is particularly interesting considering that being of an ethnic minority, on the other hand, increases the likelihood of heterogamous marriage for household heads.

3.4.2 Measures of family income

The majority of households in the sample is formed by farmers with no employment outside of the household so agricultural output equals family income, which is in accordance with the definition of family utility in Section 3.3. The value of crop yields may appear to be a good measure of family income but the data suffer from a large share of unusable data and accurately measuring the amount of agricultural output may be a challenging task, especially for subsistence farmers. Furthermore, crop yields capture income of a household at a single point in time and are relatively volatile. Family income is therefore measured by the consumption of durable goods and, thus, measured by the total value of durable assets (*value_assets*) in Ethiopian Birr.[23] The value of durable asset holdings is self-assessed by the household head but gives an indication of the long-term income of a household. In addition, it appears to be inclusive, i.e. there are very few cases of a missing valuation or quantity, and assigning a monetary value may be unproblematic for the household head in the case of tangible assets and therefore relatively accurate.

Summary statistics of the value of the household's asset holdings in rounds 1 and 4

[21] Please note that inter-religion marriages are even less likely than inter-ethnicity marriages; only 2.3% of the household heads in the sample are married to somebody with a different religious affiliation.

[22] The religious options grouped in *other_rel* due to less than 10% prevalence in the sample are *None*, *Catholic*, *Other Christian*, *Traditional/Animist* and *Other*.

[23] The most common assets listed are ploughs, hoes, shovels, kitchen utensils, and beds. In 1997, 6.709 Ethiopian Birr corresponded to one US-Dollar (International Monetary Fund, 2012).

and mean-comparison tests by whether the spouses are co-ethnics or not are presented in Table 3.2.[24]

The top panel of the table displays these statistics for the given data. Interestingly, the hypothesis is partly supported for asset holdings in round 4 but not in round 1, i.e. in round 4 ethnically homogeneous households hold more assets than ethnically diverse ones while the opposite is true in round 1. A statistically significant difference in mean asset holdings of homogamous and heterogamous households is not found for either round 4 or 1 of the ERHS, however. The Wilcoxon ranksum test, on the other hand, indicates that the two samples of the first round are not from populations with the same distribution, which, considering that heterogamous households exhibit higher asset holdings than homogamous ones, is contrary to the underlying hypothesis of this study.

Furthermore, it is apparent that the data exhibit a strong positive skew due to relatively large means compared to the medians, large standard deviations and high maximum values. In order to ensure that the findings are not driven by extreme values, outliers are excluded from the sample. Households, whose values of asset holdings in either round are in the top or bottom 1 percentile, are dropped.[25] This is a consequence of the analysis in Section 3.5 using the values of assets from both rounds simultaneously almost throughout.

The lower panel of Table 3.2 presents summary statistics for $value\_assets$ without outliers. While the minimum and median values have hardly changed, the means, maxima, and standard deviations have decreased, which validates the concern about a positive skew in the raw data. In round 4 there is almost no difference in mean asset holdings by ethnic status of the marriage, while ethnically diverse households hold more assets in round 1. Neither of these differences in means is statistically significant,

[24]Most of the data used in this study are taken from round 4. Variables from round 1 are denoted by the suffix '$\_r1$' and adjusted for inflation with the help of the Ethiopian Consumer Price Index provided as part of the International Financial Statistics database of the International Monetary Fund (2012) in the case of monetary measures, i.e. for $value\_assets\_r1$ and $value\_livestock\_r1$.

[25]Note that the main results presented in Section 3.5 are robust and even stronger if outliers in $value\_assets$ are not excluded. Results are not presented but available from the author upon request.

Table 3.2: Summary statistics of asset holdings

	mean	difference	Wilcoxon statistic	min	p50	max	sd	N
Including outliers								
Round 4								
value_assets*	538.076	104.117	0.132	6	219	33418	1591.7	679
value_assets#	433.959			15	214.2	3312	571.680	82
Round 1								
value_assets_r1*	566.332	-207.825	-1.724*	2.675	118.77	51698.12	2575.113	679
value_assets_r1#	774.157			2.675	173.073	17157.45	2160.553	82
Excluding outliers								
Round 4								
value_assets*	402.113	8.142	0.137	12	215	2989.5	496.098	659
value_assets#	393.972			15	210.4	2213.5	477.022	79
Round 1								
value_assets_r1*	351.819	-114.863	-1.538	2.675	113.42	4947.167	641.994	659
value_assets_r1#	466.682			2.675	170.13	3520.3	730.238	79

Note: As in Section 3.3, superscripts $*$ and $\#$ denote the concerned variable for homogamous and heterogamous couples, respectively. Outliers are defined as observations in the top and bottom 1 percentile of *value_assets* in at least one round, i.e. round 1 or 4, due to the simultaneous use of this variable from both rounds in the analysis in most of the analysis. Two-sample t-test for equality of the means for unpaired data with unequal variances are statistically insignificant in all cases. The null hypothesis of the Wilcoxon ranksum test is that the two samples are from populations with the same distribution. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

however. Furthermore, the null hypothesis of the Wilcoxon ranksum test that the samples are from populations with the same distribution is not rejected for either of the two rounds of the ERHS.[26] The statistical insignificance in most cases is contrary to the underlying hypothesis of the study and possibly due to the fact that no other variable is held constant.

3.4.3 Control variables

Summary statistics of basic control variables by ethnic composition of the couple are presented in Table D1 in Appendix D. Parents are statistically significantly less likely to have chosen the spouses if the marriage is heterogamous. This is denoted by the variable $parent\_choice$ that takes a value of one if the partner was decided upon by the spouses' parents and zero otherwise. This supports the idea that a preference for homogamous marriage is a tradition that is passed on through generations. The binary variables $talk\_beforemarriage$ and $same\_village\_spouse$ are of value one if the spouses have spoken to each other before the wedding and if they are from the same village, respectively, and zero otherwise. The household head and his spouse are less likely to have had verbal contact before the wedding and more likely to be from the same village if they report the same ethnic background. Only the latter difference is statistically significant, however. The differences are not surprising as parents appear to prefer their child being in a homogamous marriage and only arranged or 'kidnap marriages' are associated with no contact of the spouses before the wedding.[27] Direct contact of the spouses before the wedding is therefore also a proxy for the union being

[26] Furthermore, the Kolmogorov-Smirnov test for the equality of distributions fails to reject the null hypothesis that the samples of homogamously and heterogamously married households are drawn from the same distribution, both when outliers are in- and excluded.

[27] While it is the case that spouses, who have not spoken to each other before the wedding, are very likely to live in arranged marriages with possibly the parents choosing the partners, the reverse does not necessarily hold. The correlation between the binary variables for whether the parents have chosen the partners and whether the spouses have spoken to each other before the wedding is -32.4%. 'Kidnap marriages' are a practice in which men kidnap young women, rape them, and then propose to marry them if they are not injured. The natal families of the women have no choice but to agree to the marriage proposal as these women are not desirable candidates in the marriage market anymore because of having engaged in extra-marital sexual behavior (Muleta and Williams, 1999).

a 'love marriage'. Considering that Ethiopia is a highly diverse country with respect to ethnicity but that the populations of small villages are usually along clan and, thereby, ethnic lines, the finding that heterogamous marriages are associated with different geographical origins is to be expected.

With respect to the effects on family income, any measure that is related to how well the spouses understand each other and, thereby, how well they are likely to co-operate, is expected to have a positive effect on family income following Section 3.3. Specifically, $talk\_beforemarriage$ should be positively related to family income, while the reverse holds for $parent\_choice$. Stating a prior for $same\_village\_spouse$ is not as straightforward, however. Even though spouses from the same village are likely to know each other relatively well, there is less of a possibility to smooth location-specific risks with either of the natal families compared to a case where they would be located in different villages, which makes the effect ambiguous on theoretical grounds.

The duration of the marriage ($no\_years\_married$) and the age gap between spouses ($age\_gap\_spouses$) are measured in years. The former is slightly larger and the latter smaller in inter-ethnicity marriages in the current sample but neither difference is statistically significant. With respect to their effect on family income it is to be expected that the age gap between spouses will exert a negative influence due to cooperation between spouses possibly being hampered by large differences in age, while a prior regarding the effect of the duration of the marriage is not obvious. The number of children of the household head that live in the family are denoted by $no\_children$ and households with an inter-ethnicity marriage of the household head have slightly more children, even though this difference is not statistically significant.[28] The binary variable $school\_head$ takes a value of one if the household head has received any school-

[28]Children are part of family output U in Section 3.3 so $no\_children$ could also be considered as an outcome variable if the focus were not on agricultural co-operation and may therefore not be an ideal control variable. On the other hand, children are part of the family's work force whose size should be controlled for when investigating family income and eth_diff does not exhibit a significant coefficient when its effect on the number of children is investigated so endogeneity of $no\_children$ in the main specification should not be a serious concern. The exact same reasoning holds for the value of livetock holdings. Note that the main findings in Section 3.5 are robust to excluding $no\_children$ and $ln\_value\_livestock$ and the results available from the author upon request.

ing and zero otherwise. Household heads who are married to a non-co-ethnic have a slightly higher probability of having attended school but this difference is not statistically significant.[29]

Table D2 in Appendix D presents summary statistics of variables that are related to economic well-being other than asset holdings. The variables *wealth_parents_head* and *wealth_parents_spouse* are ordinal variables ranging from 1 through 5, in which a value of one means that the husband perceived his and his bride's parents, respectively, to be 'very poor' and a value of 5 indicates that the husband rated them as 'very rich' at the time of the wedding.[30] Interestingly, the head rates the wealth of his parents more highly and the wealth of his parents-in-law lower in the case of homogamous couples, even though neither of these differences is statistically significant. This insignificance partly invalidates possible concerns about a positive selection into homogamous marriage depending on family wealth, while a positive effect on family income can be expected due to gifts possibly given to the couple at the time of the wedding or due to support in times of need during the course of the marriage.

The variable *total_plotarea* denotes a household's total land holdings in hectares, which are higher in both rounds for heterogamous households. This difference is statistically significant only in the first round of the survey, however. The family's livestock holdings in Ethiopian Birr are measured by *value_livestock* and, again, the mean value is statistically significantly higher for inter-ethnicity couples in both rounds.[31] If land and livestock holdings also proxy for family income, these differences are contrary to the underlying hypothesis of the study. However, this is unlikely to be the case

[29]The ERHS questionnaire of the fourth round does not ask for the education of adults, the information for this variable is therefore taken from the first round. As *school_head* is the only variable at the individual level that is taken from the first round of the survey, the fact that 21 households change heads between these rounds should not pose a problem. Furthermore, the main results in Section 3.5 are robust to using the sub-sample of households whose heads have not changed between 1994 and 1997. Results are not presented but available from the author upon request.

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

[31]Outliers may also be an issue in *total_plot_area* and *value_livestock*. Excluding them may not be necessary due to their nature of being control variables and puts strain on the sample size. However, the main results are robust to excluding the top and bottom percentiles in both of these in addition to the dependent variable; The results of this exercise are available from the author upon request.

for land holdings as the Ethiopian land market is strongly regulated and land rights do not refer to the right of selling plots due to state ownership (Ali et al., 2011; Crewett et al., 2008). Livestock, on the other hand, does not exhibit a statistically significant relationship with the key explanatory variable eth_diff when other factors are controlled for.[32] Livestock holdings may not be as good a measure of long-term family income as the total value of asset holdings since livestock is not accumulated in the way durable goods are, which may be the reason for the lack of a statistically significant relationship with the spouses being co-ethnics or not. With respect to their status as control variables in the main specification, the variables $no\_children$, $school\_head$, $total\_plotarea$ and $value\_livestock$ relate to human capital or tangible production factors and are therefore expected to exert a positive influence on family income.

3.5 Empirical Analysis

This section empirically investigates the relationship between ethnic diversity in married couples and family income, i.e. the empirical validity of Assumption 3.2.

Concerns about a selection into homogamous marriage and about co-ethnicity facilitating matching with a relatively wealthy spouse are valid and they are addressed in different ways. Explanations for this endogeneity could, firstly, be that homogamy is a desired good that only relatively wealthy individuals are able to afford so that homogamous households are better off from the outset. Secondly, matching of spouses may be more effective in the way that adequately assessing a potential spouse's wealth is easier when involving a co-ethnic than in the case of a non-co-ethnic. Another potential source of endogeneity is that individuals who are willing to marry a non-co-ethnic spouse may be more 'modern', as they do not adhere to the tradition of homogamous marriage, and also more economically successful, possibly due to the use of more modern production techniques or inputs. While selection or assortative matching on the

[32]The results are displayed in Table D3 in Appendix D. Note that the value of assets are not controlled for here due to likely endogeneity with eth_diff, as postulated in the main results and the hypothesis underlying this piece of research.

basis of wealth would overstate the negative effect of heterogamous marriage on a household's economic outcomes, heterogamous couples being more modern would lead to a downward bias.

It has been proposed in the literature that marriage market conditions, for example the relative availability of potential co-ethnic spouses, may be used to instrument for the incidence of heterogamous marriage but validity of the exclusion restriction is disputable (Furtado and Trejo, 2012). It may be that the ethnic composition of the marriage market and economic outcomes are driven by the same factor, for example economic conditions leading to migration. Legitimacy of the proposed instrument is especially unlikely in Sub-Saharan Africa due to marriage outside of clan (Luke and Munshi, 2006) and migration that lead to marriage between spouses from different villages or regions so this approach is not used here.[33] Another argument against the validity of the exclusion restriction relates to the ethnic composition of the marriage market, even in the absence of migration. As mentioned in the introduction, ethnically diverse communities are found to face worse economic conditions, for example with respect to the provision of public goods (e.g. Miguel and Gugerty, 2005; Habyarimana et al., 2007). This may translate into a more difficult economic environment for households and thereby also affect the outcome variable.[34]

The issue of selection into homogamous and heterogamous marriage on the basis of wealth is initially addressed by controlling for the wealth of the parents of both spouses

[33] Another difficulty is that the unit of observation is the household and not the individual. Consequently, if an instrumental variables approach were to be used, only marriage market conditions of the household (head) could be used as no information on the specific geographical origin of either spouse is available from the ERHS. Consequently, an assumption would also have to be made that the household did not migrate from the household head's place of residence at marrying age, which is disputable, especially in a country ridden by economic crises like Ethiopia.

[34] Similarly, a two-step procedure in which the determinants of inter-ethnicity marriage are investigated in the first stage and the fitted values used in the second stage to examine the effect on family income suffers from the lack of determinants of the type of marriage that do not impact the outcome variable of interest and is therefore not employed here. Specifically, all variables available here that give information about the relationship of the spouses before the wedding and that could influence whether they are co-ethnics or not, e.g. whether they have spoken to each other before the wedding, whether they are from the same village, their age gap and the wealth of their natal families, also proxy how well they know each other and how well they get along which is likely to influence effectiveness of their cooperation in agricultural production and thereby the outcome variable.

at the time of the wedding and by including the level of asset holdings in round 1 of the ERHS.[35] This yields the main results of the paper that are supported by sensitivity checks. As a second step to verify that couples with shared ethnicity are really more productive and do not simply have a better economic status to begin with, another set of estimations is presented in which the change in asset holdings between rounds 1 and 4 is the dependent variable. The results of these empirical exercises support the productivity hypothesis underlying the current study.

Empirically testing Proposition 3.1, i.e. whether members of minority ethnic groups are more likely to enter a heterogamous union due to frictions in the marriage market, is difficult. Widespread migration and no specific data on the origin of individuals imply that original marriage market conditions at a lower geographical unit than the country-level are unknown. The main results are supported and comparable across sub-samples of household heads of majority and minority groups, which suggests that both groups suffer from heterogamous marriage in a similar fashion. The results therefore yield some evidence for the idea that difficulties of finding potential co-ethnic spouses may be responsible for the higher prevalence of heterogamous marriage in ethnic minority groups.

3.5.1 Ethnic diversity and family income

Selection into marriage with a co-ethnic based on parental income is a valid concern. Furthermore, it may be the case that parents prefer their children to be homogamously married and therefore provide a better start for the new household in terms of wedding gifts. No evidence for favoritism towards co-ethnic couples based on wedding gifts is found for the present sample, however.[36] Controlling for lagged income, ap-

[35]Note that the main results are robust to including the difference in the wealth of the parents of both spouses at the time of the wedding instead of separate variables for the wealth of both parents. Furthermore, the comparative measure is not statistically significant in either specification yielding no support for an effect of assortative matching of spouses on their subsequent economic well-being. Results are not presented but available from the author upon request.

[36]Unfortunately, there is a lot of missing data for some questions in the sample used in the main specification, especially with respect to the questions on gifts received at the wedding. However, wherever the data are relatively inclusive, the results do not support the concern of a positive selection into homoga-

proximated by the level of asset holdings in round 1 of the survey, is still advisable in light of selection concerns.

To see whether exhibiting ethnic diversity affects the agricultural performance of married couples due to less efficient co-operation as laid out in Section 3.3, I estimate the following equation using Ordinary Least Squares with robust standard errors:[37]

$$ln(Y_H) = \alpha_0 + \alpha_1 eth\_diff_H + \alpha_2 ln(Y_{H1}) + \mathbf{X}'_H\gamma + \epsilon_H \tag{3.14}$$

where Y and Y_1 denote the levels of asset holdings in rounds 4 and 1, respectively, and the observational unit is the household H. $\mathbf{X}$ includes explanatory variables as defined in Section 3.4 such as the binary variables $parent\_choice$, $talk\_beforemarriage$ and $same\_village\_spouse$. Further independent variables are the duration of the marriage and the age gap between spouses, the number of children, the wealth of the parents of both spouses at the time of the wedding, and whether the household head has received any education. In addition, we control for tangible production factors with the help of the logarithmic values of the household's land and livestock holdings.[38]

The results of the basic estimation as just described are shown in column 1 of Table 3.3, columns 2 through 6 include ethnicity, religion, and region fixed effects in different combinations.[39] The variable of interest *eth_diff* exhibits statistically significant, neg-

mous marriage with respect to wealth. Whether the union of the household head is with a co-ethnic or not has no effect on whether the groom brought land and household utensils, whether the bride brought livestock into the marriage or whether the couple was given land upon the wedding as presented in Table D4 in Appendix D. In contrast to the concerns, there is evidence that *eth_diff* has a positive effect on the likelihood of the groom bringing a house, livestock, and jewelery into the marriage. Furthermore, ethnically diverse couples exhibit a higher likelihood of receiving livestock upon marriage as demonstrated in Table D5 in Appendix D.

[37]There is a possibility that the error variances may be correlated with respect to space, ethnicity or religion. Unfortunately, the number of clusters for each of these dimensions is very low with less than 20, even at the finest stratum, so clustering standard errors is not advisable (Angrist and Pischke, 2008).

[38]The main results presented in this section are robust to controlling for the quality of a household's land holdings, 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. Results are not presented but available from the author upon request. However, inclusion of this variable leads to a small loss in observations which changes the distribution of ethnic diversity among households in the sample. As a consequence, slightly less than 10% of households are heterogamous and variability in *eth_diff* is unsatisfactory.

[39]Both ethnicity and religion dummy variables relate to characteristics of the household head. Substituting the former for ethnicity of the spouse does not qualitatively change the results and different

ative and relatively large coefficients in all columns, i.e. heterogamous couples hold 21.8%–28.4% less assets. Furthermore, couples fare better if they have spoken to each other before the wedding and worse if they are from the same village. Besides the statistical significance of the coefficients associated with these variables, their magnitude also deserves attention. If the spouses have spoken to each other before the wedding, their consumption of durable goods measured by asset holdings increases by over 21% compared to the case in which they have had no direct contact, which could be an indication of co-operation also being more efficient the better the spouses know each other. Furthermore, contact before the wedding is likely to be positively related to the union being a 'love marriage', which is likely to further enhance their co-operative skills. On the other hand, the variable indicating whether the parents chose the spouse does not exhibit a statistically significant coefficient. Being from the same village is associated with over 29% lower holdings of durable goods than in an exogamous marriage. This may be evidence for the importance of the spatial network and consumption smoothing hypothesis investigated by Rosenzweig and Stark (1989) that is absent if spouses and both sets of parents live in the same village. Another possible explanation is that men who choose a wife from another village may be more entrepreneurial and, thus, more economically successful.

Livestock holdings and the lagged value of the dependent variable have positive and statistically significant effects on current asset holdings, while no evidence of statistical significance is found for the family's land holdings. The statistically significant associations of the first two are not surprising as they are also indicators of material well-being of different strengths, the latter is not due to the inability of individuals to sell land (Ali et al., 2011; Crewett et al., 2008). While the age gap between spouses exhibits evidence of a negative relationship with asset holdings, the duration of the

religious affiliations of heads and their spouses are extremely rare. Results including fixed effects for the spouse's ethnicity instead of the head's ethnicity are available from the author upon request. The correlation between the region and religion indicators is relatively high with 51% so they are not included simultaneously. The reference category for the ethnicity fixed effects is *other_eth*, the included binary variables are *amhara*, *oromo*, and *tigray*. The base category for the religion fixed effects is *other_rel* and the included dummy variables are *orthodox*, *protestant*, and *muslim*.

Table 3.3: Results for levels of asset holdings

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_value_assets					
eth_diff	-0.254**	-0.284**	-0.224*	-0.219*	-0.218*	-0.248**
	[0.122]	[0.123]	[0.121]	[0.119]	[0.121]	[0.122]
talk_beforemarriage	0.275***	0.255***	0.218***	0.219***	0.294***	0.298***
	[0.0841]	[0.0833]	[0.0827]	[0.0819]	[0.0799]	[0.0806]
same_village_spouse	-0.365***	-0.331***	-0.300***	-0.293***	-0.299***	-0.290***
	[0.0783]	[0.0797]	[0.0768]	[0.0747]	[0.0785]	[0.0789]
age_gap_spouses	-0.0121***	-0.0107**	-0.0114***	-0.0115***	-0.00886**	-0.00937**
	[0.00429]	[0.00426]	[0.00427]	[0.00422]	[0.00413]	[0.00408]
ln_value_livestock	0.0540*	0.0710**	0.0847***	0.0907***	0.141***	0.146***
	[0.0316]	[0.0326]	[0.0322]	[0.0318]	[0.0338]	[0.0349]
no_children	0.0384**	0.0244	0.0270*	0.0273*	0.0251	0.0210
	[0.0155]	[0.0156]	[0.0154]	[0.0153]	[0.0160]	[0.0161]
school_head	0.154*	0.118	0.114	0.116	0.0598	0.0527
	[0.0789]	[0.0775]	[0.0769]	[0.0772]	[0.0746]	[0.0755]
ln_value_assets_r1	0.260***	0.277***	0.274***	0.273***	0.213***	0.219***
	[0.0300]	[0.0296]	[0.0286]	[0.0283]	[0.0315]	[0.0313]
Ethnicity FE	No	Yes	Yes	No	Yes	No
Religion FE	No	No	Yes	Yes	No	No
Region FE	No	No	No	No	Yes	Yes
N	738	738	738	738	738	738
R^2	0.218	0.248	0.275	0.274	0.318	0.307

Note: Robust standard errors in brackets. *parent_choice*, *no_years_married*, *wealth_parents_head* and *ln_plot_area* and are included but statistically insignificant in all specifications. *wealth_parents_spouse* is included and positive and statistically significant at the 10%-level in only two columns.

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

marriage and the wealth of the head's parents upon marriage do not exhibit statistically significant coefficients. The fact that the age gap between spouses is negatively related to asset holdings in a statistically significant way may also relate to their joint efforts. It may be that communication is difficult or that preferences differ if the age gap is large, thereby leading to less efficient co-operation.

Furthermore, there is limited evidence of a positive and statistically significant relationship with the wealth of the spouse's parents, the number of children and with the variable indicating whether the head has received any education. None of these associations are surprising as it may be that the spouse's parents support the family, as children are part of the family's labor force and as educated household heads are likely to have access to better inputs and a more efficient production technology.

It may be necessary to control for initial well-being more thoroughly in order to ensure that the current level of asset holdings in round 4 is not simply a consequence of better economic well-being in round 1 of the ERHS. Therefore, equation (3.14) is estimated with livestock and land holdings in round 1 instead of the current ones.[40] The results of this exercise are presented in Table D6 in Appendix D and support the main ones given in Table 3.3. In summary, the results presented here confirm equation (3.6) and thereby yield empirical support for Assumption 3.2: Ethnic diversity between spouses is negatively related to family income.

3.5.2 Checking for different effects by prevalence of ethnic group

Proposition 3.1 and the summary statistics in Table 3.1 suggest that household heads from minority ethnic groups are relatively more likely to enter a heterogamous marital union. Therefore, it may be that the effects of heterogamy differ by whether the household head is of an ethnic majority or minority background. Members of ethnic minorities may, for example, be more assimilated and therefore better able to co-operate with non-co-ethnics so the joint efforts with their spouses may not suffer from ineffi-

[40] It is not possible to include the variables from rounds 1 and 4 simultaneously due to high serial correlation.

Table 3.4: Results for levels of asset holdings by prevalence of ethnic group

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_value_assets					
Ethnic majority (*other_eth*=0)						
eth_diff	-0.106	-0.140	-0.0408	-0.0458	-0.305*	-0.311**
	[0.155]	[0.157]	[0.159]	[0.160]	[0.158]	[0.154]
N	497	497	497	497	497	497
R^2	0.246	0.280	0.306	0.309	0.313	0.308
Ethnic minority (*other_eth*=1)						
eth_diff	-0.398**			-0.327*		-0.203
	[0.176]			[0.183]		[0.165]
N	241			241		241
R^2	0.314			0.347		0.451
Chow test						
Test statistic	29.205			24.409		23.159
F-Critical value (α=0.05)	1.706			1.637		1.658
Ethnicity FE	No	Yes	Yes	No	Yes	No
Religion FE	No	No	Yes	Yes	No	No
Region FE	No	No	No	No	Yes	Yes

Note: Robust standard errors in brackets. Inclusion of the standard ethnicity dummy variables in the lower panel is not possible as all household heads are from one of the minority ethnic groups and grouped in *other_eth*. The null hypothesis of the Chow test that the coefficients in the two samples are identical is rejected in all cases at the 5%-level of significance.

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

ciency induced by different ethnic backgrounds. This would imply that the effect of *eth_diff* found in the main results could be driven by members of ethnic majorities. To investigate this empirically, equation (3.14) is estimated for subsamples. The results for households in which the head belongs to one of the three majority ethnic groups are reported in Table D7, the corresponding results for cases in which the household head is from an ethnic minority are presented in Table D8, both to be found in Appendix D. A summary of the coefficients of interest is presented in Table 3.4.[41]

The results presented in Table 3.4 do not show significant evidence of heterogamous marriage affecting the levels of asset holdings in different ways for household heads belonging to the majority or minority ethnic groups. The coefficient on *eth_diff* is statistically significant and negative in two columns for each sub-sample. The Chow test reported in the bottom panel of the table, however, suggests that the coefficients in the sub-samples are not identical. Overall, the results are weaker than the main ones, possibly due to the smaller sample sizes and the low prevalence of inter-ethnic marriages among the majority ethnic groups (8.9%). In summary, the results support the idea that heterogamous marriages are not more prevalent among ethnic minorities because the negative effect on the co-operation between spouses is weaker, but because they are faced with larger difficulties of finding co-ethnic spouses.

3.5.3 Ethnic diversity and changes in family income

Another possibility to address the concern of self-selection and to account for the initial value of the outcome variable is to use its change between rounds 1 and 4 of the survey as the dependent variable. This ensures that the main findings are not driven by the fact that households in which the head is married to a co-ethnic are wealthier to begin with but focuses on their productivity, i.e. the effect of ethnic diversity between spouses on the change in long-term family income is investigated. It may, however, be the case that higher initial wealth leads to a larger increase in family income as well,

[41] Including an interaction term between *eth_diff* and *other_eth* in equation (3.14) is not advisable as the interaction term exhibits extremely low variability in the sample.

Table 3.5: Results for changes in asset holdings relative to assets in round 1

	(1)	(2)	(3)	(4)	(5)	(6)
	(Δ value_assets)/value_assets_r1					
eth_diff	-1.911*	-2.135*	-1.673	-1.453	-1.869*	-2.494**
	[0.994]	[1.112]	[1.040]	[0.921]	[1.115]	[1.103]
talk_beforemarriage	1.923**	1.734*	1.509*	1.590*	1.553*	1.613*
	[0.923]	[0.919]	[0.912]	[0.901]	[0.895]	[0.897]
same_village_spouse	-0.145	0.00826	0.250	0.488	-0.309	-0.0743
	[0.873]	[0.867]	[0.858]	[0.819]	[0.907]	[0.903]
age_gap_spouses	-0.110**	-0.0958**	-0.101**	-0.101**	-0.0991**	-0.102**
	[0.0442]	[0.0411]	[0.0416]	[0.0415]	[0.0421]	[0.0422]
ln_total_plotarea	0.321	0.508	0.473	0.329	0.355	0.494
	[0.365]	[0.436]	[0.428]	[0.367]	[0.498]	[0.506]
ln_value_livestock	-0.359	-0.260	-0.202	-0.120	0.215	0.195
	[0.287]	[0.299]	[0.306]	[0.313]	[0.343]	[0.337]
no_children	-0.199	-0.325*	-0.303*	-0.272	-0.423**	-0.422**
	[0.176]	[0.175]	[0.176]	[0.175]	[0.184]	[0.184]
school_head	-0.638	-0.913	-0.884	-0.808	-1.345	-1.380
	[0.838]	[0.875]	[0.849]	[0.830]	[0.909]	[0.918]
N	738	738	738	738	738	738
R^2	0.018	0.047	0.056	0.051	0.063	0.057
Ethnicity FE	No	Yes	Yes	No	Yes	No
Religion FE	No	No	Yes	Yes	No	No
Region FE	No	No	No	No	Yes	Yes
N	738	738	738	738	738	738
R^2	0.022	0.050	0.074	0.073	0.088	0.062

Note: Robust standard errors in brackets. *parent_choice*, *no_years_married*, *wealth_parents_head* and *wealth_parents_spouse* are included but statistically insignificant in all specifications.

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

for example through the possibility of purchasing agricultural inputs. As Y_{H1} may not be included as an explanatory variable because it would then show up on both sides of the equation, the difference in assets is scaled by asset holdings in round 1 and equation (3.14) amended in the following way:[42]

$$(Y_H - Y_{H1})/Y_{H1} = \alpha_0 + \alpha_1 eth\_diff_H + \mathbf{X}'_H\gamma + \epsilon_H. \tag{3.15}$$

The results for the specification outlined in equation (3.15) are presented in Table 3.5. Again, equation (3.6) and Assumption 3.2 are supported as there is evidence of a negative effect of heterogamous marriage on the change in asset holdings. The coefficient on *eth_diff* is only statistically significant in four out of the six columns, however. The coefficients are less straightforward to interpret but support the mechanism proposed in this study. The coefficient of determination is relatively low in all columns, which is not surprising, considering that the regression model employed here attempts to explain the relative change in assets with mainly socio-economic variables rather than precise measures for productivity, but also indicates that these results should be interpreted with care.

3.6 Conclusions

The present study investigates why marriages in Sub-Saharan Africa usually involve members of the same ethnic group (e.g. Cazes, 1990; Nave, 2000), even if their families are from different locations. While it is understood that spreading out family ties geographically acts as a coping mechanism against location-specific shocks (Rosenzweig and Stark, 1989), the present paper adds a purely economic motivation for intra-ethnicity marriage in developing economies. Explanations have so far mainly been made involving the facilitated transmission of cultural values and norms to children (e.g. Bisin and Verdier, 2000) in the context of developed economies.

[42]Note that the change in asset holdings may be negative so a logarithmic transformation of the dependent variable would result in an unjustified loss of observations.

This paper focuses on the effect of ethnic diversity on family income and thereby adds micro evidence at the household level to the discussion on the effect of ethnic diversity on economic performance, focusing on a rural setting in developing economies. I argue that co-ethnics have a similar production technology and are therefore more successful in agricultural production due to more efficient co-operation between spouses. This increases the returns of all agents so homogamous marriage is a strictly preferred strategy. The fact that heterogamous marriage more often involves members of minority than majority ethnic groups is proposed to be grounded on frictions in the marriage market that lead to larger difficulties of finding co-ethnic spouses among minorities.

The empirical findings support the hypothesis that heterogamous marriage is associated with lower family income. Specifically, a household in which the head and his spouse are of different ethnic backgrounds exhibits a lower consumption of durable goods as compared to a household in which the marriage is within ethnic boundaries. Furthermore, the negative association between heterogamy and family income is found to be of similar magnitude for ethnic majority and minority groups. This supports that the negative effect of heterogamous marriage on economic outcomes does not differ by degrees of assimilation but that the higher prevalence of inter-ethnicity marriages among minority groups is due to frictions in the marriage market.

The paper adds insight into the multi-faceted effect of ethnicity on societal structures and conditions, which is especially important in African developing economies due to the challenges related to their ethnically diverse populations. While this study does not suggest that ethnically heterogamous marriage should be discouraged, a mechanism to justify marital traditions based on the economic productivity of couples is proposed. Where the tradition of homogamous marriage is interrupted, for example in situations of displacement or forced migration, policies can be designed to assist in replacing these mechanisms and in facilitating the understanding and co-operation between non-co-ethnic spouses in order to secure livelihoods. This specifically applies to members of ethnic minority groups as they are often at a disadvantage in their ac-

cess to, for example, production factors and also have a higher probability of marrying outside their ethnic group, which in turn, hampers family income according to the findings of this study.

Chapter 4

Female Land Titling and Children's Outcomes

The research paper forming this chapter is developed from the working paper "Does reinforcing spouses' land rights improve children's outcomes? Evidence from a quasi-natural experiment in rural Vietnam" that is co-authored with Gaia Narciso and Carol Newman. It was presented at the annual conference of the Irish Society of New Economists (2009) in Limerick, Ireland, the GREP QSS Conference (2009) in Dublin, Ireland, the annual conference of the Scottish Society (2010) in Perth, Scotland, the annual conference of the Irish Economic Association (2010) in Belfast, Northern Ireland, the Nordic Conference in Development Economics (2010) in Helsinki, Finland, and at a research workshop at the Central Institute for Economic Management (2010) in Hanoi, Vietnam. The authors are grateful to Christian Danne, Benjamin Elsner, Marcel Fafchamps, Chris Ksoll, Rocco Macchiavello, Karen Mayor, Finn Tarp, and participants of various seminars and workshops at Trinity College Dublin for helpful comments.

4.1 Introduction

> "As a co-owner of our land, I feel more involved in the decision making of the family. I want to make sure we earn and save enough money to have a good house, and to give our children a good education. Ever since my name has been on the LURC [Land Use Right Certificate], I feel more secure about the future." - Nguyen Thi Ha, a 42-year old mother from Nghe An province (UN Volunteers, 2004, p. 1)

Gender equality, female empowerment and the elimination of child labor are fundamental elements of economic development, as set out in the Millennium Development Goals (United Nations, 2009). According to the International Labour Organization (ILO), about 215 million children between the ages of 5 and 17 are engaged in child labor around the world. Approximately two thirds of child workers are unpaid family laborers, while agriculture represents the largest sector employing approximately 60% of the child workforce. Girls in particular face the burden of being involved both in agricultural child labor and domestic work, which is generally not accounted for in official statistics (International Labour Organization, 1999; Diallo et al., 2010).

The aim of this paper is to investigate the relationship between laws intending to strengthen women's rights, and children's outcomes, namely child labor and educational attainment. To this end, we analyze the effects of a land reform which was introduced in Vietnam in 2003 and which constitutes a step to strengthen women's land rights within the household (UN Volunteers, 2004). The land reform was indeed ratified in response to the pressure of Vietnamese women's groups (Akram-Lodhi, 2005). We provide evidence that the land reform contributed to reducing girls' involvement in agricultural labor and somewhat to increasing their educational attainment, while no effect is found for boys. Several features make our findings particularly interesting. First, no change regarding inheritance and separation of assets in case of divorce is brought about by the land law, it is simply restating existing rights. Second, we study

the effect of being *de jure* subject to the 2003 Land Law rather than of *de facto* implementing it at the household level. Therefore, our findings are likely to reflect a change in customs and social norms driven by formal institutions towards more gender equality.[1]

Following the land decollectivization introduced by the *Doi Moi*[2] reform program towards the end of the 1980s, the 1993 Land Law launched the issuance of land use certificates (LUCs), which assign land use rights to households' land holdings. According to the 1993 Land Law, a household's LUC lists all plots the household has rights to and is (re)issued every time an additional plot is registered with the local government. Until 2003 land use certificates usually reported the name of the household head only, i.e. customarily the husband's name in the case of married couples. In compliance with the recent Vietnamese 2003 Land Law, land use certificates must report the names of *both* spouses for jointly owned plots if the LUC is (re)issued after 2003 (The National Assembly of The Socialist Republic of Viet Nam, 2003).

The 2003 Land Law constitutes a change of form rather than substance: the law does not affect land ownership with respect to inheritance or land allocation in the case of divorce. Both spouses were entitled to equal land rights of jointly owned plots, regardless of whether one or both names were reported on the land use certificate, even before the introduction of the 2003 Land Law. Visible joint ownership may still lead to a shift of bargaining power within the household towards the wife because she does not need to prove being a co-owner in the case of divorce, which enhances and expedites access to her share of the family's land holdings. Her outside options and, thus, her threat point are therefore increased due to the facilitated separation of land holdings and her faster access to these in the case of divorce.

[1] A gender equality law was implemented in Vietnam in 2007 as well. Note that it does not impact on our identification strategy as the scope of the law is to ensure equal rights of women "in the fields of labour, employment, education and health care; to improve the quality of women's participation in economic, political and social fields; and to enhance the capacity of national machinery for the advancement of women" (United Nations, 2007, p. 1) and as spouses have been entitled to equal land use rights even before the introduction of the 2003 Land Law.

[2] *Doi Moi* is translated as 'change and newness' (Do and Iyer, 2008).

By restating women's rights to land holdings, the 2003 Land Law allows us to analyze how legal reforms are transformed and adopted by custom and social norms, especially in light of an investigation of the introduction rather than the implementation of the law. If women had preferences for girls or wished to mitigate existing gender inequalities favoring boys, increased female bargaining power within the household would be reflected in lower intensities of child labor and higher educational attainment among girls.

Given possible endogeneity in the implementation of the 2003 Land Law at the household level, we exploit the introduction of the land law rather than its actual implementation. This means that we investigate the effect of being part of the population that is targeted by the land law, irrespective of whether or not the law is implemented at the household level, as opposed to not being part of the target population of the law. By using a unique household dataset that allows inspection of the ownership of land rights at the individual plot level, we show that reinforcing existing land rights of female spouses has positive effects on girls' outcomes. It reduces their likelihood of participating in agricultural household production and somewhat increases their educational attainment. We argue that the lack of findings for boys partly reflects a move towards mitigating the differences in outcomes between girls and boys and therefore a move towards more gender equality, but may partly also mirror women's preferences for girls. A series of robustness checks gives us confidence in our findings. We disentangle the effects of possible concurrent driving factors such as exclusive ownership by one spouse, plot registration *per se*, and land acquisition from the impact of the 2003 Land Law on child labor and children's educational attainment.

Child labor in Vietnam has declined substantially since the 1990s. Edmonds and Pavcnik (2005) demonstrate that an increase in the real price of rice associated with trade liberalization can account for almost half of the reduction in child labor in Vietnam in the 1990s. However, significant heterogeneity in child work rates is still observed. Edmonds and Turk (2002) provide evidence that the decrease in child workers

has been the smallest in urban areas, the Central Highlands and the South Central coast. Moreover, girls are found to be more likely to work in the household and in the family's businesses, and their work rates have declined to a smaller extent than those of boys during the 1990s. The authors attribute the difference in work rates between boys and girls to different levels of decision-making power within the household and to the gender division of labor (Edmonds and Turk, 2002).

In many developing countries, and especially in Asia, besides the differences in workloads, investment in education often exhibits a gender bias, with girls being at a disadvantage. Primary school enrollment rates are high considering Vietnam's level of GDP per capita due to the introduction of regulations in the Vietnamese Constitution in 1992, which made primary education mandatory and free of tuition fees. Primary school enrollment rates have increased from 69% in 1994-95 to 96% in 2006-07 according to a report by UNICEF (2010). However, other costs associated with education still occur, e.g. the cost of books, pens and clothing. In situations of financial distress, these and the opportunity cost of education often lead to the withdrawal of children from school (World Bank, 1999). Our analysis focuses on the effects of the land reform on educational attainment of children above primary school age.

The general notion that women in low-income countries often have a lower share of power in household decision-making than women in developed countries (Pitt and Khandker, 1998) also holds in Vietnam, according to a report by the World Bank (1999). In all of the four provinces investigated by the World Bank, gender inequality exists and different levels of decision-making power within the household are reported over issues like the allocation of resources, workloads, and reproductive decisions.[3]

Our study is related to the literature documenting that the gender of the income recipient matters for the outcomes of children. Pitt and Khandker (1998) test for differences in the effects of parental participation in micro credit programs on children's schooling in Bangladesh. Mothers' participation is found to have robust positive ef-

[3]The four provinces investigated by the World Bank (1999) are: Lao Cai, Ha Tinh, Tra Vinh and Ho Chi Minh City.

fects on schooling rates, both for sons and daughters, with differences depending on the type of credit program, while participation of the father only impacts on schooling rates of boys. In her seminal paper, Duflo (2003) investigates the relationship between an old-age social pension program and the health status of children living with a recipient of the pension. The author finds a positive effect of the pension on girls and no effect on boys living with female pension receivers. No effect is found for children living with male pension receivers. Qian (2008) investigates the effects of increases in sex-specific income on children in China: a rise in female income, while keeping male income constant, lowers child mortality among daughters and has positive effects on educational measures for all children. On the other hand, an increase in male income, while keeping female income constant, raises child mortality among daughters and worsens their educational attainment, with no effect on boys.

The present paper furthermore adds to the growing literature on the effects of laws and reforms aiming to ensure equal rights of men and women. Field (2003) investigates a nationwide land titling program in which joint land rights were assigned to spouses in order to reduce gender inequality in Peru. She proposes that a reallocation of property rights affects the relative bargaining power of the wife by altering her divorce threat point and finds that fertility decreased in the target population of the program. In addition, Bezabih and Holden (2010) investigate a land reform in Ethiopia that attempts to increase land certification in general but also involves visibly assigning joint land ownership to both spouses by means of stating the names of both the husband and the wife on the land certificate. While the authors do not investigate this particular aspect of the reform, they find evidence for the reform narrowing the agricultural productivity gap between male- and female-headed households that is reportedly due to higher tenure insecurity among female-headed households. Similarly, Newman et al. (2012) find that land certification itself has positive effects on productivity in Vietnam. Furthermore, joint titling in the names of both the household head and his spouse, conditional on titling of the plot and its acquisition after the 2003 Land

Law, also enhances productivity (Newman et al., 2012).

Recent papers have investigated the impacts of the Hindu Succession Amendment Act, whose aim was to equalize inheritance rights across male and female heirs in India. Deininger et al. (2010) find that the reform had positive implications on the educational attainment, on the age at marriage, and on the likelihood to inherit land for female heirs, even if the increase was not sufficient to attain gender equality with respect to inheritance. Roy (2011) also finds that the Hindu Succession Amendment Act increased educational attainment of women that were subject to the reform at schooling age. In addition, Brulé (2010) finds that this law led to increases in perceived land ownership and in self-reported bargaining power of women. We depart from these findings to show that laws reaffirming women's rights to land holdings, by increasing female bargaining power within the household, have an impact on children's outcomes.

Furthermore, our study contributes to the emerging literature on the relationship between formal and informal institutions as it aims to enhance the understanding of how legal reforms are transformed and adopted by custom and social norms. Aldashev et al. (2012a) study how a formal law implemented by the state can "defend the rights of disadvantaged groups when customary norms favor the interests of traditional elites" (Aldashev et al., 2012a, p. 797). Using a model of legal dualism, the authors show how the formal law can act as a 'magnet' in shaping customary norms and protect minorities or marginal groups (Aldashev et al., 2012a,b).

This is indeed the case with the Vietnamese 2003 Land Law. Firstly, the law did not actually change the spouses' statutory rights in terms of inheritance or in the case of divorce. Secondly, the implementation of the law was delayed by local officials. According to anecdotal evidence "[t]he all-important local officials who administer and interpret the law often revert to age-old traditions and customary practices, which favor men, and thus failed to deliver on the law's promises" (UN Volunteers, 2004, p. 1). Notwithstanding the delays in the implementation of the law, the introduction

of the 2003 Land Law is found to have a positive impact on girls' outcomes. The 2003 Land Law therefore appears to act as an application of the legal dualism discussed by Aldashev et al. (2012a,b): On one hand, the formal institution reaffirms women's rights to land; On the other, customary practices are ultimately shaped by the law itself.

The remainder of the paper is structured as follows. Section 4.2 provides background information regarding legal aspects of Vietnam's land law system. Section 4.3 discusses the household survey data employed in the analysis. Section 4.4 introduces the estimation strategy and presents the main results. Section 4.5 explores the robustness checks, Section 4.6 concludes.

4.2 Land Reforms in Vietnam

In 1988 the Vietnamese government implemented the *Doi Moi* reform program, the first move towards a market economy.[4] Local governments privatized land use rights and allocated the land, which until 1988 had been farmed collectively, to households and individuals. Although land allocation was relatively slow, it achieved an equitable assignment of land use rights across households, a notion supported by Ravallion and van de Walle (2004) who do not find any evidence of the land allocation favoring households with government jobs.

As a next step in the land reform, the 1993 Land Law prescribed the issuance of land use certificates (LUCs), and made land use rights tradeable. Although land is still not owned by individuals,[5] land use rights can be transferred, exchanged, inherited, and used as collateral following the 1993 Land Law.[6] LUCs grant the right to use the assigned plot for 20 years in the case of annual crops land and for 50 years in the case of perennial crops land. Local authorities allocate the land to households on the

[4]See Ravallion and van de Walle (2004, 2006, 2008) and Kirk and Tuan (2009) for a thorough analysis of Vietnam's agrarian transition.

[5]In Vietnam land is owned by the entire Vietnamese people with the State being the exclusive representative unit of the people regarding management of the land (The National Assembly of The Socialist Republic of Viet Nam, 2003).

[6]The LUC gives the right to transfer and rent out the land but not necessarily to determine the choice of crops to cultivate on that land (The National Assembly of The Socialist Republic of Viet Nam, 2003). Markussen et al. (2009) find that 52% of the plots in their sample are restricted regarding crop choice.

basis of the households' needs, for example with respect to the number of household members, and issue LUCs that list the plots which the household has use rights to. However, these rights are conditional on compliance with the land law and on the individual using it for the designated purpose and in an effective and environmentally friendly fashion without harming adjacent land users (The National Assembly of The Socialist Republic of Viet Nam, 2003). Investments in the land in order to cultivate it and increase its value are encouraged as implied by the long-term nature of the land use right. The 1993 Land Law was perceived as a further commitment by the government to secure property rights and led to an increase in the willingness to undertake long-term investments, for example in irrigation and multi-year crops (Do and Iyer, 2008).

The issuance of LUCs involves both pecuniary and non-pecuniary costs. Several actions of local bureaucracy are necessary in the process of granting land use rights so as to determine whether the farmer is eligible to the land and whether the transfer is legal, to settle existing disputes over the plot and to issue the actual LUC. In order to have a LUC issued, farmers have to pay a fee, which is around 20,000 Vietnamese Dong.[7] However, fee exemptions are often granted to boost land registration rates in more remote regions and especially in mountainous areas (Do and Iyer, 2008). Land may be used as collateral when applying for credit and may also be leased out with permission of the authorities. Should the LUC holder die, the land use right is transferred to heirs like an asset; In the absence of heirs, the Vietnamese state recovers the land. Recovery of land is also permitted under special circumstances that require expropriation, for example during a war period, provided a reasonable compensation is granted to the expropriated land user (The National Assembly of The Socialist Republic of Viet Nam, 2003).

According to the 2000 Marriage and Family Law, all land holdings that were acquired during marriage must be divided equally between spouses in the case of di-

[7] In 2003, 15,509.58 Vietnamese Dong corresponded to one US-Dollar (International Monetary Fund, 2012) so the fee was approximately 1.29 US-Dollars at the time the law was passed.

vorce.[8] They have to be divided in recognition of the situation and property of each spouse, of his/her investment and effort on the land, and of other contributions to family income, where housework has to be treated in the same fashion as income-generating labor (The National Assembly of the Socialist Republic of Viet Nam, 2000).

The 2003 Land Law brought about a significant change in the titling of land use certificates as LUCs usually only reported the household head's name until 2003 (UN Volunteers, 2004). Article 48 of the 2003 Land Law explicitly mentions that "[i]n case[s] where the land use rights are under joint ownership of the husband and wife, the certificate of such land use rights must include full names of the husband and full names of the wife" (The National Assembly of The Socialist Republic of Viet Nam, 2003, p. 29). Practically, the inclusion of the spouse's name on the LUC should automatically happen when the household requests having the LUC (re)issued in order to include an additional plot. Following the 2000 Marriage and Family Law spouses are officially entitled to equal rights to land holdings acquired during the marriage, irrespective of which names are stated on the LUC. Thus, the scope of the 2003 Land Law only extends to reaffirming women's equal rights to land holdings, rather than to altering existing use rights.

4.3 Data

The main source of data employed in this study are two rounds of the Vietnam Access to Resources Household Survey (VARHS), conducted in 2006 and 2008 in twelve provinces of Vietnam and forming a panel to the largest part.[9] The VARHS was first conducted in 2002 and initially covered four provinces only.[10] The two following

[8]The acquisition of land is legally not possible due to communal ownership in Vietnam. Note that we use the term 'plot acquisition' for the act of buying use rights to land for the remainder of this paper.

[9]The Vietnam Access to Resources Household Survey was developed in collaboration between the Development Economics Research Group (DERG), Department of Economics, University of Copenhagen, and the Central Institute of Economic Management (CIEM), the Institute for Labour Studies and Social Affairs (ILSSA), and the Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD), Hanoi, Vietnam. The twelve surveyed provinces are: Ha Tay, Nghe An, Khanh Hoa, Lam Dong, Dac Lac, Dac Nong, Lao Cai, Dien Bien, Lai Chau, Phu Tho, Quang Nam and Long An (CIEM et al., 2007).

[10]The four provinces are: Ha Tay, Phu Tho, Quang Nam and Long An (CIEM et al., 2007).

rounds carried out in 2006 and 2008 extended the initial 2002 sample to 3,269 households in 2008. Data for subsequent rounds were collected in 2010 and 2012.

The purpose of the VARHS is to gain quantitative information on possibilities and constraints of the rural population of Vietnam in accessing resources and markets. The VARHS contains general demographic characteristics of household members and more specific information on agricultural production, access to markets, and sources of income. In particular, the survey includes extensive information on agricultural land, its acquisition and use rights at the plot level, which enables detailed investigation of the effects of the 2003 Land Law on the outcomes of children. The 2008 round of the survey is the main source of data employed in this investigation, while the 2006 round is used for robustness checks.

The second source of data is the 2004 Vietnam Household Living Standards Survey (VHLSS), conducted by the General Statistics Office (GSO). The VHLSS sample overlaps with the VARHS sample, thus allowing the construction of a combined dataset.

Table 4.1 presents summary statistics for the sample of children between the ages of 6 and 14 years living in a household whose head is married. The current sample is used in our assessment of the effects of the 2003 Land Law on child work, which we measure in terms of children's participation in household production comprising agriculture, forestry and aquaculture.[11] This measure is an applicable definition of child labor for our purposes as agricultural household production is an important source of income in the rural areas that form our sample. The International Labour Organization rates agriculture as one of the three most dangerous sectors for children's health and safety and recognizes agriculture as a priority sector for the elimination of child work (International Labour Organization, 2006).

Table 4.1 furthermore includes mean-comparison tests of variables for male (denoted by '$\_boys$') and female children (denoted by '$\_girls$'). Girls constitute 50.9% of

[11]Note that we simply refer to this type of work, i.e. work in the household's production related to agriculture, forestry, and aquaculture, as an involvement in 'agricultural household production' for the remainder of the paper.

Table 4.1: Summary statistics – Child work sample

	mean	difference	min	p50	max	sd	N
HH_production_boys	0.261	-0.022	0	0	1	0.440	636
HH_production_girls	0.283		0	0	1	0.451	658
school_boys	0.917	-0.003	0	1	1	0.277	636
school_girls	0.919		0	1	1	0.272	658
years_edu_boys	4.755	0.042	0	5	9	2.315	636
years_edu_girls	4.713		0	5	10	2.402	658
age_boys	11.057	0.009	7	11	14	2.221	636
age_girls	11.047		7	11	14	2.261	658
first_born_boys	0.234	-0.013	0	0	1	0.424	636
first_born_girls	0.248		0	0	1	0.432	658

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

the sample and a higher share of girls than boys is involved in agricultural household production ($HH\_production$ takes a value of one if the child works in agricultural household production and zero otherwise), although the difference between boys and girls is not statistically significant. There is no statistically significant difference between boys and girls regarding school enrollment rates ($school$ is binary and indicates whether a child is enrolled or not), reflecting that the Vietnamese Constitution made primary education mandatory in 1992. Boys have achieved slightly more years of education ($years\_edu$) than girls, who are also slightly younger (age) but more likely to be the first-born child ($first\_born$) in this sample.[12] However, none of these differences in means is statistically significant.

Table E1 in Appendix E displays summary statistics at the household level. About 19% of the households in this sample have had their land use certificate (re)issued after 2003, i.e. after the 2003 Land Law was introduced ($LUC\_after2003$ takes a value of one if the LUC was (re)issued after 2003 and zero otherwise).[13] Thirteen percent of house-

[12]Note that the restriction on the sample in terms of age is 6-14 years. With the further conditions on the sample, i.e. living in a household whose head is married and no missing data for the variables used in the analysis in Section 4.4, all children at the age of 6 years are lost.

[13]The percentage of children in our sample living in a household that is *de jure* subject to the 2003 Land Law is 18.18%.

holds have registered a plot on the LUC after 2003 without having acquired an additional plot in the same time frame ($LUC\_after2003\_reg$) and 14.3% of the households in this sample hold a LUC that reports the names of both spouses ($both\_names\_LUC$). Approximately 21% of households have acquired an additional plot after the introduction of the law ($plot\_after2003$). All of the latter three variables are binary.

The household head is female in 5% of the households (fem_head) with an average age of approximately 44 years (age_head). Given that parental education is missing in some cases and that Vietnamese rural households often span more than two generations, we consider the maximum number of years of education among adults (above the age of 18) within the household, which exhibits a median value of 9 years of schooling ($max\_years\_edu\_hh$). On average households have rights to almost 5 plots ($plots\_total\_rights$), and most households have at least one plot on which rice was planted in one of the previous three seasons ($rice$ takes a value of one if this is the case and zero otherwise). The total area of plots varies greatly, from as small as 36 square meters to as large as 326,000 square meters ($area\_plots$).[14]

Self-reported knowledge about the contents of the 2003 Land Law exists in 22% of the households ($know\_law$). As we are interested in female bargaining power within the household and as women's unions are important sources of information, we control for whether any female household members is active in one or not with the help of the binary variable $womens\_union$. Women's unions play an important role in Vietnamese society and, given the low membership fee, participation tends to be relatively widespread. About 62% of the households in our sample have at least one member who is active in a women's union.

About 31% of the households receive private transfers ($transfer$ is also binary) and the value of the total durable goods of the household ($value\_durable$) is given in Vietnamese Dong.[15] The median number of children in a household is 2 ($number\_children$),

[14]This includes the total size of all plots the family gets some utility from, i.e. those the family has rights to and operates, those it does not have rights to but rents in to operate, and those it has rights to but rents out.

[15]The value of durable goods is the total self-estimated value at the time of the 2008 VARHS for all

which is at least in part a result of Vietnam's history regarding the two-child policy introduced in the late 1980s.[16] In the main results we control for family composition with the help of binary variables for households composed of a married head and two ($couple\_2k$), three ($couple\_3k$) or four children ($couple\_4k$). Further controls include the distances to the nearest primary ($dist\_primary$), lower ($dist\_secondary\_lower$), and upper secondary schools ($dist\_secondary\_upper$). The majority of households belongs to the ethnic group $Kinh$, denoted by the binary variable $kinh$.

Table 4.2 reports the child-level information for the sample of children between the ages of 11 and 18 years not attending school at the time of the 2008 survey. We use this sample for the assessment of effects of the 2003 Land Law on the duration of education. We restrict the sample to children that did not attend school at the time of the survey in order to capture the educational attainment of children that have finished their education, which reduces the sample size significantly. The sample contains all children that fulfill this criterion, are above the age of primary schooling, and live in a household whose head is married. Boys enjoy on average 0.61 more years of education than girls, while a higher share of girls is involved in agricultural household production also in this sample. For both sexes the great majority of children in this age group are involved in agricultural household production, boys are older and more likely to be the first-born child than girls. Only the differences in the means of $years\_edu$ and $first\_born$ are statistically significant.

Summary statistics at the household level for this sample are reported in Table E2 in Appendix E. Approximately 12% of the households have registered an additional plot on the land-use certificate after 2003 and 13% of the households in the sample hold LUCs that report both spouses' names.[17] The higher age of the household head reflects

of the household's durable goods. These include color TVs, black and white TVs, satellite dishes, video or DVD players, stereo systems (CD and radio), radios, cassette players (mono), telephones (including mobile phones), refrigerators, air conditioners, washing machines, hot water heaters, motorcycles, bicycles, boats, feed grinding machines, rice milling machines, grain harvesting machines, pesticide sprayers, tractors, ploughs, carts, cars, and personal computers.

[16]Implementation of the two-child policy and fines in the case of having additional children were heterogeneous across households and influenced by the geographical location and political involvement of household members (Bélanger et al., 2003).

[17]The percentage of children living in a household that is that is *de jure* subject to the 2003 Land Law is

Table 4.2: Summary statistics – Education sample

	mean	difference	min	p50	max	sd	N
HH production_boys	0.649	-0.055	0	1	1	0.478	231
HH production_girls	0.704		0	1	1	0.457	213
years_edu_boys	7.139	0.608*	0	8	12	3.057	231
years_edu_girls	6.531		0	7	12	3.744	213
age_boys	16.316	0.156	11	17	18	1.837	231
age_girls	16.160		11	17	18	1.894	213
first_born_boys	0.372	0.077*	0	0	1	0.484	231
first_born_girls	0.296		0	0	1	0.457	213

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

the older cohort of children considered in this sample relative to the one presented in Table E1. About 4% of the households are headed by a woman, while women's union membership is lower than in the previous sample: Approximately 51% of the households have at least one member who is active in a women's union.

4.4 Main Empirical Analysis

According to the 2003 Land Law, land use certificates should report both names in case the couple was married before the last plot was registered on the household's LUC and if registration occurred after 2003, the year the land law was introduced (The National Assembly of The Socialist Republic of Viet Nam, 2003). Approximately one third of the couples in our samples that fulfill these criteria have the names of both the husband and wife stated on their LUC. We do not find any evidence of a statistically significant relationship between law implementation at the household level and observable household characteristics such as ethnicity, employment status of household members and wealth measured by the value of durable goods as presented in Table E3 in Appendix E. We find some evidence, however, that families, who have planted rice in one of the previous three seasons are less likely to have both names stated on the LUC.

16.22% in this sample.

On the other hand, there is evidence for a positive relationship of implementation of the law and receiving transfers, knowledge about the content of the 2003 Land Law and membership in a women's union, which points towards the household having to explicitly request the implementation of the law.

The weak implementation of the 2003 Land Law is the foundation of our estimation strategy in which we exploit the effects of the introduction of the land law on children living in households that are *de jure* subject to the 2003 Land Law rather than *de facto*. Households are *de jure* subject to the land law if the household head is married and if the LUC has been (re)issued after 2003 for the purpose of registering an additional plot. Households are *de facto* subject to the law in the presence of law implementation at the household level, i.e. if the household head is married, if the LUC has been (re)issued after 2003 *and* if it states the names of both the household head and his spouse.

Given the anecdotal evidence reported in the introduction and the results presented in Table E3, implementation of the law at the household level is likely to have been delayed due to customary rules favoring men. Therefore, households with both names on the land use certificate may be characterized by a relatively high degree of female empowerment to begin with. In light of Aldashev et al. (2012a,b), we maintain that knowledge of being *de jure* subject to the 2003 Land Law may constitute empowerment by re-assuring the spouse in her rights and her knowing that her name should also be on the LUC, thus allowing her bargaining position to increase within the household as argued by Akram-Lodhi (2005).[18] Due to possible endogeneity of law implementation at the household level not captured by observable characteristics, the identification of the effects of the land law hinges on a comparison of the effects of plot registration before and after 2003 on children's outcomes, irrespective of whether or not the LUC bears both names.

[18]It may also be the case that women did not always know that they had equal land use rights as their husbands before the introduction of the law. Therefore, the introduction of the law, even if not implemented in a specific household, may have induced a shift in bargaining power as women now know (if they were informed about the law) that they hold equal rights as their husbands and that, from a legal perspective, their names should also be stated on the LUC if registration occurred after 2003.

It is worth noting that, conditional on having acquired a plot after the introduction of the law, we do not find any evidence of a statistically significant relationship between plot registration after 2003 and observable indicators of household wealth such as the logarithmic values of durable goods, of the total size of the land holdings or the household receiving private transfers. The results of this exercise are presented in Table E4 in Appendix E. There is, however, some evidence that plot registration after 2003 is negatively correlated with the head or his spouse being employed in a privately owned company and with rice cultivation. The latter is not surprising as households that have cultivated rice in any of the previous three seasons are likely to be constrained in their crop choice which indirectly implies that the rights to their plots are recognized by the commune so that (re)issuing the LUC may not appear necessary. We control for rice cultivation in our specification to minimize its influence on our identification strategy.[19] Furthermore, registration after 2003 is positively correlated with maximum education among adults in the households and with the head belonging to the ethnic majority group $Kinh$, although these results are not robust and depend on the specification. Very important for the validity of our identification strategy is the fact that neither knowledge about the law nor membership in a women's union exhibits a statistically significant coefficient. This reassures us that the decision to register an additional plot after the introduction of the 2003 Land Law is not related to the implications of the law and therefore exogenous.

In the main specification we investigate the effects of having registered at least one plot on the LUC after 2003 on child labor, measured by whether children participate in agricultural household production or not, and on the educational attainment of children. The econometric specification that yields the main results employs Ordinary

[19]Note that rice cultivation is not significantly related to either outcome variable in the main specification outlined in the following paragraphs.

Least Squares (OLS) with robust standard errors and appears as follows:[20]

$$W_{ihd} = \varrho_1 LUC\_after2003_{hd} + \varrho_2 fem_{ihd} + \varrho_3 LUC\_after2003_{hd} * fem_{ihd} + \mathbf{X}_{ihd}\varpi + \mathbf{H}_{hd}\varphi + \mathbf{\Phi}_d + \epsilon_{ihd} \tag{4.1}$$

where W_{ihd} denotes one of the two outcome variables: the binary variable measuring participation in agricultural household production ($HH\_production$) or the number of years of education ($years\_edu$) of child i in household h located in district d. $LUC\_after2003$ is the main explanatory variable which takes value one if the household has registered at least one plot on its land use certificate after 2003 and zero otherwise; fem is a dummy for the gender of the child, taking value one if the child is female and zero otherwise. In the presence of gender equality we would expect the coefficient on fem to be statistically insignificant. If women have a preference for girls or wish to reduce existing gender inequalities, we would expect the increased bargaining power within the household brought about by the 2003 Land Law to be reflected in lower child labor and higher educational attainment among girls. This means that the estimated marginal effect for girls, which is the sum of the coefficients on $LUC\_after2003$ and on the interaction term, would be statistically significant and negative. Stating a prior for the marginal effects for boys, given by the coefficient on $LUC\_after2003$, is

[20] As participation in agricultural household production is a binary dependent variable, a Probit estimation technique appears sensible. This, however, makes the interpretation of the marginal effects of the interaction term less straightforward. Furthermore, the inclusion of district fixed effects, even with dummy variables and in separate regressions for boys and girls to avoid the use of the interaction term with gender, is problematic as a number of successes and failures are perfectly predicted by the district dummy variables. This reduces the number of observations by approximately one third but supports the main results: The law lowers the likelihood of girls to participate in agricultural household production while no effect is found for male children. However, maximum likelihood estimation with fixed effects suffers from the 'incidental parameters problem' and therefore inconsistent estimates (Greene, 1993; Lancaster, 2000). Dropping the district indicators increases the number of observations again and yields negative effects of being *de jure* subject to the law on child labor for both sub-samples of children. These results should be interpreted with care, however, as controlling for location is necessary due to regional differences in the aptitude of officials to implement and educate about the law. For these reasons a linear probability model is employed to generate the main results but the findings using the Probit estimation technique are available from the author upon request. In addition, it may be the case that the error variances of children growing up in the same household are not independent from each other. Table E6 presented in Appendix E presents the main results for standard errors being clustered at the household level in the specification outlined in equation (4.1) and yields support for the main results reported in columns 1 and 2 of Tables 4.3 and 4.4.

not as straightforward.

We control for household characteristics, **H**, and children's characteristics, **X**. Regarding household characteristics, we control for gender of the household head, the head's age, family composition, ethnicity, knowledge of the 2003 Land Law, whether rice was cultivated on any of the household's plots during the previous three seasons, whether a member of the household is active in a women's union, whether the family receives private transfers, and maximum education among adults within the household.[21] Furthermore, we control for the natural logarithms of the value of durable goods and of the total size of all plots,[22] the distance to the nearest primary, lower and upper secondary schools. With respect to individual characteristics, we control for age and whether the child is the first-born child. Finally, we control for district fixed effects Φ in order to take into account geographical differences, especially regarding the behavior of officials, for example their willingness to implement the law or to inform rural households about its content.[23]

4.4.1 Child work

Table 4.3 reports the key results for participation in agricultural household production as the dependent variable, Table E5 in Appendix E includes more detail regarding the control variables in the main results. The findings consistently support our prior of a negative relationship between the 2003 Land Law and the involvement of girls in child labor. Column 1 reports the results of the main specification without household con-

[21] Note that the main results do not qualitatively change when $max\_years\_edu\_hh$ is substituted with either the years of education of the household head or his spouse. Results are not presented here but available from the author upon request.

[22] Substituting in the total number of plots that the household has rights to for ln_area_plots does not alter the main findings. The results of this exercise are not presented but available from the author upon request.

[23] Note that the main results, i.e. columns 1 and 2 of Tables 4.3 and 4.4 are largely supported when district fixed effects are not included. A summary of the coefficients of interest is presented in Table E7 in Appendix E. There is still consistent evidence that the law lowers the likelihood of girls to participate in agricultural household production and some evidence that it has a positive effect on the duration of their education. Interestingly, the exclusion of district fixed effects leads to a significant coefficient for the marginal effect of boys in columns 1 and 2: The law has a statistically significant and negative effect on the probability of boys being involved in agricultural child labor if location is not controlled for, even though the effect is smaller than for girls.

trols. Living in a household that is *de jure* subject to the 2003 Land Law does not have any effect on the likelihood of boys participating in agricultural household production, as the estimated coefficient on $LUC\_after2003$ is not statistically significant. The estimated coefficient on the dummy variable fem is positive and statistically significant, which suggests that girls are more likely to participate in agricultural household production than boys in the absence of the law. The estimated coefficient on the interaction term $LUC\_after2003 * fem$ is negative and statistically significant.

The lower panel of Table 4.3 reports the marginal effects of being *de jure* subject to the land law for girls, i.e. the sums of the estimated coefficients on $LUC\_after2003$ and on the interaction term, and the respective test statistics and p-values of the Wald test. The marginal effects for girls are negative and statistically significant, indicating that the 2003 Land Law reduces the likelihood of girls to participate in agricultural household production. This result supports the idea that the introduction of the land law may have shifted the balance of power within the household, giving greater bargaining power to women who in turn want to improve the outcomes of girls in order to mitigate existing gender inequalities among the children in the household. The results hold when household controls are included (column 2); The marginal effects for girls are negative and statistically significant. The land law, by reaffirming women's land rights, decreases the probability of girls to be involved in child labor by 14.0-15.2%.

In the next step we disentangle these effects from the possible endogeneity associated with the implementation of the 2003 Land Law at the household level. We exclude households from the sample that have registered at least one plot after the introduction of the 2003 Land Law *and* whose land use certificates bear both spouses' names. Put differently, we test for the effect of being subject to the 2003 Land Law on children's outcomes in the absence of law implementation at the household level. Implementation of the land law requires knowledge of the law as well as the willingness to explicitly request its application. Reducing the sample does not alter the results (column 3).

Table 4.3: Results for child work

	(1)	(2)	(3)	(4)	(5)	(6)
			HH_production			
LUC_after2003	-0.0406	-0.0473	-0.0681			
	[0.0450]	[0.0436]	[0.0545]			
LUC_after2003_reg				-0.0727	-0.0639	-0.0817
				[0.0468]	[0.0452]	[0.0603]
fem	0.0432*	0.0437*	0.0452*	0.0347	0.0360	0.0383*
	[0.0233]	[0.0233]	[0.0235]	[0.0219]	[0.0219]	[0.0226]
LUC_after2003*fem	-0.0997**	-0.105**	-0.131**			
	[0.0459]	[0.0446]	[0.0566]			
LUC_after2003_reg*fem				-0.0947	-0.111*	-0.127
				[0.0605]	[0.0615]	[0.0810]
Marginal effect for girls	-0.1404	-0.1518	-0.1987	-0.1674	-0.1754	-0.2084
F-statistic	16.12	14.99	16.20	12.00	13.21	15.14
p-value	0.0001	0.0002	0.0001	0.0007	0.0004	0.0002
Household controls	No	Yes	Yes	No	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Restricted	Full	Full	Restricted
N	1294	1294	1212	1294	1294	1212
R^2	0.117	0.166	0.171	0.119	0.166	0.169

Note: Robust standard errors in brackets.

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

A potential concern is that our findings for child labor may be driven by plot acquisition rather than by plot registration under the 2003 Land Law. We introduce a modified measure of being *de jure* subject to the land law to the specification presented in equation (4.1). The dummy variable $LUC\_after2003\_reg$ takes value one if the household has registered a plot after 2003 but has not acquired additional plots over that period and zero otherwise. This variation in the definition of our key explanatory variable is a first attempt to disentangle the effects of plot acquisition from those of plot registration under the law. We will return to this issue in more detail in Section 4.5. The results presented in the last three columns of Table 4.3 confirm our previous findings with respect to the effect of the 2003 Land Law. The law decreases the probability of girls being involved in child labor but does not impact on the work participation rates of boys, when excluding and including household controls (columns 4 and 5, respectively) and in the reduced sample (column 6). Consequently, there is evidence that the land law positively affects the outcomes of girls with respect to child labor, while no impact is found for boys, thus mitigating gender inequality.

4.4.2 Educational attainment

In this section we present results for the duration of education in years as the dependent variable for the sample of children between the ages of 11 and 18 years, i.e. above primary schooling age, living in a household whose head is married. The key results are reported in Table 4.4, the marginal effects for girls are again given in the lower panel. More detail on the control variables in the main results is presented in Table E5 in Appendix E.

Columns 1 and 2 present the results of the main specification as outlined in equation (4.1), when excluding and including household controls. The 2003 Land Law does not have any effect on the duration of education for boys, and in the absence of the land law, the duration of education is not significantly different between boys and girls with respect to statistical significance, although the estimated coefficient on fem is negative.

Table 4.4: Results for educational attainment

	(1)	(2)	(3)	(4)	(5)	(6)
			years_edu			
LUC_after2003	-0.300	-0.359	-0.461			
	[0.797]	[0.818]	[0.942]			
LUC_after2003_reg				-0.748	-0.876	-0.892
				[0.891]	[0.896]	[1.099]
fem	-0.358	-0.324	-0.401	-0.364	-0.334	-0.385
	[0.397]	[0.378]	[0.384]	[0.389]	[0.371]	[0.383]
LUC_after2003*fem	0.886	1.023	2.438***			
	[0.784]	[0.790]	[0.880]			
LUC_after2003_reg*fem				1.282	1.498	2.598**
				[0.970]	[0.981]	[1.105]
Marginal effect for girls	0.5863	0.6637	1.9778	0.5342	0.6222	1.7068
F-statistic	0.74	1.00	4.84	0.53	0.74	3.63
p-value	0.3922	0.3203	0.0300	0.4684	0.3929	0.0595
Household controls	No	Yes	Yes	No	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Restricted	Full	Full	Restricted
N	444	444	429	444	444	429
R^2	0.132	0.233	0.245	0.133	0.235	0.243

Note: Robust standard errors in brackets.

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

The 2003 Land Law does not have any statistically significant impact on educational attainment for girls if household controls are excluded from the specification (column 1) or included (column 2).

In column 3 we restrict the sample in the same fashion as in Table 4.3, i.e. we exclude households that have registered at least one plot after 2003 and whose LUC reports the names of both spouses. The estimated coefficient on the interaction term $LUC\_after2003 * fem$ is positive and statistically significant. The marginal effect of the 2003 Land Law on the educational attainment of girls is positive and statistically significant. It indicates an additional two years of education if they live in a household that has registered a plot after the introduction of the 2003 Land Law, conditional on not having implemented it.

The findings are comparable when the alternative measure $LUC\_after2003\_reg$ is considered. The marginal effect for girls is only statistically significant if households that have implemented the law are excluded (column 6). It should be noted that these effects for the duration of girls' education are very large, but on the other hand not very robust so they should be understood as limited evidence for an effect of the 2003 Land Law on the educational attainment of girls. No effect of the 2003 Land Law on the educational attainment of boys is found.

4.5 Robustness Checks

We conduct three types of robustness checks to rule out that possible concurrent factors are driving the results found in Section 4.4. First, given that the 2003 Land Law reinforces equal rights for both spouses on each plot acquired during marriage due to the existence of one LUC per household listing all plots with rights, we restrict the sample to couples who were with certainty married before registering at least one plot under the 2003 Land Law. Second, we disentangle the effects of plot acquisition from the effects of plot registration under the 2003 Land Law. Finally, we examine the effects of plot registration in absence of the 2003 Land Law. The robustness checks strongly

support the main findings with respect to child work: The 2003 Land Law leads to a lower likelihood of girls participating in agricultural household production.

4.5.1 Restricted sample

In the analysis presented in Section 4.4 we have focused on the effects of the 2003 Land Law on children living with a married household head and have assumed that the household head was married prior to registering the latest acquired plot. This assumption is reasonable considering that out of wedlock childbearing is uncommon in Vietnam (Friedman et al., 2003)[24] and that the youngest children included in our sample were born in 2002, i.e. before the introduction of the Land Law.[25] The Vietnam Access to Resources Household Survey (VARHS) as well as the Vietnamese Household Living Standards Survey (VHLSS) contain information regarding current marital status, but not on marital history. Given the overlap in the samples of the VHLSS and the VARHS, we combine the information contained in the 2004 VHLSS and the 2006 and 2008 VARHS to restrict the sample to children living in households whose head was with certainty married before having registered at least one plot on the land use certificate.[26] By doing so, we adopt a conservative approach and exclude children living in a household that is not with certainty subject to the 2003 Land Law because of the possibility of exclusive ownership of all plots by one spouse.

Columns 1 and 2 of Table 4.5 report the estimation results for participation in agri-

[24] While the children in our sample are only selected on the basis of age to include effects on children who may not be biological children of the household head whose family they live in, the large majority of children in our sample are the biological children of the household head. Specifically, this is the case for 89.4% of the children in the work sample and for 96.2% in the sample used for the investigation of the effect of the law on educational outcomes. Note that the main results do not qualitatively change if the sample is restricted to biological children of the household head; The results are available from the author upon request.

[25] According to the 2000 Marriage and Family Law land use rights acquired during marriage are generally considered jointly owned by the spouses (The National Assembly of the Socialist Republic of Viet Nam, 2000).

[26] We restrict the 2008 VARHS sample to include households whose heads were married in 2004 according to the 2004 VHLSS and who registered at least one plot after 2004, and to households whose heads were married in 2006 according to the 2006 VARHS and registered at least one plot after 2006. It is not possible to establish the sequence of events for all households due to the lack of information regarding the specific dates, which results in a loss of observations beyond the one intended by the restriction criteria.

Table 4.5: Child work and educational attainment - Restricted sample

	(1)	(2)	(3)	(4)
	HH_production		years_edu	
LUC_after2003	-0.173	-0.131	-1.324	-3.261
	[0.107]	[0.0839]	[1.139]	[2.438]
fem	0.00882	0.0213	-0.466	-0.744
	[0.0447]	[0.0485]	[0.463]	[1.004]
LUC_after2003*fem	-0.0522	-0.111	1.990**	2.426
	[0.0751]	[0.0705]	[0.874]	[1.467]
Marginal effect for girls	-0.2255	-0.2411	0.6664	-0.8349
F-statistic	5.27	8.75	0.27	0.30
p-value	0.0241	0.0040	0.6089	0.5860
Household controls	No	Yes	No	Yes
Individual controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Sample	Age 6-14		Age 11-18	
N	367	367	99	99
R^2	0.125	0.266	0.093	0.356

Note: Robust standard errors in brackets.

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

cultural household production as the dependent variable following the specification outlined in equation (4.1) in the conservatively restricted sample. In line with our previous findings, being *de jure* subject to the 2003 Land Law reduces the likelihood of girls to participate in agricultural household production. The lower panel of Table 4.5 presents the marginal effects for girls: the negative effect of the 2003 Land Law on girls' work rates is statistically significant when household controls are excluded (column 1) and included (column 2). We do not find any statistically significant effects for boys or evidence of gender inequality among children in absence of the law with respect to participation in agricultural household production.

Columns 3 and 4 report the results for the duration of education in years as the dependent variable, the marginal effects for girls are presented in the lower panel. We do not find evidence for an effect of the land law on the duration of education for boys or girls, or for gender inequality in this restricted sample.

4.5.2 Plot acquisition as the driving factor?

Bar and Basu (2009) and Basu et al. (2010) show, both theoretically and empirically, that the relationship between child labor and plot acquisition exhibits an inverted U-shape. As a next step in our robustness checks, we disentangle the effects of the 2003 Land Law from the effects of plot acquisition. We introduce the variable $plot\_after2003$, which takes a value of one if the household has acquired a plot after 2003, and zero otherwise. The rationale for this exercise is to ensure that the main findings are the result of plot registration under the 2003 Land Law and not driven by the acquisition of an additional plot. We amend equation (4.1) by replacing $LUC\_after2003$ with $plot\_after2003$, also in the interaction term.

If plot acquisition is not the driving factor of the reduction in the likelihood of girls to participate in agricultural household production, the estimated marginal effects for girls should not be statistically significant. Table 4.6 reports the results of this exercise. None of the estimated coefficients are statistically significant for participation in

agricultural household production being the dependent variable for both boys or girls, which indicates that there is no statistically significant impact of land acquisition on children's participation in agricultural household production in our sample, excluding or including household controls (columns 1 and 2, respectively).

Table 4.6: Child work and educational attainment - Plot acquisition effects

	(1)	(2)	(3)	(4)
	HH_production		years_edu	
plot_after2003	0.00816	-0.00973	1.308**	1.210**
	[0.0476]	[0.0447]	[0.645]	[0.565]
fem	0.0220	0.0190	0.155	0.208
	[0.0254]	[0.0257]	[0.412]	[0.408]
plot_after2003*fem	0.00400	0.0160	-1.904**	-1.960***
	[0.0581]	[0.0579]	[0.732]	[0.727]
Marginal effect for girls	0.0122	0.0063	-0.5955	-0.7506
F-statistic	0.09	0.02	0.82	1.69
p-value	0.7600	0.8769	0.3679	0.1963
Household controls	No	Yes	No	Yes
Individual controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Sample	Age 6-14		Age 11-18	
N	1294	1294	444	444
R^2	0.108	0.156	0.150	0.250

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

Columns 3 and 4 present the estimation results for educational attainment as the dependent variable. We find a statistically significant and positive effect of plot acquisition on the duration of education for boys, which may be the result of a wealth or income effect. Specifically, boys gain slightly over one additional year of education if a plot has been acquired after 2003. The estimated coefficient of the interaction term $plot\_after2003 * fem$ is negative and also statistically significant. However, the marginal effects for girls are not statistically significant; we can therefore conclude that plot acquisition is not the driving force behind the limited effects of the 2003 Land Law on the educational attainment of girls found in Section 4.4.

4.5.3 Plot registration as the driving factor?

In order to isolate the effects of the 2003 Land Law from the effects of plot registration *per se*, we take advantage of the panel structure of the VARHS and employ the data of the round of the survey conducted in 2006. We use the econometric specification presented in equation (4.1) and go back by two years in every respect, i.e. for the dataset as well as for the definition of the main explanatory variable. The idea is to isolate the impact of the land law on child labor by considering the effect of land use certificates (re)issued after 2001, instead of land use certificates (re)issued after 2003. The new variable $LUC\_after2001$ takes value one if at least one plot was registered after 2001 but none after 2003, i.e. not after the 2003 Land Law effectively came into effect, and zero otherwise.[27] If the effect found for children's outcomes is indeed related to the introduction of the 2003 Land Law, we should not observe any evidence of a statistically significant impact of the variable $LUC\_after2001$ on child work or the duration of education for girls.

For neither boys nor girls are the marginal effects of registering a plot after 2001 and before 2004 on their likelihood of participating in agricultural household production statistically significant as shown in columns 1 and 2 of Table 4.7, which rules out that the effects found for girls in Section 4.4 are driven by the mere registration of a plot rather than by registration under the 2003 Land Law.

Columns 3 and 4 present the results for the duration of education as the dependent variable, excluding and including household controls, respectively. As the estimated coefficient on $LUC\_after2001$ is statistically insignificant, registration of an additional plot after 2001 and before 2004 does not have any effect on the duration of education for boys. Furthermore, none of the marginal effects for girls are statistically significant, thus ruling out that the limited effects on the educational attainment of girls presented

[27] Note that the main results are not sensitive to using a comparable definition of the main explanatory variable, i.e. if $LUC\_after2003$ takes a value of one if at least one plot was registered after 2003 but none after 2005. This alternative specification furthermore ensures that our main findings can be attributed to the 2003 Land Law and are not driven by the gender equality law that was implemented in 2007. The results are not presented here but available from the author upon request.

Table 4.7: Child work and educational attainment - Plot registration effects

	(1)	(2)	(3)	(4)
	HH_production		years_edu	
LUC_after2001	0.0465	0.0377	0.619	0.517
	[0.0526]	[0.0517]	[0.451]	[0.494]
fem	-0.00655	-0.00727	-0.149	-0.112
	[0.0176]	[0.0179]	[0.213]	[0.196]
LUC_after2001*fem	-0.0282	-0.0190	-0.0485	-0.127
	[0.0556]	[0.0525]	[0.586]	[0.547]
Marginal effect for girls	0.0183	0.0186	0.5704	0.3896
F-statistic	0.23	0.21	1.45	1.08
p-value	0.6302	0.6491	0.2309	0.3013
Household controls	No	Yes	No	Yes
Individual controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Sample	Age 6-14		Age 11-18	
N	1847	1847	1167	1167
R^2	0.191	0.224	0.242	0.332

Note: Robust standard errors in brackets. Data from the 2006 VARHS.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

in Section 4.4 are due to mere plot registration.

4.6 Conclusions

A growing strand of the literature on household economics has analyzed the impact of the gender of income recipients on children's outcomes. Furthermore, the effects and implications of laws and reforms in developing countries aimed at strengthening women's rights have been the topic of recent studies. Departing from this literature, we study how reinforcing women's rights to land affects child labor and the educational attainment of children. On the basis of a recent Vietnamese land law and with the help of household survey data, we demonstrate empirically that the introduction of laws that reinforce joint land titling of both the household head and his spouse has positive effects on the outcomes of girls living in households that are part of the target population of this law.

We provide robust evidence in favor of a negative association between legal exposure to the land law and the likelihood of girls to participate in agricultural household production. The 2003 Land Law decreases the probability of child labor among girls by approximately 15% according to our main results. Furthermore, we find some evidence for a positive impact of the law on the duration of education for girls. We do not find comparable effects for boys.

In absence of the law, girls are found to be more likely to play an active role in agricultural household production while no evidence is found for gender inequality with respect to educational attainment. It therefore appears that the increased bargaining power of women brought about by the 2003 Land Law can at least partly mitigate existing gender inequalities in work rates among children and may translate into enhanced educational attainment for girls only.

The robustness checks support the main findings: the effects found for girls can be attributed to the 2003 Land Law, ruling out other concurrent driving factors. In particular, we use a sub-sample of children living in households that are with certainty

part of the population targeted by the 2003 Land Law in order to exclude exclusive ownership of land use rights by one spouse. Furthermore, we ensure that neither the acquisition nor the mere registration of an additional plot acts as the driving factor instead of land registration under the law. By employing a previous round of the survey, we are able to study the impact of plot registration on children's outcomes *before* the introduction of the 2003 Land Law.

According to our findings, the introduction of laws aiming to strengthen the position of women within the household by visibly stating existing equal land use rights of spouses positively impacts on the outcomes of girls, especially regarding their involvement in child labor, by changing customary rules.

Chapter 5

Conclusions

5.1 Conclusions to the Thesis and Policy Implications

The purpose of this thesis is to enhance the understanding of family structures, bargaining processes and the control over family income within marital unions in the developing world.

Chapter 2 studies the formation of polygamous family structures to explain why first wives are generally found to attract larger shares of family income. As a complementary explanation to different levels of bargaining power originating from the position among wives, a selection effect is proposed in which highly productive women are more strongly demanded in the marriage market and are therefore more likely to become first wives. Furthermore, highly productive wives, who are relatively likely to be first wives, attain a higher share of the family's income due to higher contributions in its production and due to larger outside options when not married. This paper therefore demonstrates that polygamous families should not be treated as one family for the purposes of aid or interventions aiming to increase the educational attainment of children, but rather as a collection of nuclear families, consisting of polygamously married women and their children. Special attention should, in addition, be paid to children of junior wives, who are often at a disadvantage compared to those of first wives.

Chapter 3 investigates another aspect of partner choice: the tradition of marriage within ethnic groups, even if spouses are from different locations. It is proposed that,

due to more efficient co-operation among co-ethnics, ethnically homogamous couples achieve larger agricultural outputs so that intra-ethnicity marriage is a preferred strategy. Due to frictions in the marriage market leading to larger difficulties of finding a co-ethnic spouse in minority ethnic groups, the latter exhibit a higher prevalence of inter-ethnicity marital unions. The tradition of ethnically homogamous marriage may have evolved as a strategy to secure livelihoods. Thus, families based on a marriage of the household head to a non-co-ethnic should be paid special attention to for the purposes of the provision of aid or interventions aiming to increase agricultural productivity. Furthermore, in settings where adherence to the tradition is difficult, for example due to displacement or forced migration, co-operation between non-co-ethnic spouses may be facilitated with the help of information or training. Furthermore, as members of minority groups are more likely to marry a non-co-ethnic and as this is associated with lower family income, the situation may be even more severe if minority members are generally at a disadvantage compared to members of the majority with respect to income or access to production inputs. Households involving a heterogamous marriage of the household head should therefore receive special attention from programs attempting to increase agricultural productivity.

Chapter 4 discusses the effect of reforms aiming to reinforce female rights for the allocation of family resources. The Vietnamese land law of 2003 changed the custom towards more gender equality and succeeded at strengthening the female bargaining position, as measured by better outcomes of children, within families belonging to the target population of the law. It is shown that, even though the law is only implemented in a fraction of the concerned households, families in which the wife has a right to equally stated land rights as the household head and, consequently, the implementation of the law, girls are less likely to be involved in child work and exhibit higher educational outcomes, while no comparable effect is found for boys. This paper, however, also illustrates the need for uniform and mandatory implementation of reforms of this kind. Women should not have to be in a relatively powerful position to have the

law implemented by officials, but implementation should be automatic to strengthen especially those women who are not in a position to request that both names be put on the land use certificate.

5.2 Future Research Directions

With respect to the framework developed in Chapter 2, an extension incorporating non-constant male productivity would be informative, also regarding the formation of polygamous versus monogamous marital unions. Overall, the main predictions would not change but, if men differed by a substantial amount, remaining single in the first period and becoming the second wife of a relatively productive man could be a profitable strategy for women. In addition, this would explain which men and women self-select into polygamous unions as only relatively productive men would be able to attract more than one wife. With respect to the interplay between female productivity, rank, and attracted shares of family income, it would be helpful to test the theoretical framework in experiments in the field. The setup would be comparable to the one proposed by Munro et al. (2010) but introducing female productivity to the game in order to disentangle the effects of rank and productivity. The proceeds of a production process generated by a polygamous marital structure, i.e. a man and at least two wives, and cash received in the form of a gift would secretly be allocated by the household head. The predictions of the model would be confirmed if the difference in the shares of female income received would be greater (with the first wife attracting the largest share) when female productivity played a role in the production process as opposed to the case of windfall income received by the family.

Despite there being a vast amount of research on the implications of ethnic diversity at different levels as laid out in Chapter 3, there are questions at the microeconomic level that have not been addressed yet to the best of my knowledge. Regarding the framework developed in this paper, a possible avenue for research is the role of mixed-ethnicity individuals, i.e. the offspring of inter-ethnicity couples, in societies.

Communities with a large share of members of mixed ethnicity may, for example, be less affected by the negative effects of ethnic diversity than those with two or more distinct groups that have not integrated. Due to their affiliation with two ethnicities, mixed-ethnicity individuals may share production technologies and preferences with two ethnic groups so that efficient co-operation may be possible for them with a larger absolute number of individuals. This may enhance economic performance, and possibly the provision of public goods, also at a more aggregate level than the household. A concern here is endogeneity so that the existence of individuals of mixed ethnicity would have to be induced by an exogenous event, for example involuntary migration.

The findings of Chapter 4 would ideally be supported with data from other countries that have undergone a similar land reform in order to inform policy making and confirm the notion that equal land titling strengthens a wife's position within the family. Optimally, comparable results would be found in countries in which the visible statements of land rights is not only compulsory but also strictly enforced so that exogenous assignment to the implementation of the law is present. From a research perspective this would, furthermore, be interesting in a case where land rights are initially held by one spouse only and a reform assigns equal rights by titling the land jointly. Given suitable data, an investigation of the effect of these reforms on the distribution of bargaining power with outcome variables additional to the ones used here, for example the shares of income spent on different commodities like nutrition, education, luxury goods, and medication, on self-reported bargaining power, and on the likelihood of domestic abuse, would be informative.

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Appendix

A Appendix to Chapter 2: The matching process with more type $\bar{p}$ women than men

As the matching of spouses outlined in Section 2.2.3 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 2.2 so that there may be more type $\bar{p}$ women than men. Furthermore, let there be some type $\underline{p}$ women:

Assumption A.1. $N < \bar{F} < F$.

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 Appendix to Chapter 2: Tables

Table B1: Summary statistics for polygamous households

	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 B2: 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	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 B3: 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 B4: 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 B5: 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 B6: 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.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C Appendix to Chapter 3: Relaxing Assumption 3.5

If the probabilities of the income from heterogamous marriage in period 1 being at least as big as the expected income from period 2 are equal to zero, $m_i = 0$ for $i = A, B$, and equation (3.9) changes to:

$$\delta_{A2} = \frac{(1-\delta_A)E_A}{(1-\delta_A)E_A + (1-\delta_B)E_B} = \frac{1}{2}$$

and analogously for δ_{B2}. Similarly, comparing δ_{A2} and δ_{B2} reduces to comparing the numerators as the denominators are identical:

$$\begin{aligned}(1-\delta_A)E_A &\gtreqless (1-\delta_B)E_B \\ \delta_A(1-\delta_A)(E_A+E_B) &\gtreqless \delta_B(1-\delta_B)(E_A+E_B) \\ \delta_{A2} &= \delta_{B2}\end{aligned}$$

so the probabilities of being matched to a co-ethnic are identical across groups in the second period. However, as $\delta_A > \delta_B$ by definition, the probability of heterogamous marriage over both periods is higher in group B, which confirms the findings of Section 3.3.3.

On the other hand, if these probabilities are equal to one, all individuals propose marriage in period 1, irrespective of whether they are matched to a co-ethnic or not, which results in the total prevalence of heterogamous marriage in group i simply being equal to $(1-\delta_i)$. Consequently, members of the minority group have a higher chance of heterogamous marriage also in this case as $\delta_A > \delta_B$.

Furthermore, the findings also hold if only $m_A = 0$ and $0 < m_B \leqslant 1$ or if the probability of income from heterogamous marriage in period 1 being at least as big as the expected income from period 2 is equal to one only for group A. The reverse cases, however, are not feasible as δ_{A2} may not be smaller than δ_{B2} due to Assumption 3.6.[1]

[1]The results for these special cases are not presented but available from the author upon request.

D Appendix to Chapter 3: Tables

Table D1: Summary statistics of basic control variables

	mean	difference	min	p50	max	sd	N
parent_choice*	0.392	0.100*	0	0	1	0.488	659
parent_choice#	0.291		0	0	1	0.457	79
talk_beforemarriage*	0.353	-0.052	0	0	1	0.478	659
talk_beforemarriage#	0.405		0	0	1	0.494	79
same_village_spouse*	0.392	0.202***	0	0	1	0.488	659
same_village_spouse#	0.19		0	0	1	0.395	79
no_years_married*	20.017	-2.123	0	19	87	13.229	659
no_years_married#	22.139		1	20	70	15.477	79
age_gap_spouses*	9.538	0.880	-20	9	40	7.828	659
age_gap_spouses#	8.658		-12	7	44	7.893	79
no_children*	4.334	-0.135	0	4	16	2.48	659
no_children#	4.468		0	4	11	2.541	79
school_head*	0.314	-0.015	0	0	1	0.465	659
school_head#	0.329		0	0	1	0.473	79

Note: As in Section 3.3, superscripts $*$ and $\#$ denote the concerned variable for homogamous and heterogamous couples, respectively. 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 D2: Summary statistics of control variables related to economic well-being

	mean	difference	min	p50	max	sd	N
wealth_parents_head*	2.994	0.032	1	3	5	0.772	659
wealth_parents_head#	2.962		1	3	5	0.898	79
wealth_parents_spouse*	2.991	-0.085	1	3	5	0.812	659
wealth_parents_spouse#	3.076		1	3	5	0.781	79
total_plotarea*	2.424	-0.683	0.0002	1.625	27.35	2.605	659
total_plotarea#	3.107		0.125	1.75	27.125	3.892	79
total_plotarea_r1*	2.033	-0.829**	0	1.3125	17.4375	2.134	659
total_plotarea_r1#	2.862		0	1.75	17.5	2.909	79
value_livestock*	2741.983	-605.479*	3	1900	31390	3333.558	659
value_livestock#	3347.462		4	2100	10685	2986.089	79
value_livestock_r1*	2467.558	-956.172**	0	1310.75	141074.2	6052.207	659
value_livestock_r1#	3423.729		0	2140	13321.5	3465.173	79

Note: As in Section 3.3, superscripts $*$ and $\#$ denote the concerned variable for homogamous and heterogamous couples, respectively. 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 D3: Results for levels of livestock holdings

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_value_livestock					
eth_diff	0.0648	0.111	0.143	0.0987	0.118	0.0853
	[0.0928]	[0.0944]	[0.101]	[0.0945]	[0.0904]	[0.0926]
parent_choice	0.222***	0.125*	0.107	0.194***	0.0834	0.0842
	[0.0652]	[0.0649]	[0.0658]	[0.0652]	[0.0665]	[0.0666]
talk_beforemarriage	-0.0952	-0.0439	-0.0527	-0.0467	-0.00928	-0.0119
	[0.0732]	[0.0740]	[0.0743]	[0.0761]	[0.0760]	[0.0770]
same_village_spouse	-0.00779	-0.0669	-0.0487	-0.00318	-0.0898	-0.0828
	[0.0696]	[0.0669]	[0.0691]	[0.0712]	[0.0686]	[0.0682]
no_years_married	0.00456*	0.00593**	0.00611**	0.00501**	0.00645***	0.00666***
	[0.00240]	[0.00243]	[0.00242]	[0.00242]	[0.00236]	[0.00239]
ln_total_plotarea	0.216***	0.198***	0.193***	0.199***	0.195***	0.207***
	[0.0599]	[0.0606]	[0.0601]	[0.0592]	[0.0672]	[0.0678]
school_head	0.149**	0.170**	0.172**	0.163**	0.213***	0.211***
	[0.0677]	[0.0663]	[0.0667]	[0.0682]	[0.0663]	[0.0671]
ln_value_livestock_r1	0.470***	0.450***	0.461***	0.462***	0.417***	0.413***
	[0.0505]	[0.0514]	[0.0509]	[0.0515]	[0.0564]	[0.0563]
Ethnicity FE	No	Yes	Yes	No	Yes	No
Religion FE	No	No	Yes	Yes	No	No
Region FE	No	No	No	No	Yes	Yes
N	667	667	667	667	667	667
R^2	0.417	0.453	0.457	0.425	0.473	0.466

Note: Robust standard errors in brackets. *wealth_parents_head*, *wealth_parents_spouse*, *age_gap_spouses* and *no_children* are included but statistically insignificant in all specifications.

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

Table D4: Results for assets brought to marriage I

	(1)	(2)	(3)	(4)
eth_diff	0.134	0.0971	0.0570	0.0370
	[0.159]	[0.159]	[0.166]	[0.172]
parent_choice	-0.191*	-0.173	0.176	0.156
	[0.105]	[0.106]	[0.112]	[0.116]
talk_beforemarriage	0.151	-0.0221	-0.282**	0.0535
	[0.105]	[0.106]	[0.115]	[0.117]
same_village_spouse	-0.264***	-0.403***	0.260**	0.0750
	[0.0992]	[0.101]	[0.105]	[0.108]
no_years_married	-0.0190***	-0.0123***	-0.00945**	0.00509
	[0.00435]	[0.00382]	[0.00422]	[0.00387]
age_gap_spouses	0.0160**	0.00968	-0.00225	-0.00509
	[0.00655]	[0.00636]	[0.00662]	[0.00631]
wealth_parents_head	0.00340	0.00464	0.0837	-0.0657
	[0.0639]	[0.0618]	[0.0667]	[0.0690]
wealth_parents_spouse	0.0768	0.0430	0.0814	0.00220
	[0.0613]	[0.0599]	[0.0660]	[0.0632]
school_head	0.128	-0.162	-0.0363	0.309***
	[0.105]	[0.104]	[0.113]	[0.110]
N	736	725	715	735
Chi-squared	43.94	32.74	23.47	13.56
Pseudo R-squared	0.0575	0.0348	0.0297	0.0164

Note: Robust standard errors in brackets. Binary dependent variables and probit estimation in all columns. Dependent variables: (1) land brought into marriage by groom, (2) household utensils brought into marriage by groom, (3) livestock brought into marriage by bride, (4) land received upon marriage. No fixed effects; Results mostly robust to inclusion of ethnicity, religion and region dummy variables.

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

Table D5: Results for assets brought to marriage II

	(1)	(2)	(3)	(4)
eth_diff	0.335**	0.358**	0.452***	0.311*
	[0.169]	[0.163]	[0.168]	[0.177]
parent_choice	-0.412***	-0.146	0.384***	0.240*
	[0.104]	[0.105]	[0.110]	[0.123]
talk_beforemarriage	-0.0621	-0.252**	-0.234**	-0.225*
	[0.105]	[0.105]	[0.107]	[0.129]
same_village_spouse	-0.285***	-0.104	0.0164	0.0990
	[0.0993]	[0.0980]	[0.101]	[0.119]
no_years_married	-0.0141***	-0.00627*	-0.0111***	0.00951**
	[0.00396]	[0.00370]	[0.00383]	[0.00420]
age_gap_spouses	0.0326***	0.0176***	0.000301	-0.0117*
	[0.00692]	[0.00643]	[0.00661]	[0.00709]
wealth_parents_head	-0.00808	0.182***	0.156**	0.0808
	[0.0615]	[0.0623]	[0.0639]	[0.0737]
wealth_parents_spouse	0.0773	0.0107	0.0303	-0.0219
	[0.0608]	[0.0587]	[0.0616]	[0.0708]
school_head	-0.0550	-0.0245	0.153	0.126
	[0.105]	[0.104]	[0.110]	[0.122]
N	735	736	728	688
Chi-squared	57.36	31.32	41.31	24.51
Pseudo R-squared	0.0716	0.0335	0.0458	0.0379

Note: Robust standard errors in brackets. Binary dependent variables and probit estimation in all columns. Dependent variables: (1) house brought into marriage by groom, (2) livestock brought into marriage by groom, (3) jewelery brought into marriage by groom, (4) livestock received upon marriage. No fixed effects; Results mostly robust to inclusion of ethnicity, religion and region dummy variables.

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

Table D6: Results for levels of asset holdings, *_r1* controls

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_value_assets					
eth_diff	-0.271**	-0.289**	-0.208*	-0.212*	-0.299**	-0.313**
	[0.124]	[0.123]	[0.124]	[0.122]	[0.124]	[0.122]
talk_beforemarriage	0.191**	0.193**	0.168*	0.163*	0.206**	0.204**
	[0.0913]	[0.0883]	[0.0895]	[0.0895]	[0.0860]	[0.0865]
same_village_spouse	-0.435***	-0.398***	-0.356***	-0.351***	-0.337***	-0.331***
	[0.0824]	[0.0840]	[0.0827]	[0.0804]	[0.0840]	[0.0843]
age_gap_spouses	-0.0101**	-0.00791*	-0.00864*	-0.00888**	-0.00510	-0.00582
	[0.00446]	[0.00444]	[0.00447]	[0.00443]	[0.00435]	[0.00431]
ln_total_plotha_r1	-0.0324	-0.0426	-0.0362	-0.0211	-0.00546	0.00663
	[0.0298]	[0.0343]	[0.0353]	[0.0323]	[0.0370]	[0.0371]
ln_value_livestock_r1	0.0555	0.0620*	0.0859**	0.0909**	0.0918**	0.0862**
	[0.0363]	[0.0370]	[0.0380]	[0.0376]	[0.0360]	[0.0360]
no_children	0.0381**	0.0282	0.0334**	0.0320*	0.0293*	0.0254
	[0.0172]	[0.0175]	[0.0168]	[0.0167]	[0.0178]	[0.0179]
ln_value_assets_r1	0.274***	0.291***	0.286***	0.286***	0.225***	0.235***
	[0.0320]	[0.0312]	[0.0308]	[0.0307]	[0.0330]	[0.0327]
Ethnicity FE	No	Yes	Yes	No	Yes	No
Religion FE	No	No	Yes	Yes	No	No
Region FE	No	No	No	No	Yes	Yes
N	685	685	684	684	685	685
R^2	0.224	0.256	0.279	0.276	0.316	0.304

Note: Robust standard errors in brackets. *parent_choice*, *no_years_married*, *wealth_parents_head* and *school_head* are included but statistically significant in all specifications. *wealth_parents_spouse* is included and positive and statistically significant at the 5%-level in only two columns.

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

Table D7: Results for levels of asset holdings for ethnic majorities

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_value_assets					
eth_diff	-0.106	-0.140	-0.0408	-0.0458	-0.305*	-0.311**
	[0.155]	[0.157]	[0.159]	[0.160]	[0.158]	[0.154]
talk_beforemarriage	0.374***	0.354***	0.302***	0.316***	0.380***	0.377***
	[0.115]	[0.110]	[0.110]	[0.108]	[0.107]	[0.107]
same_village_spouse	-0.498***	-0.439***	-0.374***	-0.411***	-0.329***	-0.339***
	[0.0975]	[0.100]	[0.0982]	[0.0957]	[0.100]	[0.100]
age_gap_spouses	-0.0169***	-0.0145***	-0.0133**	-0.00661	-0.0127**	-0.0131***
	[0.00513]	[0.00507]	[0.00517]	[0.00664]	[0.00501]	[0.00500]
ln_total_plotarea	-0.0450	-0.0616	-0.0737*	-0.0617	-0.0865**	-0.0864**
	[0.0434]	[0.0440]	[0.0429]	[0.0416]	[0.0402]	[0.0401]
ln_value_livestock	0.185***	0.205***	0.229***	0.224***	0.222***	0.226***
	[0.0480]	[0.0463]	[0.0461]	[0.0461]	[0.0470]	[0.0473]
no_children	0.0647***	0.0478**	0.0481**	0.0432**	0.0553***	0.0516**
	[0.0214]	[0.0214]	[0.0208]	[0.0210]	[0.0211]	[0.0212]
ln_value_assets_r1	0.206***	0.228***	0.253***	0.251***	0.181***	0.194***
	[0.0369]	[0.0367]	[0.0361]	[0.0358]	[0.0387]	[0.0369]
Ethnicity FE	No	Yes	Yes	No	Yes	No
Religion FE	No	No	Yes	Yes	No	No
Region FE	No	No	No	No	Yes	Yes
N	497	497	497	497	497	497
R^2	0.246	0.280	0.306	0.309	0.313	0.308

Note: Robust standard errors in brackets. *parent_choice*, *no_years_married*, *wealth_parents_head* and *school_head* are included but statistically insignificant in all specifications. *wealth_parents_spouse* is included and positive and statistically significant in all columns.

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

Table D8: Results for levels of asset holdings for ethnic minorities

	(1)	(2)	(3)
	ln_value_assets		
eth_diff	-0.398**	-0.327*	-0.203
	[0.176]	[0.183]	[0.165]
same_village_spouse	-0.202	-0.189	-0.266**
	[0.124]	[0.119]	[0.121]
age_gap_spouses	-0.00400	-0.00478	-0.000785
	[0.00728]	[0.00740]	[0.00696]
ln_total_plotarea	0.140***	0.155***	0.0780
	[0.0484]	[0.0493]	[0.0570]
ln_value_livestock	-0.0651	-0.0387	0.0328
	[0.0424]	[0.0411]	[0.0428]
no_children	-0.00384	-0.00504	0.00122
	[0.0230]	[0.0232]	[0.0257]
school_head	0.239*	0.219*	0.128
	[0.129]	[0.128]	[0.121]
ln_value_assets_r1	0.364***	0.327***	0.257***
	[0.0445]	[0.0441]	[0.0508]
Religion FE	No	Yes	No
Region FE	No	No	Yes
N	241	241	241
R^2	0.314	0.347	0.451

Note: Robust standard errors in brackets. *parent_choice*, *no_years_married*, *wealth_parents_head*, *wealth_parents_spouse* and *talk_before_marriage* are included but statistically insignificant in all specifications.

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

E Appendix to Chapter 4: Tables

Table E1: Household summary statistics – Child work sample

	mean	min	p50	max	sd	N
LUC_after2003	0.188	0	0	1	0.391	846
LUC_after2003_reg	0.130	0	0	1	0.337	846
both_names_LUC	0.143	0	0	1	0.350	846
plot_after2003	0.214	0	0	1	0.410	846
fem_head	0.051	0	0	1	0.220	846
age_head	43.900	21	42	88	10.175	846
max_years_edu_hh	7.937	0	9	12	3.480	846
plots_total_rights	4.861	0	4	18	2.923	846
area_plots	10916.85	36	4750	326000	20396.6	846
rice	0.741	0	1	1	0.438	846
know_law	0.219	0	0	1	0.414	846
womens_union	0.624	0	1	1	0.485	846
transfer	0.307	0	0	1	0.462	846
value_durable	17625.04	0	8475	1044500	50381.3	846
number_children	2.604	1	2	9	1.132	846
couple_2k	0.306	0	0	1	0.461	846
couple_3k	0.233	0	0	1	0.423	846
couple_4k	0.182	0	0	1	0.386	846
dist_primary	2.730	0	1	1000	34.356	846
dist_secondary_lower	3.487	0	1.6	1000	34.378	846
dist_secondary_upper	9.742	0	6	90	11.515	846
kinh	0.691	0	1	1	0.462	846

Table E2: Household summary statistics – Education sample

	mean	min	p50	max	sd	N
LUC_after2003	0.117	0	0	1	0.321	343
LUC_after2003_reg	0.085	0	0	1	0.279	343
both_names_LUC	0.131	0	0	1	0.338	343
plot_after2003	0.195	0	0	1	0.397	343
fem_head	0.041	0	0	1	0.198	343
age_head	47.262	25	46	89	9.925	343
max_years_edu_hh	7.233	0	8	12	3.589	343
plots_total_rights	5.682	0	5	16	3.143	343
area_plots	11855.4	60	6516	227494	18741.88	343
rice	0.819	0	1	1	0.385	343
know_law	0.184	0	0	1	0.387	343
womens_union	0.513	0	1	1	0.501	343
transfer	0.262	0	0	1	0.441	343
value_durable	12156.13	0	5950	517000	31445.58	343
number_children	2.668	1	2	8	1.362	343
couple_2k	0.163	0	0	1	0.370	343
couple_3k	0.280	0	0	1	0.450	343
couple_4k	0.248	0	0	1	0.432	343
dist_primary	7.596	.1	1	1000	76.133	343
dist_secondary_lower	8.500	.1	2	1000	76.089	343
dist_secondary_upper	12.555	0	7	80	14.061	343
kinh	0.557	0	1	1	0.497	343

Table E3: Implementation of the 2003 Land Law

	(1)	(2)	(3)
	both_names_LUC		
know_law	0.00514	0.0537	0.0853*
	[0.0583]	[0.0518]	[0.0441]
fem_head	-0.00779	0.00143	-0.0114
	[0.100]	[0.0869]	[0.113]
age_head	-0.00109	0.000637	-0.000904
	[0.00264]	[0.00267]	[0.00380]
max_years_edu_hh	0.00217	0.00545	0.00374
	[0.0103]	[0.0112]	[0.00656]
rice	-0.253***	0.0150	-0.100**
	[0.0622]	[0.0804]	[0.0434]
womens_union	0.0871*	0.0435	0.102*
	[0.0521]	[0.0596]	[0.0522]
transfer	0.154***	0.136**	0.00933
	[0.0581]	[0.0631]	[0.0637]
couple_2k	-0.0314	0.0108	-0.0246
	[0.0687]	[0.0818]	[0.0568]
couple_3k	0.127	0.109*	0.0888
	[0.0800]	[0.0583]	[0.0922]
couple_4k	-0.0657	-0.0537	-0.111*
	[0.0837]	[0.0698]	[0.0557]
District FE	No	Yes	No
Province FE	No	No	Yes
N	302	302	302
R^2	0.130	0.056	0.075

Note: Robust standard errors in brackets. The observational unit is a household in which at least one plot has been registered on the LUC after the introduction of the 2003 Land Law. ln_area_plots, ln_value_assets, $kinh$ and binary variables for whether any relatives of the household head hold an office ($relative\_office$), and for whether the head or his spouse work in a privately owned company ($empl\_private\_comp$) are included in all columns but statistically insignificant.

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

Table E4: Registration after the 2003 Land Law

	(1)	(2)	(3)
	LUC_after2003		
know_law	0.0606	0.0376	0.0704
	[0.0646]	[0.0816]	[0.0474]
relative_office	-0.111*	-0.0491	-0.0885
	[0.0568]	[0.0747]	[0.0611]
fem_head	-0.162	-0.0432	-0.138
	[0.110]	[0.141]	[0.0892]
max_years_edu_hh	0.0194***	0.0118	0.0179**
	[0.00726]	[0.00925]	[0.00704]
ln_area_plots	0.0346	-0.0468	-0.0415
	[0.0228]	[0.0419]	[0.0328]
plots_total_rights	-0.00970	0.00408	0.0111
	[0.00971]	[0.0151]	[0.00839]
rice	-0.226***	-0.141	-0.126
	[0.0683]	[0.108]	[0.0816]
womens_union	0.0414	0.0144	0.0398
	[0.0505]	[0.0570]	[0.0409]
couple_2k	-0.0605	-0.139**	-0.100
	[0.0625]	[0.0659]	[0.0687]
empl_private_comp	-0.0153	-0.122*	-0.0777
	[0.0627]	[0.0698]	[0.0758]
kinh	0.122*	-0.0611	0.0495
	[0.0630]	[0.0977]	[0.0390]
District FE	No	Yes	No
Province FE	No	No	Yes
N	314	314	314
R^2	0.184	0.082	0.093

Note: Robust standard errors in brackets. The observational unit is a household in which at least one plot has been acquired after the introduction of the 2003 Land Law. $wage\_head$, $transfer$, ln_value_assets, $couple\_3k$, and $couple\_4k$ are included in all columns but statistically insignificant.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table E5: Child work and educational attainment - Control variables

	(1)	(2)	(3)	(4)
	HH_production		years_edu	
age	0.0567***	0.0593***	0.564***	0.422***
	[0.00543]	[0.00539]	[0.0888]	[0.0864]
first_born	-0.0317	-0.0337	0.385	0.962***
	[0.0244]	[0.0239]	[0.348]	[0.360]
age_head		-0.00333**		0.0199
		[0.00145]		[0.0176]
max_years_edu_hh		-0.00781		0.184***
		[0.00540]		[0.0636]
ln_area_plots		0.0346***		0.0163
		[0.0127]		[0.222]
transfer		0.0535*		0.588
		[0.0318]		[0.488]
ln_value_assets		-0.00243		0.232***
		[0.00809]		[0.0775]
couple_2k		-0.100**		0.558
		[0.0390]		[0.453]
couple_4k		-0.0930**		0.405
		[0.0432]		[0.413]
dist_primary		-0.0187**		0.0268
		[0.00824]		[0.101]
dist_secondary_lower		0.0189**		0.0369
		[0.00823]		[0.0691]
District FE	Yes	Yes	Yes	Yes
Sample	Age 6-14		Age 11-18	
N	1294	1294	444	444
R^2	0.117	0.166	0.132	0.233

Note: Robust standard errors in brackets. Coefficients on $LUC\_after2003$, fem, $LUC\_after2003 * fem$ in columns 1 and 2 identical to columns 1 and 2 of Table 4.3, the respective coefficients in columns 3 and 4 are identical to columns 1 and 2 in Table 4.4. They are not reported again for space restrictions. fem_head, $rice$, $know\_law$, $womens\_union$, $dist\_secondary\_upper$, and $kinh$ are included in columns 2 and 4 but not statistically significant. The coefficient on $couple\_3k$ is statistically significant at the 10%-level and positive with a value of 0.741 in column 4.

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

Table E6: Child work and educational attainment - Clustered errors

	(1)	(2)	(3)	(4)
	HH_production		years_edu	
LUC_after2003	-0.0406	-0.0473	-0.300	-0.359
	[0.0450]	[0.0436]	[0.797]	[0.818]
fem	0.0432*	0.0437*	-0.358	-0.324
	[0.0233]	[0.0233]	[0.397]	[0.378]
LUC_after2003*fem	-0.0997**	-0.105**	0.886	1.023
	[0.0459]	[0.0446]	[0.784]	[0.790]
Marginal effect for girls	-0.1404	-0.1518	0.5863	0.6637
F-statistic	12.15	14.62	0.64	0.77
p-value	0.0005	0.0001	0.4227	0.3803
Household controls	No	Yes	No	Yes
Individual controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Sample	Age 6-14		Age 11-18	
N	1294	1294	444	444
R^2	0.117	0.166	0.132	0.233

Note: Standard errors clustered at the household level and given in brackets. District fixed effects by inclusion of dummy variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table E7: Child work and educational attainment - No fixed effects

	(1)	(2)	(3)	(4)
	HH_production		years_edu	
LUC_after2003	-0.0848**	-0.0670*	0.697	0.126
	[0.0404]	[0.0395]	[0.610]	[0.627]
fem	0.0296	0.0274	-0.573*	-0.147
	[0.0269]	[0.0258]	[0.310]	[0.271]
LUC_after2003*fem	-0.0277	-0.0292	0.817	0.752
	[0.0571]	[0.0540]	[0.870]	[0.824]
Marginal effect for girls	-0.1125	-0.0962	1.5147	0.8777
F-statistic	7.83	6.20	5.91	2.40
p-value	0.0052	0.0129	0.0155	0.1217
Household controls	No	Yes	No	Yes
Individual controls	Yes	Yes	Yes	Yes
District FE	No	No	No	No
Sample	Age 6-14		Age 11-18	
N	1294	1294	444	444
R^2	0.082	0.173	0.220	0.409

Note: Robust standard errors in brackets.

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