

The impact of Wealth and Female autonomy on Fertility Decisions in Nepal: An Econometric Analysis

by

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Abstract

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The last fifteen years, the fertility rate in Nepal has declined significantly. In the same period, the country has, despite political unrest and a civil war, experienced economic growth. Nepal has, contrary to its neighboring countries, India and China, not used legal action to limit its population growth. The fertility rate in Nepal is now below India's rate, and is reaching the replace rate. In this thesis I explore the role of families' wealth and female autonomy in determining individual fertility. Using cross sectional household data from 2006 I test the effect of wealth, female autonomy and other socioeconomic status on number of children. Except from wealth and female autonomy, emphasis is put on the strong preference for boys in the Nepalese society. Preference for boys is tested using gender of first child as a natural experiment. The theoretical foundation is based on Gary Becker's work, where there is assumed a trade-off between the number of children and human capital invested in them.

Ordinary Least Squares and Poisson Regression is applied, and the results are calculated and presented using STATA.

My findings suggest that female autonomy is an important determinant of individual fertility; households where the husband has relatively more intra-household power get significantly more children compared to other groups. Wealth and education is also important

determinants, but the effect of female education is only significant for low levels of education. Preference for boys is present, and this might have consequences, as sex-selective abortions are a potential threat when son-preferences are accompanied by decreasing fertility.

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1. Introduction

In Nepal, the fertility rates are declining at an impressive pace. The country is among the large group of developing countries that experiences decreasing population growth. During the last fifteen years, there has been a reduction in the fertility rate from about five children per women to around 2.5 children, which is close to the replacement fertility rate. In other words, Nepal has managed to solve what is regarded a problem for many developing countries, high population growth.

According to classical economic theory, population growth and economic development are closely linked. Thomas Malthus claimed in the eighteenth century that the size of a nation's population always will be limited by economic resources and possibilities. A more modern approach to fertility (represented for example by the work of Gary Becker) argues on the other hand that economic development will reduce the number of children. When a country gets richer, women will get better income possibilities and the cost of raising children (lost income) will increase. This and the fact that improved economic conditions also implies better schools and better health system may induce families to reduce the number of children and use more resources on each child. Household members may, however, have different preferences over this *Quantity- Quality trade-off*. In Nepal most of the decisions are made by men, on the other hand much of the burden associated with raising a family fall on the women. The main objective with this study is to determine how family wealth and intra-household power relations affect the fertility rates.

The patriarchic nature of the Nepalese society is also represented through fertility preferences on another level; the preference for boys. An interesting question is how preference for sons affects fertility rates. Looking to other Asian countries, reduced fertility leads to an excess of boys because of sex-selective abortion. Is this a concern in Nepal as well? Using gender of the first born child as a natural experiment, I investigate to what extent gender-preferences are present in today's Nepal. Other socioeconomic variables such as caste, occupation, marriage, and family planning indicators are also tested.

Exploring these effects, I use household data from Nepal, 2006. Individual fertility is regressed on a number of variables. The fact that the independent variable (number of children) is a count variable violates key assumptions behind the OLS regression method. Hence, I apply Poisson Regression as well as Ordinary Least Squares (OLS) in my analysis.

Both have advantages and disadvantages, however, their results are found to be nearly identical.

I find that wealth is significantly correlated with fertility for most levels, and that both husband's and wife's education level is affecting number of children. The effect is largest for low levels of wealth and female education. Regarding male education, the effect is most important for high levels. Female autonomy *is* a significant determinant for fertility, most notably is that the families with the lowest level of female autonomy get significantly more children than other groups. Boy preferences are definitely an issue in Nepal. The natural experiment clearly indicates that families where the first child is a girl get more children, compared with families whose first born child is a boy. The results are stronger when the gender of the two first children is used.

Initially, the thesis launches a discussion of population growth in a general context, its relationship with economic development, and the case of Nepal. The background chapter also describes my fieldwork, carried out in Nepal last year. I continue with the theoretical framework, a chapter containing a historical outline of population economics theories, a simple outline of the Becker-Model, and some insights into the relationships between female autonomy and fertility. Methodology and hypotheses follows, before I present my findings. The most important conclusions from my empirical analysis are presented in the findings chapter, while the thesis is summed up with a discussion regarding future challenges.

2. Background

Falling fertility is on the agenda throughout the world. In Europe, the declining population growth and the ageing population causes concern about the future of the welfare states, while the same trend in developing countries is regarded as good news because high population growth usually is seen as closely linked with low economic and human development.

This chapter presents some contemporary issues related to population in the developing world and Nepal in particular. In addition to this, my fieldwork, carried out in October and November 2009 is summarized. In the fieldwork part I take a deeper look at fertility patterns in Nepal, fertility preferences, and norms, based on my experiences. Finally, boy-preference, its consequences for fertility and the potential consequences it can have for the society is sketched.

2.1 Population

The Economist stated the following on its front page in October 2009: “Falling Fertility – How the population problem is solving itself” (The Economist 2009). This sentence captures at least three interesting points; *Falling Fertility*, *Population problem* and *Solving itself*.

“Falling fertility”

In the developing world, fertility rates are declining rapidly. A look at the World Bank statistics shows the following development in the Total Fertility Rate (TFR)¹:

Table 1: Total Fertility Rate in selected Regions & the World.

Region	1990	1995	2000	2005
East Asia & The Pacific	2,62	2,16	2,01	1,96
Europe & Central Asia	2,30	1,85	1,61	1,62
Latin America & The Caribbean	3,23	2,89	2,66	2,36
Middle East & North Africa	4,89	3,85	3,21	2,89
South Asia	4,29	3,87	3,45	3,08
Sub-Saharan Africa	6,29	5,93	5,59	5,30
World	3,26	2,91	2,72	2,59

Source: The World Bank (2010)

The general pattern in Table 1 is that fertility is quite dramatically declining in most parts of the world. This in itself is interesting to study, as it has affected and will affect countries and

¹ TFR is expected total births per women if she lived through all her fertile years.

families throughout the world in the years to come. The population composition is interesting in itself, but not least because population and economy are interconnected. The labor market, the education level, technology of production and migration are all affected by and affects the population composition and size through both aggregate and individual effects.

“Population Problem”

The heading implies that we are dealing with a problem, more specifically a problem concerning the population; we are too many people. Partly is this a question of total resources, partly about the allocation of resources, and partly a normative question. Whether we are too many or not, are not my main concern and are definitely outside the scope of this thesis. However, most of the population growth is taking place in parts of the world where the resources are scarce. A climate crisis and a resource crisis are frequently being predicted and more people means more resources needed. *What happens when every Chinese wants a car?* is a typical rhetorical question being asked to symbolize the challenges ahead. Everyone deserves the same standard of living as we have in the industrialized countries, but it is difficult to see how it can be delivered with the resources available. Owning a car is one thing, but more important for millions of households are the more basal needs of everyday life, such as food on the table and safe drinking water.

What is the optimal number of children for a family? From a community’s stock of resources point of view, the answer to this question can be “few”. From a family’s point of view, which needs some extra pair of hands to contribute to the family economy, the answer can be “quite a few”. Families like this might contribute to a population growth that is potentially a threat for the already pressured resource foundation in the community. Most would however agree that constraining the family’s choices regarding their own family is an inappropriate interference into the private sphere². If there is a population problem, is there a solution?

“Solving itself”

Or at least; *being solved*. The scope here is that, *population growth* is the problem and the *falling fertility* is the solution. Socioeconomic analyses of fertility have been carried out in many countries, with different angles and across various academic disciplines. In economics, the usual way to begin is by assuming that there is a trade-off between quality and quantity of

² Even though some countries, China in particular, has implemented policies to limit family size.

children³. The trade-off implies that when people, due to different reasons, want higher quality children, the cost of raising children increases, making parents substitute from many children to fewer children while investing more in each. The theoretical foundations, including the outline of the Quality-Quantity Model is presented later.

Table 2: Population growth rate in selected Regions.

Region	Pop. growth (annual percent)	1990	1995	2000	2005
East Asia & The Pacific		1,60	1,25	0,93	0,81
Europe & Central Asia		0,64	0,10	0,09	0,07
Latin America & The Caribbean		1,85	1,68	1,47	1,24
Middle East & North Africa		3,43	2,10	1,94	1,87
South Asia		2,10	1,89	1,79	1,56
Sub-Saharan Africa		2,81	2,69	2,64	2,50
The World		1,70	1,47	1,30	1,19
The World (Total Population)		5 278 893 731	5 689 010 289	6 084 911 264	6 466 751 511

Source: World Bank (2010)

As seen from Table 2, the problem is indeed getting “solved”. The population growth is declining (the *population* is of course still increasing, however only barely in Europe), and declining fertility is the main reason.

Falling Fertility and Population Growth

Population growth is the relationship between how many people are added to the population and how many leave the population, births relative to deaths. The less developed countries usually have high birth and death rates. The death rates normally decline at some point in the development process *followed* by a drop in fertility. This is described as *the demographic transition theory* and will be investigated further in the theory chapter.

There is an important difference between the birth rate, which is directly linked to the population growth, and the fertility rate which is an individual measure. A high fertility rate does not necessarily cause high population growth, because the age distribution dimension in the country is not accounted for when measuring fertility rates. A country that has gone from a high fertility level, to a lower level in a fast pace, might still experience high population

³ See Nguyen-Dihn(1990), Hondroyiannis (2004) and Zhang (1990) for examples from Vietnam, Greece and China.

growth, due to a young population. First the fertility has to decline, before the young population (caused by the earlier high level of fertility) will keep the population growth at a high level for some time. At a later stage, the population growth can stabilize at a lower level. From 1985 to 1995, Nepal's declining fertility and birth rate was accompanied by an *increased* population growth rate, underscoring the point that population development involves complex and slow processes.

This is partly a discussion of terminology, but also of interpretation. Fertility and population growth are obviously very closely linked. In my empirical analysis, the number of surviving children at the individual level is used as the dependent variable. Number of children is thus highly *relevant* to the issue of population growth, but is no *measure* of population growth.

I hope my findings to some degree have validity for other countries and areas of the world, but my main focus is on Nepal and the Nepalese society.

2.2 The Nepalese Context

Why look to Nepal when studying population in development countries? Nepal is ranked as 144 of 182 countries in the last HDI index⁴, making it the poorest country in the South Asian region. South Asia is one of the regions that have experienced a big drop in fertility rate since 1990 (Table 2). It is important to investigate the dynamics behind this drop to understand the societal changes taking place. It is also important as a means to understand and predict the development in areas of the world where population growth and fertility rates are still high. Nepal has two neighboring countries, China and India, who have both used untraditional⁵ means to limit population growth. Nepal has had a high level of fertility, but has experienced a remarkable decline the last years, a drop from 4.6 in 1996 to 3.1 in 2006, according to the DHS Surveys (Ministry of Health and Population [Nepal] 2007a)

The geography

Nepal is an agricultural society with 85 percent of its 29 million-population living in the countryside. It is a landlocked country with India south, east and west, and China (Tibet) to the north. Nepal is usually divided into three ecological zones, the Himalayan Mountains or the Mountain zone in the north, the flat Terai zone in the south and the Hills zone clustered in the middle. Most People live in the Terai and the Hills, with approximately equal shares, while some 1.5 million live in the mountains. Administratively, the country is divided into

⁴ Human Development Index (UNDP 2010).

⁵ Both has used legal matters to limit family size.

five regions, Far-western, Mid-western, Western, Central and Eastern, with most people living in the two eastern regions. The regions are divided into 14 development zones, again divided into a total of 75 districts. On a smaller scale, Nepal has approximately 3000 Village Development Committee's (VDCs) and 58 municipalities (cities). Every VDC has nine wards, which is the smallest unit of administration.

The People

Nepal is an ethnically diverse country. The Hindu caste system has many similarities with the Indian. As well, there are many ethnic minorities, many of whom have their own language, and there are also some religious minorities. The Hindus account for approximately 57 percent of the population, the ethnic groups 37 percent and the Muslims, the largest religious minority, 4 percent. Even though the ethnic groups and the Muslims are outside the caste system, they are definitely included in the "hierarchical" system based on the castes, and they are often also referred to as castes. As well as being divided by castes, people from the Hills and Mountains regard themselves as "more Nepali" than the Terai people, so there is a geographical division as well. The system is highly complex and my intention is not to give an extensive introduction to the caste system here⁶. In my analysis, I have sorted the population based on certain criteria, which will be accounted for in the Variables and Hypotheses chapter.

As stated, Nepal is a poor country. About one third of the Nepali population lives below the poverty line (Bhatta and Sharma 2006), and there are large differences between rich and poor. The economy has experienced growth during the last 20 years. This growth has led to decreasing poverty, while inequality may have increased (Hatlebakk 2008).

The political situation in today's Nepal is somewhat unstable. After the ten year long civil war between the Maoists and the government, the King resigned and a republic was established in 2008. Recent disagreements between the ruling parties and the Maoists have caused troubles for both the writing of a constitution and the political stability in the country. The Prime minister today is from the Communist Party Marxist-Leninist (UML) of Nepal, ruling in a coalition government without the support of the Maoist Party (the party with most seats in the parliament). A new constitution was supposed to be signed on May 28 this year, but the deadline is now extended with one year.

⁶For further reading about Nepalese castes, see e.g. Harka Gurung (2006).

2.3 Fieldwork

In November 2009, I did a short field study in Nepal to increase my contextual knowledge about the Nepalese society and to better understand how family-size, contraception and other fertility-related issues are understood in Nepal. During a four-week-period, I interviewed 30 households in two villages, as well as health workers, NGO workers and scholars involved in family planning. My experiences from the fieldwork will not be presented as findings, but I will use them throughout the thesis to better explain the reasoning behind my hypotheses and the results presented. Here I will, however, give a short summary of the fieldwork and some of the most central and important lessons I learned from it. The questionnaire used in the household interviews can be found in the appendix, and information received from the short survey will be provided upon inquiry.

The Interviews

The household interviews were done in two villages in Morang district in the eastern Terai zone, close to the Indian border. The average fertility rate in both the eastern region and the Terai zone corresponds with the rate in the country as a whole. The Terai Zone has traditionally been a densely populated area, but has experienced a massive immigration by people from the Hills. The people living in the Terai are hence a mix of people from both areas. The village of Haraicha has a diverse population with a mixture of ethnic groups from both the Terai and the Hills. Bajhanatpur was chosen because it has a large Dalit⁷ population.

Interviews were done using questionnaires with both general questions about the households' assets, education and occupation, and more specific question regarding the respondents' fertility history and thoughts around the fertility situation in Nepal. Most of the questions were open, and questions were adjusted, added and removed, depending on the age, sex and situation of the respondent. Each interview took approximately 30 minutes. An experienced interpreter was used during the interviews.

Haraicha and Bajhanatpur, the two villages where we did interviews are both within a two hour drive from the second largest city in Nepal, Biratnagar. After deciding in which villages to do the interviews, I got access to voter lists with names of all the residents in each ward. Then I randomly decided in what wards to do the interviews, and furthermore picked every 15 household from the list. I did a total of 30 household interviews in the two villages. The small number of respondents makes my findings inappropriate for statistical analysis. However, the

⁷ A Dalit is a low-caste, often referred to as "untouchable". They are at the bottom of the caste system.

diversity in caste, ethnicity, education and age among my respondents has in my opinion been sufficient to give me substantial insights to some trends in family formation in Nepal.

In Nepal, every ward is supposed to have its own Female Community Health Volunteer (FCHV⁸). The FCHV is one female that is chosen by the community's mothers group to have contact with the VDC's health post and provide health related information to the families in the ward. Most of the information the FCHVs provides maternal and newborn health, as well as family planning. They provide door-to-door- information, mothers' group meetings and people can come to their house to get information. The FCHVs will therefore have good knowledge about attitudes towards contraception among the inhabitants of the ward and they also have opinions on how many children it is normal to have, if this has changed and if so, why. It was therefore natural to interview the FCHVs in most of the wards where household interviews were done. To what extent a FCHV is present in every ward in every Nepali village, I do not know, but there is supposed to be one. I definitely got the impression that the system was working quite well in the two villages visited, and they are central in delivering basic health services to woman and children in particular⁹.

Small family is a happy family?

The most surprising experience for me during my interviews was the level of awareness about the economic consequences of child-raising, present among almost all respondents. In some way or another, most of the families were concerned with the expenses of getting and raising children.

Also of interest, was how synchronized the respondents were regarding some of the questions. Nearly all the respondents answered "2-3" to the question "How many children is it normal to get in your caste?" Some had the impression that the lower castes got more children, but the lower-caste households mostly answered the same as the rest (again, this is not statistically appropriate work). The synchronization of the responses gives me the impression that information has successfully been transmitted from government and/or family planning agencies through health workers to the people.

Regarding the Nepali peoples' experience with family-size, it was obvious that this is not just a statistical issue; the declining fertility was clearly something most people had an opinion

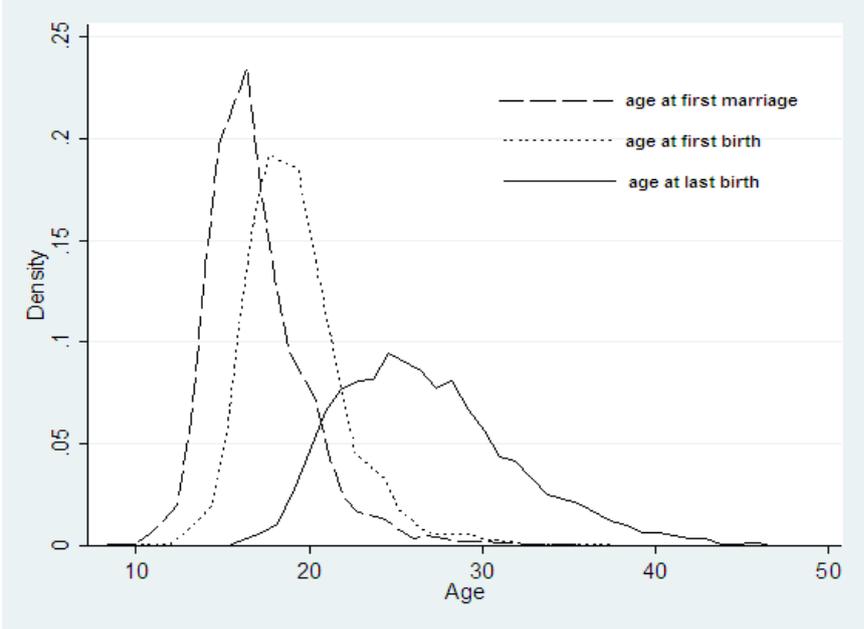
⁸ The term volunteer is maybe not accurate anymore, as they after a strike now receive about 25 NOK per month for their work.

⁹ See for example Ministry of Health and Population [Nepal] (2007b).

about and had reflected upon. I got different answers, most of them related to better education. Increased food prices were also by some regarded as a reason to reduce the number of children. How the real prices of food have changed the last 10-15 years, is something I do not know, but I suspect that the reason that this was a frequent answer had mostly to do with a recent steep increase in food prices. The availability of contraception and a saying that “Small family is happy family” was also repeated at numerous occasions.

One trend regarding the fertility pattern among Nepalese women that I learned during my fieldwork was that they marry and get their first child early, often before their twentieth birthday. Some then start using contraception quite early as well, while some continue to get children. This fits well with the information from the DHS dataset.

Figure 1: Fertility Pattern among Nepalese women



The graph shows the distribution of age at first marriage, age at first birth and age at last birth. The age at last birth shows the age of the respondent at her last birth, given that she does not want any more children, is sterilized or is declared infecund.

7791 of 10793 have ever given birth, 8640 have ever been married and 6027 is in the “last birth” group.

The graph in Figure 1 shows that most women get married and have children before they turn 20. Somewhat more unclear is the picture of when they get their last child, but most are under 30, half are 25 or younger. In other words, there are clear indications that it is quite normal to get children early and then actively avoid to get more children. The figure does not contain information about those who are not finished with getting children and some might use contraception to postpone/space births. The “age of last birth” line is no absolute

representation of at which age Nepalese women stop giving birth, but it gives a reasonable indication.

Another point of interest is how number of children corresponds with fertility preferences. The table below shows the respondents ideal number of children¹⁰ from the DHS in 1996 and 2006:

Table 3: Ideal Number of Children in Nepal, 1996 and 2006

1996			2006		
# of children	Frequency	Percent	# of children	Frequency	Percent
0	2	0.02	0	37	0.34
1	218	2.64	1	787	7.31
2	2,987	36.24	2	6,477	60.14
3	2,844	34.50	3	2,577	23.93
4	1,767	21.44	4	748	6.95
5	259	3.14	5	94	0.87
6	102	1.24	6	36	0.33
7	25	0.30	7	6	0.06
8	21	0.25	8	4	0.04
9	5	0.06	9	1	0.01
10	11	0.13	10	2	0.02
12	2	0.02	12	-	-
Total	10,769	100.00	Total	8,243	100.00

The number of children the respondents state as ideal is of course likely to be affected by their *actual* number of children. Still, Table 3 shows that a majority of the Nepalese women regard two children as the optimal number, and that the view on family-size has changed somewhat during the ten years between the surveys. However, the Fertility rate has declined more than the desired fertility, indicating that increased availability of contraception has been an important facilitator for the decline, also suggested by Karki and Krishna (2008).

I account the change in the perceptions of “the ideal family-size” in changes in norms in the Nepalese society. One of my respondents, a Dalit tailor, stated that: “People will laugh at you if you get many children”, indicating that family size is an issue that is subject to social stigma, “the ideal family” can be said to be partly constructed in the social sphere. Norms are difficult to test empirically, and a deeper look into how preferences and behavior have changed over time because of changing norms and awareness, calls for another approach.

¹⁰ Response to the question:” If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?” and “If you could choose exactly the number of children to have in your whole life, how many would that be?” asked to respondents with and without children respectively. The non-numeric answers (181 in 1996 and 23 in 2006) are removed.

Nevertheless, some of my socioeconomic variables are obviously connected with norms, which will be discussed further in the forthcoming chapters.

2.4 The Preference for sons

Preferences for sons relative to daughters are apparent in Nepal (Leone, Matthews and Zuanna 2003 and Koolwal 2007). In this section, the issue and the consequences are sketched, while a detailed discussion about the potential for an excess of sons due to the combination of son-preference and declining fertility is presented in the discussion chapter.

When daughters get married, they are regarded as a member of the in-law's family rather than their own parents'. This means that they will not contribute with old-age security or help out in their family's home after they are married. Daughters are also expected to bring dowry into their marriage, making them a monetary expense for the family¹¹. This is obviously opposite for boys. In addition, only sons can traditionally perform the rituals at their father's funeral¹². This is regarded as highly important in many families.

Strong gender preference can have serious negative consequences, for instance if it leads to biased gender ratios. As long as the fertility rate is high the problem is negligible, but as the fertility rate is declining and the boy-preference is present, the problem of a sex bias in the population arises. If or when ultrasound and other technology gets widely available in Nepal, accompanied by further decline in fertility, sex-selective abortion can become a serious problem in Nepal, as it is in some parts of India (Arnold, Kishor and Roy 2002). The concept of gendercide¹³ is important to have in mind, as the problem is present in the region and boy-preference absolutely is present in Nepal. Amartya Sen was among the first to address the issue of an excess of boys, in his 1990 article "More Than 100 Million Women Are Missing" (Sen 1990). Nepal is for now following the "normal" pattern, with 104 boys born per 100 females, while in India and China, 112 and 117 boys are born per 100 girls respectively¹⁴.

But the preference itself also affects the fertility rate. My impression from interviewing health personnel and households is that the norm today is to get two children, but that it is accepted to get more if you have been "unlucky" (hence the "2-3" answer I frequently got when I asked about the normal number of children).

¹¹ A Hindu saying states: "Bringing up a daughter is like watering your neighbors' garden".

¹² However, at former Prime Minister GP Koirala's funeral earlier this year, his daughter actually lit the funeral pyre (BBC 2010).

¹³ Gendercide refers to the widespread killing of unborn (and born) girls experienced in India and China.

¹⁴ CIA World Factbook (CIA 2010)

Empowering women and raising the value of girls is important for its own sake, but also to prevent what could be a serious problem for mothers, daughters and also the society as a whole.

I did not get any indication that it was normal to try to find out the sex of the baby before giving birth in Nepal, but the preference for sons were definitely present. However, some young respondents seemed less occupied with the issue than their parents. The issue of boy-preferences, its implications and consequences for the future is discussed in depth in the Hypotheses, the Findings and in the Conclusions.

All in all, the fieldwork gave me interesting information and not least, the ability to interpret my results in the context they deserve to be interpreted. However, even though the contextual knowledge is important, my work is based on econometric analysis grounded on an economic theoretical foundation. I continue with the presentation of the theory.

3. Theoretical Framework

The history of economic population theories begin with one of the classical economic theories. Thomas Malthus is frequently mentioned together with Marx, Smith and Ricardo as one of the pioneers in the field of economics. He still receives support for his theory on population development today, 220 years after he launched the first edition of his essay, “On the Principle of Population”. The first part of the historical section of this chapter portrays Malthus’ contribution to population economics.

The theory of the demographic transition is another approach that has been central in population studies in multiple social sciences, including economics, geography and sociology, and will thus also be central in my historical outline. The history continues with the emergence of microeconomic models of fertility behavior and the academic dispute that followed between two schools of microeconomic fertility-models. Two newer and more specific economic models of fertility are sketched.

The historical part is included to give a chronological presentation of some of the most important theories in the field of population development. As well as being chronological, it starts out with the larger scope of population and economic development, moves through a more detailed description of change in population patterns and ends with a narrower focus on individual fertility decisions.

The second of the three sections in this theory chapter is a presentation of a simple model inspired by Gary S. Becker, one of the main contributors in applying microeconomic concepts to family behavior. The empirical analysis that comes later in my thesis will to a large degree rest on his assumption that families’ demand tend to shift from quantity to quality of children as income increases.

Lastly, some insights from the field of sociology are borrowed as the theoretical background for discussing female autonomy and fertility.

3.1 Theoretical History

“Population, when unchecked, increases in a geometrical ratio, Subsistence, increases only in an arithmetical ratio” (Malthus 1798a)

Thomas Robert Malthus starts his famous essay, “On the principle of population” with a suggestion that population cannot exceed food-production. He claims that population has the

potential to grow at a geometric rate, while food production can only grow at an arithmetic rate. He also claims that population growth will slow down because the poor will adjust their number of children to the reduced food supply and hence get fewer children (Malthus 1798b). An argument like this is quite the opposite of what is regarded the mainstream view now. Most of the population growth is taking place among the poorest, and that the rich reduce their reproduction. Even though Malthus' essay is one of the classics in the history of economics, it is also a theory that has met massive critique during the last couple of hundred years. His failure to recognize that food production actually *can* grow quite fast (because of technological progress) and that population has a tendency to slow down as living standard increases has been criticized extensively (Sachs 2008).

The Malthusian model provides a framework where the population and the economy have a relatively fixed relationship. We start by considering a population on the consistence level with a stable population that is adjusted to the level of resources. If this population, for example because of technological progress or access to more land, experiences an upward shift in its supply of resources, the population will first have a period of higher living standard. In the next stage, population will begin to grow, until the population size has outweighed for the gain in standard of living. The population will stabilize itself on the initial level of living standard, or income per capita in more modern terms. In other words, the population will always converge towards a steady-state with constant income per capita. The model seems to be regarding humans in a very strict biological manner, not far from how animals behave (Darwin was actually highly inspired by the work of Malthus), but it separates us from animals in one particular sense. While animals maximize their reproduction rate with respect to available resources, humans take into account that their progenies shall not be living in poverty, having a predictive element in their decision-making that the animals lack. Still, the Malthusian theory has failed to predict the population and economic development that we have seen from the start of the nineteenth century and until today.

Where did he go wrong?

Economists have over the last year been criticized extensively for not being able to predict, but being very good to explain why things happened they way they did¹⁵. Perhaps then, is it no surprise that Malthus' model fits well with the population growth and economic development in the world until he launched his theory, but from that point on, the theory does

¹⁵ Referring to how economists are accused of not being able to predict the financial crisis in 2008, but are lining up to explain "what went wrong".

not hold. There are two central assumptions on which the theory rests, that have been violated the last two centuries. In Malthus' theory, a fixed supply of land implies that higher population growth inevitably leads to lower income per capita. History has shown that technological progress makes it possible for the population to grow over time together with both constant and increasing living standard. As well, Malthus claimed that population grows whenever income per capita is increasing. What is observed is that population growth might follow the economic growth in the beginning, but at some point, income per capita continues to grow (or even accelerates) while population growth rate declines. In some parts of the world, we even look at a declining population (Weil 2009).

Malthus' view on how the world is or is getting "overpopulated" has however gained some momentum as a consequence of the recent climate crisis and energy shortage. Even though technological innovations might be able to support a rapid population growth, more people means more resources have to be used, resources that contribute to global warming and climate change¹⁶. It should also be mentioned, that even though the Malthusian model is inappropriate to explain the world's population pattern, the model can still be useful in geographically limited areas.

The Demographic Transition Theory

Another important theory in the history of demography is the theory of the demographic transition. Unlike Malthus' predictions, the theory of the demographic transition fits well with the later population development, at least in the western world. The demographic transition states, in short, that a society will move from a situation with uncontrollable and high mortality *and* fertility (sometimes referred to as a Malthusian stage or Malthusian stagnation), via a phase of lowered mortality rate but still high fertility (in this period the population obviously grows rapidly), to a stage of low mortality and low fertility. The decline in mortality is due to better healthcare, hygiene etc. The following fall in fertility, on the other hand, is not that straightforward to account for.

The theory of demographic transition was developed in the 1930s, but it seems some scholars worked on the same principles simultaneously, not knowing about each other's work. Frank Notesteins 1945 article *Population: The Long View*, is often seen as one of the first to define the dynamics that lay behind the theory (Kirk 1996).

¹⁶ See for example Jeffrey Sachs' short comment *The Specter of Malthus Returns* (2008), Cohen (1995) and Guillebaud and Hayes (2008).

The historical picture of population development is complex and fragmented. The world population has been growing for thousands of years, and will continue to grow for some time. The rates, however, differs largely in both time and space. The population growth-rate in the world as a whole grew to its maximum during the 1960s and has been declining since (Schultz: 1997). The world is soon to reach 7 billion inhabitants, but the projections for the future are uncertain. The recent projections seem to be somewhat adjusted downwards compared to those from 15-20 years ago¹⁷. For those most pessimistic about that the growing population will lead to a dramatic resource crisis and self-destruction of our planet, this is good news.

This declining rate has two explanations; either the mortality rate is increasing, or the fertility rate is declining. Even though mortality rates can increase in geographically limited areas in periods, the reason for the stabilization of the world population is falling fertility. My theoretical focus now shifts toward models that more specifically look at fertility and fertility determinants.

The Entering of the Microeconomic Focus on Individual Fertility

The classical models presented above both explain population development on an aggregate level. From the 1950s, economists started to develop theories to better understand how household choices affect population, using concepts from micro-economics to explain fertility differentials. Analyzing family behavior in a traditional economic utility-maximizing way of thinking is largely influenced by the work of Gary S. Becker.

Gary S. Becker won the Nobel Prize in 1992 for “having extended the domain of microeconomic analysis to a wide range of human behavior and interaction, including nonmarket behavior”¹⁸ His contribution to the economics of the family is probably his most important work and what he is in particular known for is his models that focus on a trade-off between quantity of children and the quality on each child¹⁹.

In short, the quality-quantity theory is based on an assumption that families face a trade-off between quantities of children, that is, how many children they want, and quality of children they get, that is, how much do they want to invest in each of them. Quality is not an

¹⁷ Both UN and the World bank projected in 1990 the world population to be 10 billion in 2050, while UN now projects it to become around 9 (McNicoll 1992 and UN 2008).

¹⁸ From the press release (Nobel prize 1992).

¹⁹ See for example Becker (1960), Becker and Lewis (1973) and Becker (1992).

expression of talent or abilities. Higher quality is defined as the utility gained from investing more in a child (Becker 1960).

This tradition started in the 1950s, and has been developed further through the 60s, 70s and 80s. Liebenstein and Mincer also made early contributions to the field (Schultz 1997). Mincer focused on one particularly important aspect regarding the costs of children. In *Market Prices, Opportunity Costs, and Income Effects* (Mincer 1963) Mincer underscores that the price a consumer pays for a commodity has to include the opportunity cost of time, that is, the loss the consumer has to face for not participating in money generating activities. This point is of great importance for family economics. Time spent in the family has that feature that it does not generate money and that it takes up time that could have been allocated to work. Especially mother's income, since she traditionally has spent most of the time raising children, has been an important component in defining "the cost of children" in this literature.

Critique of Becker; the Pennsylvania School

Of the most controversial points in Becker's original model, is how it handles preferences. He takes the consumers tastes as given, and the changes in behavior are explained by changes in prices and income opportunities. Becker's view on exogenous tastes was to be challenged from another group of economists that meant that a household's preferences are subject to change.

Following Becker's classic 1960 article, *An Economic Analysis of Fertility*, Richard Easterlin launched an alternative approach, which would lead to an academic dispute between Chicago-Columbia school (Becker and his supporters) and the Pennsylvania school (led by Easterlin) (Sanderson 1976). Both schools used a microeconomic, utility maximizing framework as the basis for their analysis (Olsen 1994), but the Pennsylvania faction emphasized that households demand of children is decided by biological constraints and social norms. The shaping of preferences or tastes is central in the Pennsylvania approach, as are mortality rates and physical attributes (Easterlin 1975).

One of the most influential articles from the Pennsylvania school is Harvey Leibenstein's *The Economic Theory of Fertility Decline* (1975). This is partly a critique of the Becker-model and partly an alternative approach to deal with fertility differentials. Leibenstein argues that the utility of children differs between different status groups and different income groups. He does not strictly reject that the quantity-quality effect is present, but emphasizes that preferences vary greatly between groups and that preferences do not necessarily have

anything to do with income. He also stresses that the utility of children do not have the normal diminishing-returns-feature. In some societies (like Nepal), having two children is regarded as a minimum. The utility will then perhaps be large for number one and two, while maybe decrease dramatically from the third and so forth.

The polemics between the two camps softened from the late 1970s. Especially the Chicago-Columbia school moved towards the Pennsylvania, and during the late 80s Becker modified his view even on the way preference should be used in economic modeling, leading the schools even closer to each other (Pollak and Watkins 1993). From the 1990s, the two groups tried to find out how they could take advantage of their different strengths, rather than focusing on each other's weaknesses (Olsen 1994 and Pollak and Watkins 1993). For instance they agreed upon main point is that higher income leads to fewer and "better" children expected by both (Sanderson 1976). My theoretical foundation is inspired by both schools.

Some Economists (like Leibenstein) have also used insights from the field of sociology in their modeling. Sociologists have also been influenced by the way in which economists regard fertility and fertility decisions. Both Pollak and Watkins (1993) and Olsen (1994) mention this sociological view as a third group of influential contemporary fertility researchers. The sociological view is focusing on norms and group dynamics as important determinants for fertility behavior.

Alternative Economic Approaches to Fertility Modeling

In addition to the general models, economists have made use of more specific models to explain fertility differences. Eric Jensen (1990) presents a model where he explicitly looks at the old-age security motive for getting children, parents' need for care when they are too old to work. He develops a two-period model based on the Lexicographic Safety First (LSF) principle.²⁰ In the first period, parents try to get the number of children they regard as the minimum necessary to obtain a certain level of welfare in their old-age period their security-level. During this period, the parents will try to minimize their birth-intervals, or hoard²¹. In the next period, all other interesting variables come into play and affects total number of children.

²⁰ LSF is a concept usually applied in agricultural economics. It states that instead of allocating the inputs to maximize profits, a farmer chooses a strategy where he aims to maximize his probability to reach some minimum level of output (or minimize the probability of *not* reaching that level). This level is marginally above a disaster level.

²¹ Hoarding refers to a situation where parents basically try to get as many children as they can as quick as possible.

Another interesting view worth mentioning is laid out by Øystein Kravdal. He looks at the relationship between education and fertility, focusing on community level effects. As well as individual education, *others*²² education can have effect on the household's fertility. On the community level, availability of information, change in norms as a result of a generally more educated community, and changes in the labor market can be relevant factors. The neighbor's attitudes can affect your own thoughts regarding family, and on the country level, educational reforms can lead to deep changes for the population as a whole, also across education levels. He finds some evidence of such effects in his cross-country study of sub-Saharan African countries (Kravdal 2001).

3.2 The Quality-Quantity-theory

In this part I will start with a discussion about parents' motive for getting children and further show how the quality-quantity trade-off can be used to explain why parents might desire fewer children when their income increases.

Why do families want children?

There are some obvious biological reasons, for example the desire to reproduce and there's also joy and comfort related to children. None of these will be accounted for specifically, but they are included in the preferences. What I do deal with, is the economic motive. The relationship between the relative importance of biological, economic and "joy and comfort" motives differs both in time and across countries. I expect the economic part of the decision making to have relatively higher importance in low-income countries than in the industrialized countries. The economic motive for getting children can be divided into three parts:

- Costs
 - All costs related to bringing up children
- Gains
 - Gains from children's production, either in the labor market or in the household.
 - Old-age-security

The costs and gains of children depend on how many children you have, and how much you invest in each of them. The old-age-security depends on the same, but most important in this

²² *Others* can refer to neighbors, village residents, fellow countrymen etc. (Kravdal 2001:235)

respect is probably to have one surviving provider. In the following presentation of the quality-quantity model, I do not explicitly divide between different motives behind the desire for children.

The Outline of a Simple Model

Based on the framework presented in Bardhan and Udry (1999: 22-24), I consider a family whose utility depends on the number of surviving children, n , their quality, z , and consumption of market goods, x :

$$U = U(x, n, z; \alpha)$$

The utility is assumed to be increasing in consumption of market goods and in children's quality. Regarding number of children, the effect on utility is uncertain, but a higher number will probably give higher utility when number of children is relatively small. Children's quality (or human capital) is produced by a time-input: parents time spent with children, t , and a monetary input: children-consumption, c :

$$z = Z(c, t; \beta)/n$$

Children's consumption is money spent in children's human capital, such as schooling and health. The α in the utility function is a vector of exogenous factors affecting the households preferences and β in the production function is a vector of the household technology that affects the production of child quality. Both consumption and time is constrained by parents' participation in the labor-market:

$$w(1 - t) = p_x x + p_c c$$

The cost of spending time (t) with children is the income loss, tw , because the time could be spent generating income. The p 's are the prices of market goods and child consumption, respectively. The family's problem is to maximize utility with respect to own consumption, number of children, children-consumption and time spent with children.

$$\max_{x, n, c, t} U(x, n, z; \alpha)$$

For the purpose of this thesis, the maximization of the utility function is not of great importance, but this formal framework provides me with tools to discuss how the quality-quantity model works.

In this model, one restrictive assumption is made. All children in a family are assumed to have (or get) the same level of quality, so an increase in quality for one child, applies to every child in the household. By the same token, getting another child means investing the same amount of time and money as has been invested in previously born children. This is a normal approximation when modeling household fertility,²³ but is worth mentioning, as it is a critical assumption. It has received deserved criticism (Schultz: 1997) for not accounting for differences between first-born and later-born, and more importantly; between boys and girls. For the sake of my analysis, the assumption is wrong, but for the sake of discussing the main points of the quality-quantity theory, it does not make a significant difference.

The family in this simple model faces a situation where there is a trade-off between parents' consumption of market goods, number of children and the quality of the children. Spending more time working increases the possibilities of consume, but at the same time reduces the possibility to spend time with their children, hence *not* investing in their human capital. Higher number of children means that, holding the time spent with children constant, each child will have less quality. Quality of children can be produced by either allocating money or time to them. Allocating money to children's consume reduces the possibilities to consume market goods. On the other hand, allocating time to children is in conflict with participating in income-generating activities. At the same time, children can also be seen as investment goods, so investing both time and money in them can be regarded as switching from immediate to future consumption.

The Effect of Income on Fertility

The main question that I seek to answer through the quality-quantity-model is: How does income affect fertility? Gary Becker states it like this:

An increase in income must increase the amount spent on the average good, but not necessarily that spent on each good. (...) Since children do not appear to be inferior members of any broader class, it is likely that a rise in long-run income would increase the amount spent on children (Becker 1960: 211)

Becker's quote implies that an increased wage should lead to "more children", but that most of the increased wage is allocated to increased quality and not quantity. "More children" is not necessarily referring to "a higher number of children", but "the amount spent on children". Thus, increased wage can actually lead to *fewer* children demanded even though children is assumed to be a normal good, if the cost of quality is large enough to dominate the

²³ Used e.g. in Beckers original model (Becker 1960).

income effect (Becker 1992: 188). The model I present does not provide any clear-cut answers to how this works, but does leaves plenty room for discussion about the matter.

An increase in the wage-rate of the female parent in the household, first and foremost increases the opportunity cost of raising children, the price of t . Following normal labor-theory, increased income has two effects. The income effect will make the individual work less, as she can earn the same amount of money while working fewer hours. The substitution effect makes the worker allocate more hours to wage-labor, substituting away from leisure (in this model, time spent on children's training) which has become relatively more expensive. If the women in question choose to dedicate more time to work because of the increased wage, I would assume at the same time that the family wants to share the extra income between adult and child consumption, x and c . The time spent with children is reduced so to keep the level of quality *per child* (z) constant, the family has the choice between increasing amounts spent on each child (c) or to reduce number of children (n) or both. If (i) the price of child quality is sufficiently high, (ii) the returns from investing in child quality is sufficiently high (investing much in one gives higher expected returns than investing less in two), or (iii) the increased income has reduced the need for old-age security, it is likely that the household will choose to get fewer children as a result of the wage-increase.

In the discussion above, the mother was the one that experienced the wage-increase. If the husband/male-parent receives an increased wage *and* the women do most of the household work (including raising children), the cost of spending time with children is constant, while the income is increased. Intuitively, this will lead to higher demand for market goods, quality of children *and* number children, but higher number of children means that the mother has less time with each of them, so more has to be spent on c to keep quality per child constant. As Becker points out in the quote above, if the household's preferences change and/or the price of quality is high, a wage increase for the husband can *also* lead to fewer children.

Further Interpretation

How do preferences change with income? If the increased income is related to general economic growth, preferences can shift towards more human capital in each child and fewer children because of modernization of both production technologies and the society as such (Bardhan and Udry 1999: 122-123). As well, modernization and income growth can increase the availability and quality of the education system, making it possible to invest more in quality.

Preferences can also be affected by norms and social awareness. An exogenous change in the perception of the importance of education, or the awareness of the potentially negative consequences of having large families can affect the relationship between utility gained from quality and utility gained from quantity of children. Other socioeconomic factors are also relevant in the preference parameter. A family living on a small family farm in the Himalayas may have different rate of returns from investing time and money in children than a family in Kathmandu. The availability of schooling and job opportunities might make education more important in urban than in rural areas. Discrimination in the labor market (between gender and castes for instance), can also lead parents to avoid investing in children if the expected returns from investing in education is low. Electricity and other household technologies can make the time spent at home more efficient²⁴.

3.3 Female Autonomy and Fertility

Sociologist Karen O. Mason (1987) introduces some interesting concepts on the relationship between intra household power structures and fertility in development countries. She sums up five arguments for how female autonomy should be inversely related to fertility. Firstly, early marriage can be associated with high fertility, and female autonomy is likely to decrease the relative importance of early marriage. Concerning contraception usage, higher relative power can both make the wife's voice in fertility related issues stronger and encourage "innovative behavior, such as using modern contraceptives"(Mason 1987: 738). This second point obviously rests on the assumption that women have a desire for fewer children than men. Further, the opportunity cost of children increases if more autonomous females are more likely to get education and well paid jobs. Lastly, if the general equality of genders in the *society* is increased, men's concern for women's well- being is probably greater. This could reduce fertility; again, conditional on that the demand for children differs across sexes (Mason 1987). Both Dyson and Moore (1983) and Morgan et al (2002) find that female autonomy indeed is negatively related to fertility behavior. Both studies are carried out in South and South East Asia, and should therefore be applicable to the Nepalese society as well.

I expect fertility (measured as number of children) to be affected by a number of variables, some of which are directly associated with the Becker Model, some are not. The quality-quantity model has been shown difficult to test empirically (Hotz et al 1997 and Rosenzweig and Wolpin 1980), but the goal for this thesis is not to test the Becker Model as such, but to

²⁴ This can work directly or more likely through the fact that less time is spent on cooking etc, leaving more time free to spend with children.

use some of the concepts from his model as a foundation for parts of my analysis. As Zhang (1990) point out, it is useful to combine the Chicago-school approach with other elements.

4. Empirical Model & Methodology

From the theory, I move toward the empirical work, presenting the empirical model, the data, the empirical methodology and my hypotheses.

4.1 Empirical Model

Even though there are many interesting ways to model fertility, the Quality-Quantity model provides a good theoretical framework as a basis for my empirical analysis. Income and education will have effects on the demand for both quality and quantity of children, and this will be analyzed within the concepts and relationships provided by the model. In addition to the effects explained in the Becker-model, I focus on female autonomy, socioeconomic background variables, and gender-preferences. Attitudes towards fertility and family size are often made both inside the family and also as a process where the extended family, the community and to a certain degree the whole society is involved. A typical notion to use in this respect is “norms”. If there are differences between regions or castes and this effect does not diminish when income and education is accounted for in the model, it is reasonable to assume that there are differences in norms that lead to these differences. There are few (but some) logic explanations to why geography and ethnicity *per se* should have any effect on fertility. This is discussed and explained in detail in both the Variables and Hypotheses chapter and the Analysis chapter.

Instead of the Becker-model on structural form, I construct a reduced form equation where number of children is as a function of the exogenous variables.

The reduced form equation will then be as follows:

$$Y = f(A, W, F, Z), \quad Y = 0, 1, 2, \dots, N$$

Y is the number of children, and is defined as a function of the respondent’s age (A), wealth (W), female autonomy (F) and a group of other explanation variables, (Z), that includes socioeconomic status, education, preference for sons and others.

4.2 The Data

Demographic and Health Surveys

The data used is based on the Nepal Demographic and Health Survey (DHS), 2006. The organization Measure DHS have since 1984 been involved in DHS-surveys throughout the

developing world. USAID is the main economic contributor and ICF Macro is implementing the surveys. In Nepal, the NGO New Era had the responsibility of the interviews. The first round of DHS surveys done in Nepal was in 1987, and the 2006 edition is the fifth round of DHS surveys in Nepal.

My dataset comprise information about 10 793 women and 4 397 men from 8 707 households, and is nationally representative (Ministry of Health and Population [Nepal] 2007b). The dataset is divided into 7 recode files, women, men, births, children, couples, household and household member. For this thesis, only the women recode file is necessary. The men's recode could be useful, but only to fill out missing information about the respondent's husbands. Only a fraction of the women have their husbands interviewed, so it is not applicable in my analysis. The women recode file contains all necessary information regarding births, households and husbands that is useful for my purpose. All interviewed women are all in their fecund age, that is, 15-49. The questionnaire used in the survey contains questions about the respondent's health, family relations, household characteristics, education, occupation, births, children's health and other questions related to socioeconomic status, health and demography.

The unmarried women are removed from the dataset, because they can cause disturbance for some variables. Especially regarding the female autonomy variable are the unmarried women a problem, because their position in the household is not the same as for married women²⁵. None of the 2100 unmarried respondents report that they have ever given birth, thus, no respondents of interest is missed²⁶. It could be interfered that when so many of the respondents without children are excluded, interesting information about those choosing not to have children are lost. However, it is not normal for Nepalese women to choose to not get any children. I do expect that most of the removed respondents will marry and get a family at some point, though this is something I cannot know for sure. The removal of these respondents also reduces the problem with the dataset being zero-inflated, which will be discussed in the Methodology section. In the analysis, three samples are used; i) the all married sample, ii) all married with at least one child and iii) all married with at least two children. This is due to the specification of the dependent variable, which will be accounted for later in this chapter.

²⁵ To be more accurate; unmarried women are regarded part of the family they are born into, while married women are regarded as part of the family they are married into.

²⁶ Giving birth before marriage is socially unacceptable in Nepal. Some underreporting is obviously expected, but I believe that the number anyway is extremely low.

Sample Design

The DHS data is usually weighted. The reason for this is that the probability that a household is selected to take part in the survey is not necessarily the same for every household. For example, if the probability of being selected is different in urban or rural areas, this has to be accounted for to make the sample representative on a national level (Rutstein and Rojas 2006: 12-13). Urban respondents are intentionally oversampled to get a representative selection. This is adjusted for by sampling weights (Ministry of Health and Population [Nepal] 2007b).

The sample for the 2006 Nepal DHS is based on a two-stage stratified selection. At the first stage, 260 primary sampling units (PSUs)²⁷ are selected, with probability of being selected corresponding to their size. At the next stage, on average 30 households in urban and 36 in rural areas is selected. The number of households in each PSU varies. According to Anjushree Pradhan at New Era (with whom this was discussed in Kathmandu), the reason for this is that after the rural PSU's are chosen, they are divided into groups of twelve households of which three groups are randomly chosen. When the number of households is not exactly divisible by twelve, one of the groups will be larger or smaller. If this group is chosen as one of the three groups, the number of households in the PSU is not exactly 36. This is supposed to be an issue only for rural areas. In the urban areas, 30 households are individually drawn. This does not fit perfectly with the number of households per PSU observed in the dataset, probably due to replacements because of non-responses.

4.3 Empirical Methodology

In this chapter, the econometric methods used in the analysis, namely the Ordinary Least Squares (OLS) analysis and Poisson Regression Model are presented. The major challenge regarding my dataset is that number of children, the dependent variable, is an integer valued variable that is not normally distributed. Traditionally, this is assumed to make the OLS estimator biased. The Poisson Regression model is specifically designed to deal with such data, and is therefore also applied. However, it is not obvious which model gives the best results, but it makes sense to use more than one econometric model, at least for the sake of comparison.

²⁷ The PSU's are subwards in urban areas. In rural areas every PSU is a subward, a ward or a collection of wards in rural areas. The definition of a ward is found in the Background-Fieldwork chapter.

After presenting the OLS model, its assumptions, and a more detailed discussion of its limitation handling integer-valued variables (or *count data*); a presentation of the Poisson Regression Model is given.

Throughout this chapter, I use fertility data in general and the DHS data in particular to exemplify. This is however not a part of the analysis, which is done in the next chapter.

4.3.1 The OLS Regression Model

The OLS regression model is based on the Classical Linear Model (CLM) assumptions (Wooldridge 2006). The simple regression model states that a variable, y , changes in a certain manner as another variable, x , changes. In economic analysis, we are interested in finding out how variables affect each other, for instance how fertility changes with income. Equation (4.1) formulates the problem in the following way:

$$y = \beta_0 + \beta_1 x + u \quad (4.1)$$

where y is the explained (dependent) variable and x is the explanatory (independent) variable. β_1 and β_0 defines the relationship between the two variables. The β_1 measure the marginal effect; how y changes when x changes, and β_0 is a constant; its effect on y is not dependent on the value of x . When displaying the relationship graphically, β_0 is the intercept on the y -axis, and β_1 is the slope parameter. The the error term is represented by u and includes all other factors that affect y except from x . This model is hardly used since it only allows for one explanatory variable. The Multiple regression model can be written as:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k + u \quad (4.2)$$

Where β_1 is the parameter expressing the relationship between x_1 and y , likewise for β_2 through β_k , while β_0 , y and u has the same interpretation as in the simple model. In the OLS method, it is assumed that the y and the β 's has a linear relationship:

Assumption 1, Linear in Parameters:

The population model can be written as: $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k + u$ where $\beta_0, \beta_1, \dots, \beta_k$ are unknown parameters (constants) of interest and u is an unobservable random error term.

This implies that the relationship between the dependent and independent variables follow a linear pattern, that the relationship is the same regardless of the value of the variable.

Assumption 2, Random Sampling:

We have a random sample of size n $\{x_{i1}, x_{i2}, \dots, k, y_i: i = 1, \dots, n\}$ following the population model in assumption 1.

When doing statistical analysis, information from the whole population of interest is usually not available or is highly impractical to collect. A selection is then drawn from the population. The selection we use in the regression model is randomly sampled:

The estimated OLS regression model is:

$$y_i = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \dots + \hat{\beta}_k x_k + \hat{u} \tag{4.3}$$

where $\hat{\beta}_1 \dots \hat{\beta}_k$ represents estimates of the population values, and \hat{u} is the estimated error term, the residual. The variables in the estimated model must have the characteristic that they are not perfectly correlated:

Assumption 3, No Perfect Collinearity:

In the sample (and therefore in the population), none of the independent variables are constant, and there are no exact linear relationships among the independent variables.

Perfect collinearity is present when two of the independent variables for some reason are exactly the same or a variable is an exact linear function of (an) other variable(s). If I for example included both education in years of schooling and months of schooling as independent variables, perfect collinearity would be present. The way to deal with the problem is remove the variable(s) that causes collinearity. The interpreting of regression coefficients is the effect of a variable, when all other variables are held constant. This does not make sense when two or more variables have exact linear relationship. Some collinearity is of course not necessarily problematic and is practically impossible to avoid. However, high degree of multicollinearity can make the estimates difficult to interpret.

The population error term is an unknown parameter. In the Classic Linear Model, the expected value of the error term needs to have the following property:

Assumption 4, Zero Conditional Mean:

The error term, u , has an expected value of zero given any value of the independent variables.

In other words, $E(u|x_1, x_2, \dots, x_k) = 0$

The interpretation of assumption 4 is that all relevant factors that affect y are included in the model; the error term should be zero on average.

Assumption 5, Homoskedasticity:

The error, u , has the same variance given any value of the explanatory variables. In other

words $Var(u|x_1, \dots, x_k) = \sigma^2$

The variance is an important concept in regression analysis. It is an expression of the variation in the variable's values around the mean of the variable. The estimator variance is a measure of how far away from the true parameter the estimator is expected to be.

When obtaining the estimator variance, the homoskedasticity assumption is central. If the variance is *not* constant for all values of the independent variables, heteroskedasticity is present. Heteroskedasticity might make it difficult to get significant variables, and in addition cause interpretation difficulties. There might be good reasons for a data to exhibit heteroskedasticity, and although it could be a major problem, it can be corrected for in statistic computer applications²⁸.

In addition to being have a zero conditional mean and being homoskedastic, the error is assumed to be normally distributed:

Assumption 6, Normality

The population error, u is independent of the explanatory variables, x_1, x_2, \dots, x_k and is normally distributed with zero mean and variance σ^2 : $u \sim Normal(0, \sigma^2)$

This is a strong assumption, implying that the sum of the unobserved factors is independent of the variables and normally distributed. Whether this assumption is correct depends on the data on hand. However, the error term is unobserved, so whether it is normally distributed or not is a theoretical discussion. Even more important is whether a violation of the assumption poses a large problem and how to deal with it. For big samples, a violation is not a big problem and taking the log of the dependent variable can make the distribution closer to the normal

²⁸ The variance estimator in my empirical analysis corrects for heteroskedasticity The variance estimator in the survey command in STATA is using the Huber-White robust variance.

(Wooldridge 2006). Under the CLM assumption, the OLS estimators are BLUE, Best Linear Unbiased Estimators²⁹. The normality assumption's applicability concerning count data is discussed later.

Obtaining the estimators

The OLS method applies to the linear regression model, meaning that there is a linear connection between the explanatory variables (the x 's) and the explained variable (the y). The estimates are obtained by minimizing the sum of the squared residuals. The estimation method used is called the *Method of moments approach*. The Method of Moments approach uses the sample average as the unbiased estimator. In this section, for simplicity, I use the simple regression model with one explanatory variable:

$$\begin{aligned} y_i &= \beta_0 + \beta_1 x_i + u_i \\ \Rightarrow u_i &= y_i - \beta_0 - \beta_1 x_i \end{aligned} \quad (4.4)$$

To find the estimator, we use that the expected value of the error is zero and assumption 4:

$$E(u) = 0 \quad (4.5)$$

In addition, the covariance between x and u is expected to be zero³⁰:

$$Cov(x, u) = E(xu) = 0 \quad (4.6)$$

Inserting the regression model into 4.6 and 4.7 gives:

$$E(y - \beta_0 - \beta_1 x) = 0 \quad (4.7)$$

$$E[x(y - \beta_0 - \beta_1 x)] = 0 \quad (4.8)$$

The aim is to find estimates for the parameters. We have a selection of n respondents and estimate the population parameter counterparts using:

$$\frac{1}{n} \sum_{i=1}^n (y_i - \hat{\beta}_0 - \hat{\beta}_1 x_i) = 0 \quad (4.9)$$

²⁹ Best=with lowest variance, Linear=linear in parameters, Unbiased=the estimator is an unbiased estimator of the true population parameter.

³⁰ Zero covariance means that the variables are independent of each other (not correlated).

$$\frac{1}{n} \sum_{i=1}^n x_i (y_i - \hat{\beta}_0 - \hat{\beta}_1 x_i) = 0 \quad (4.10)$$

Rewriting 4.10:

$$\frac{1}{n} \sum_{i=1}^n y_i - \hat{\beta}_0 - \hat{\beta}_1 \frac{1}{n} \sum_{i=1}^n x_i = 0$$

and defining the means:

$$\frac{1}{n} \sum_{i=1}^n y_i = \bar{y} \text{ and } \frac{1}{n} \sum_{i=1}^n x_i = \bar{x}$$

Gives

$$\bar{y} = \hat{\beta}_0 + \hat{\beta}_1 \bar{x} \Rightarrow \hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x} \quad (4.11)$$

When the slope parameter is known, the intersection is easily computed by 4.11. Inserting this equation into 4.10 gives:

$$\sum_{i=1}^n x_i [y_i - (\bar{y} - \hat{\beta}_1 \bar{x}) - \hat{\beta}_1 x_i] = 0 \Rightarrow \sum_{i=1}^n x_i (y_i - \bar{y}) = \hat{\beta}_1 \sum_{i=1}^n x_i (x_i - \bar{x})$$

($\frac{1}{n}$ is dropped here, as it do not affect the solution)

Using the property that:

$$\sum_{i=1}^n x_i (x_i - \bar{x}) = \sum_{i=1}^n (x_i - \bar{x})^2 \text{ and } \sum_{i=1}^n x_i (y_i - \bar{y}) = \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})$$

As long as

$$\sum_{i=1}^n (x_i - \bar{x})^2 > 0$$

The estimator is:

$$\hat{\beta}_1 = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^n (x_i - \bar{x})^2} \quad (4.12)$$

Mathematically, it can be shown that, given the assumptions, the OLS estimator is BLUE.

The calculation above is from Wooldridge (2006).

OLS and Count Data

Emphasizing the last sentence, *given the assumptions*, the OLS estimators are appropriate. Are the assumptions realistic, do they hold in my dataset, and if not, what are the consequences and further, what are the solutions?

The dependent variable in this case is a typical example of a count variable; it can only take on integer values and cannot take on negative values, $y = \{0,1,2, \dots n\}$. The typical place where the OLS assumptions are violated when dealing with count data, is the normality assumption, is the error term normally distributed? When the dependent variable is a continuous variable which can take on any values, this assumption is usually unproblematic. However, this is not the case for my dependent variable:

Figure 2: The dependent variable.

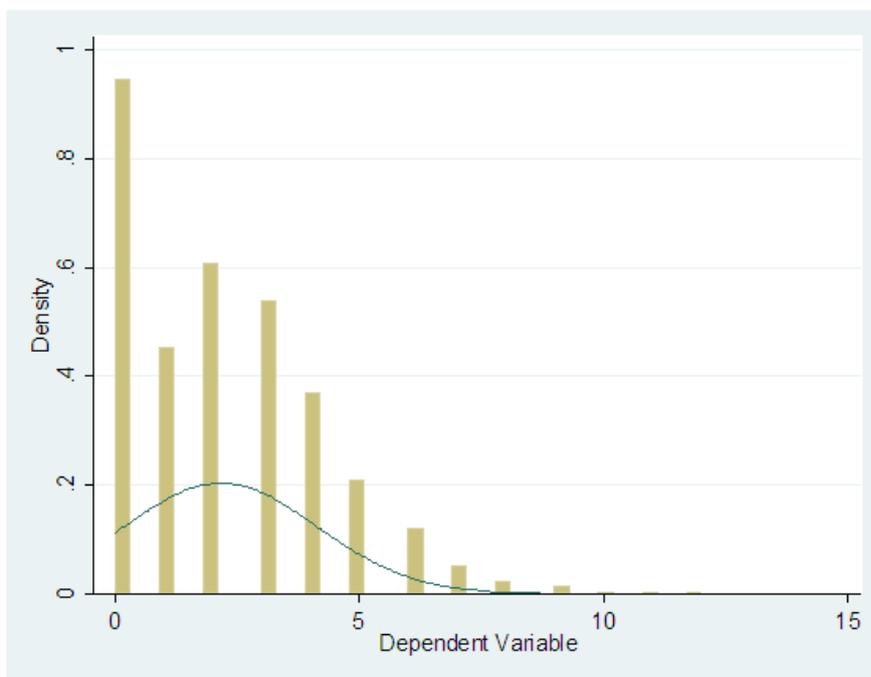


Figure 2 shows the distribution of the dependent variable in my dataset (the line in the graph is the normal distribution). Zero is the most frequent observation, and since there are no

negative responses, the distribution only have one-sided tail. The variable is not normally distributed.

When the model is predicted, it does not follow the true population distribution perfectly. The difference between the estimated and the true model are the error terms. The crucial point is thus; how are the errors distributed? Since the dependent variable is not normally distributed, the error term has the same property (Wooldridge 2006). Regarding count data, the main interference against the OLS method, is that the error term *cannot* be normally distributed because when the variable in question can only take on few values. However, if it is assumed that most of the variation in the model is explained by the independent variable, so that the difference between the estimated and the true model is not very large (and not very biased). Furthermore, as the sample is large, the error term can still be close to normally distributed.

There is however a few models that specifically deal with count data dependent variables, the Poisson Regression Model being one of the most frequently used. This model is especially appropriate for data such as the ones I am dealing with (Wooldridge 2006 and Greene 1997).

4.3.2 The Poisson Counting Process, Distribution and Regression Model

In the Poisson Regression Model, that the data follow a Poisson distribution rather than the normal distribution. The Poisson distribution is a certain probability distribution that requires that the variable follow a Poisson Counting Process.

The Poisson Counting Process

A counting process is a situation where a certain event happen a number of times in a given time interval. $N(t)$ is the number of events occurring before time t . Definition:

- a. $N(t) \geq 0$
- b. $N(t)$ is integer valued
- c. If $s < t$, $N(s) \leq N(t)$
- d. For $s < t$, $N(t) - N(s)$ gives the number of events in the time interval (s, t) .

In addition, the following features may apply to a counting process:

- a. The process possesses *Independent Increments* if the numbers of events occurring in two independent intervals are independent.

- b. The process possesses *Stationary Increments* if the distribution of the number of events taking place in a time interval is only depending on the length of the interval, not when the interval takes place.

A Poisson counting process requires both independent and stationary increments (Ross 1993).

Independent Increments

Independent Increments means that the number of events taking place in a certain interval should not be affected by how many events occurred in a preceding (or succeeding) interval. For births on an aggregate level, this does not apply; obviously the number of births in a population is affected by how many births took place 20 years ago. On the individual level it can be argued that the process of getting children has independent increments, because getting one child does not necessarily affect the possibility to get another. Medically speaking, this probably applies, unless one considers that complications during the pregnancy or birth might affect the possibility to get children later. There is also a certain period after a birth that women cannot get children, but this can be accounted for.

Putting the medical aspects aside, is it plausible to believe that any two disjoint time intervals are independent? There might be two effects at play, those who are getting many children rapidly are perhaps more disposed to get even more children. For instance, young age at first birth is often correlated with getting many children. On the other hand, the probability of getting additional children after already having one or two is likely to get smaller, decisions regarding children are affected by prior births. This depends on the number of children as well. In some situations, for example for few number of children, having given birth to one might not at all affect the desire to get another (want more than one anyway), but to believe that this will apply for all time intervals is a very strong assumption, and is probably not true.

Stationary Increments

When discussing Stationary increments, I will also begin with the medical point of view. Is it realistic to assume that all the women are identically able to get children regardless of their age? Although women from 15-49 are all in their “fertile age”, I suppose that the probability of getting pregnant and successfully give birth is larger for those between 18 and 35 than for those outside this age-group.

As previously argued I expect that most women in Nepal follow the pattern of getting married and get children early and then stop getting children after having got their desired number of

children. This does not go well with stationary increments, and I find it difficult to argue that the fertility data have this feature unless making assumptions with few links to reality.

The Poisson Regression Model

The Poisson Regression model is based on the Poisson distribution. The Poisson distribution says that the probability that x events take place in any given time interval is:

$$f(x) = \frac{e^{-\lambda} \lambda^x}{x!} \quad (4.13)$$

λ is the mean of such occurrences in the relevant time-span. In the Poisson regression model, the probability that the dependent variable takes on a certain value is:

$$Prob(Y_i = y_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}, y_i = 0, 1, 2, \dots \quad (4.14)$$

λ is a parameter related to the independent variables, for example as $\lambda = \mathbf{x}\boldsymbol{\beta}$, where \mathbf{x} and $\boldsymbol{\beta}$ are vectors of the x and β (the variables and the coefficients). Assume an ordinary regression model,

$$y = \beta_0 + \beta_1 x_1 + \dots + \beta_k x_k \quad (4.15)$$

As already discussed, the linear model has limitations when dealing with count data, but to get to the Poisson regression equation, I start with the normal linear model. I want to find the expected value of y conditional on \mathbf{x} , using an exponential function:

$$E(y|x_1, x_2, \dots, x_k) = \exp(\beta_0 + \beta_1 x_1 + \dots + \beta_k x_k) \quad (4.16)$$

The exponential function is convenient when dealing with count data, because it is always positive (so the expected value will be positive). Also, it can handle zero-values, as is not the case for the logarithm-function. Taking the log of the expected value function, gives:

$$\log[E(y|x_1, x_2, \dots, x_k)] = \beta_0 + \beta_1 x_1 + \dots + \beta_k x_k \quad (4.17)$$

In other words, the log of the expected value is a linear function. Instead of using the normal distribution, it is usual to make the assumption that the count dependent variable, conditional on the independent variables has a Poisson distribution. I define

$$E(y|\mathbf{x}) = \exp(\mathbf{x}\boldsymbol{\beta}) \quad (4.18)$$

where the expected value is the same as the exponential function presented above (function 4.16). The probability that y takes on a certain value, h , using the Poisson distribution is:

$$P(y = h|\mathbf{x}) = \frac{\exp^{-\exp(\mathbf{x}\boldsymbol{\beta})} \exp(\mathbf{x}\boldsymbol{\beta})^h}{h!}, h = 0, 1, \dots, \quad (4.19)$$

This is as the same function 4.14, but the λ is replaced by the expected value of the y or the mean of y conditional on \mathbf{x} . This distribution gives us the opportunity to find the probability $P(y = h|\mathbf{x})$ that the dependent variable takes on any value.

Problems with the Poisson Regression Model

Zero-inflated data

In count data it is not unusual that you have an excess of zeroes, or a zero-inflated dataset; the data contains more zeros than what would normally be expected.

The main reason that respondents don't have children is that they have not yet reached the age when they will get their first child. This indicates that there is an excess of zeros, but on the other hand, there is an excess of ones and twos, probably also threes and fours for the same reason. The point is that the variable is zero-inflated if interpreted as "how many do Nepalese women get", but maybe not if interpreted as "how many children do Nepalese women of different age have". The last interpretation is the correct one, and the variables concerning age and marriage will probably deal with the problem. If the data is expected to be zero-inflated, the solution is to use a model specified for such data, for example zero inflated Poisson.

Over-/underdispersion

One particular assumption of the Poisson regression is equidispersion; the dependent variables variance is equal to its mean:

$$Var(y|\mathbf{x}) = E(y|\mathbf{x}) \quad (4.20)$$

This doesn't always hold, and a normal problem is overdispersion of the variance; the variance is bigger than the mean. Underdispersion can also occur, but is less frequently experienced.

Overdispersion and underdispersion is associated with independence of events. The variance is the same as the mean of the variable if the events have independent increments. Overdispersion will occur if events are positively correlated, underdispersion if the events are negatively correlated (Nguyen-Dinh 1997). As earlier discussed, births can be argued to have independent increments. To get an indication, checking the mean and standard error is an idea. At first sight, there are signs of overdispersion in the data, as the variance of the dependent variable is 3.41, compared to the mean, 2.69.

If the model is overdispersed, the Negative binomial regression model is an option. This model is less strict regarding the relationship between the mean and variance. I do run a Negative Binomial Regression on one of the models to test for overdispersion.

Goodness-of-fit

In the OLS analysis, the R-squared is the usual way to check the goodness-of-fit, or the explanatory power of the model. The R-squared cannot be used in Poisson Regression, but STATA reports a Pseudo R-squared. The interpretation of the Pseudo R-squared (McFadden's R-squared) is not analogous to the R-squared reported in OLS regression, but should give an indication of the fit of the model.

In addition to the McFadden's R-squared and running the Negative Binomial Regression, I do a deviance goodness of fit test. A chi-squared test is testing whether the Poisson distribution is correct. The goodness of fit results will be reported in the data analysis chapter.

4.4 Variables and Hypotheses

This section explains why variables include chosen the, how they're modified to suit the model and which direction I expect their signs to have in the empirical analysis. A list of all the variables, their names and descriptive statistics are found in Appendix 2. Descriptive statistics of the most important variables is also presented in Table 4 in the findings.

4.4.1 Dependent Variable

The choice of dependent variable might have important impact on the results. Regarding fertility analysis, there are a few options. Since child-mortality-rate still is quite high in Nepal, total number children ever born, would not be the best choice. If a child dies at young age, I would expect the family to try to get another quickly after, as the decision to get the child already is taken, but the child is not alive. It is of course the surviving child and not the birth that is of interest for the family. Total number of living children is another option, but it excludes children that might have grown up before they died.

To exemplify: a family, having one son, might want another because of insurance against the possibility that one might not survive. If they get another son who dies at very early age, there is a possibility that the family will continue to try to get the second son. At some age, the parents might not replace the child, if it dies. This age is difficult to determine, but I expect that when a child has survived his or her first five years, it is unlikely that the household will try to replace the child. Under-five mortality is also the usual limit used to compute “child-mortality”. This threshold could be subject to change, especially as the fertility-rate is declining.

Another problem regarding the dependent variable is the way age affects fertility. It has two effects. One is that you get more children as your life evolves, *the same individual* will have more children when she is 30 than she had when she was 18. The other way age affects fertility is through the fact that the fertility-rate in Nepal have declined dramatically the last years. This means that, on average, older respondents will have more children than younger respondents for any period of life.

One way to partially deal with the problem, would be to exclude the youngest respondents. It is also possible to use a combination of age and fertility as the dependent variable, e.g. by using the age-specific fertility rates (ASFR)³¹. This could capture both differences within and between 5-year cohorts, but the ASFR is calculated on an aggregate level (in the DHS-reports, per 1000 women), and does not easily convert to individual level.

The dependent variable used, is based on the variable labeled “total children ever born” in the dataset. It has been modified, so it includes all living children, in addition to those that have died, but survived their first five living years. Age will be included on the right-hand-side of

³¹ ASFR is measured as the number of births divided by total women-years in a specific age group (Ministry of Health and Population[Nepal] 2007b: 63)

the regression equation as an independent variable. I use both the results from the all married selection and the results from the selection where only the respondents with at least one and two children are included. The all married selection also has weaknesses: many of the respondents with few children will be getting more children, and this effect is only partly captured in the age-variable. Comparing it with the other selections, gives me the opportunity to find out which coefficients that are clearly biased because of this effect. This partly solves the problem regarding how to isolate the two age-effects, and is in my opinion the best solution to the problem.

4.4.2 Independent variables

The education and occupation variables are included for both respondents and their husbands. A word of caution is necessary with regards to the husband-variables. They are not collected from the men's dataset, and are thus not from the interviews of the men themselves, but from the women's answer to what their men do for a living and how educated their men are. Only approximately 4500 men are interviewed, and all of them are not necessarily husbands of the respondents. Merging the datasets and including variables from the men's dataset would therefore largely reduce my sample. The cost of doing this is the potential for incorrect reporting, especially are husbands education not necessarily known by the wife. The literacy variable is also based on the respondents' ability to read a certain sentence. This is obviously not available for men in my model. However, the gains from using data from all respondents are in my opinion greater than the cost of a possible inaccurate reporting.

Variables of special interest

Income / wealth

I expect that the richer the family is, the fewer children they will have. This is a direct interpretation of Becker's assumption that as income increases, the demand of number of children will decrease, and the demand for quality will increase.

As discussed using the Quality-Quantity model, higher income can make the preferences change towards spending more on each child. Even though demand for all goods increases with increased wage, if the price of quality is sufficiently high, higher income can lead to fewer children. The opportunity-cost effect is also important, but I cannot separate between male and female wealth, and I do expect men to be the main contributor to the family economy. More children means less time spent on each, so is unlikely that more money leads

to more children, as this can result in lower quality for each, unless much more money is allocated to children's consume.

There are no income-variables in the dataset, but there is a wealth indicator. The indicator divides the respondents into five quintiles, ranging from poorest to richest. The index is based on assets, housing characteristics and sanitation and water facilities. The different components are weighted using the Principle Component Analysis³². I have changed the variable into five dummy-variables. I use this wealth indicator as a measurement of wealth and income, as I expect firstly that income and wealth in general is highly correlated and secondly that assets and housing characteristics is a good indicator of family's income levels.

Education

I include education in this section, as education is a good indicator of income-opportunities. Education affects fertility in multiple ways.

Mothers' education might increase the opportunity cost of child-bearing because higher education lead to higher income opportunities. There is a possibility that increased income make women work less, because with a higher wage, the same income-level can be reached with fewer working-hours, hence having the opportunity to raise *more* children. I do, however, expect the income effect to dominate the substitution effect, so that higher income leads to higher labor-supply.

Mother's education delays the birth of the first children, implying that the total fecund period will be smaller. This assumes that women will wait to get pregnant until she has finished her education. Choe et al (2005), finds that education to some degree leads to later marriage and that early marriage is connected to early motherhood. The paper does however not say anything about the relationship between early marriage/motherhood and total children. It is a plausible assumption in my opinion to expect early motherhood to be correlated with getting many children, also made by Mason (1987).

³² Principle Components Analysis (PCA) is a statistical method used to reduce the number of variables if you have many correlated variables that are thematically related to each other. The method is used to simplify the interpretation process or as a means to deal with multicollinearity (correlation between the independent variables). If you have a set of related indicators that are highly correlated, you can summarize these to form one variable. Each indicator is given a weight and these weights are computed in such a way, that the variation of the collected indicators is maximized. Stated differently, the squared correlation between the summarized indicators and the original variables is maximized (Dunteman 1989). In this case, it makes more sense to have one composite variable of different wealth-indicators, than to include all variables concerning housing, assets etc.

Desire for more educated *children* increases the cost of children, making households switch from quantity to quality of children. This will work through the household's utility function if education leads to higher utility of high-quality children relative to quantity. The third point is important for a society in change, like Nepal is today. Many children growing up today have parents that expect them to have more education than the parents themselves. Education is expensive, so if a family wants educated children and have limited economic resources, they will have to limit the number of children³³.

I expect education to increase awareness of possible negative consequences of having large families. I also expect more education to lead to better knowledge about contraception and better ability to get hold of and understand information about issues related to family planning. This not necessarily only apply to individual education-level, but can also have an effect if the community gets higher educated.

Education can also help to empower women. Higher educated women might be better able to stand up against pressure from husbands and in-laws. When it comes to husband's education, the effect on fertility does not work through the opportunity cost effect. The changes in preferences and attitudes is likely to change for men in the same way as for women, but all in all, I expect that men's education are less important than women's.

In the dataset, education is reported as whether the respondent has none, primary, secondary or higher education. There is also during the interviews performed a test where the respondent is asked to read a certain sentence. Dummies are used for no education, primary education, secondary education and higher education. I also use one variable for those who have no formal education, but are not analphabets, to test for the effect of informal education. Husbands' education is reported by the respondents (their wives); no education, primary, secondary and higher education.

Female autonomy

Nepal is a society where women have significantly lower status than men. Females are for instance less likely to get education and jobs than men are (Ministry of Health and Population [Nepal] 2007b). They also carry most of the burden of household-duties, including caring for and raising children. Regarding education and work (especially work outside the agricultural sector), increased female autonomy will increase the opportunity cost of children if female

³³ Public education is free in Nepal, but books and uniforms are not. Many also prefer (non-free) private schools, and having children in school means that they are not helping out at home or contributing to the family economy.

empowerment increase the probability that women get education and jobs. This effect will however probably be captured in the education and work variables.

If the wife in the family faces greater costs of getting children than the husband because of the heavier burden during the pregnancy and the up-bringing process, women might have stronger preferences for limiting the number of children than men³⁴. If this is the case, then I will assume that higher degree of female autonomy will give the women more power over contraception usage and other decisions affecting fertility. In the theory chapter, multiple levels on which female autonomy can affect fertility were presented. Women also experience substantial pressure by husband and in-laws when it comes to delivering the desired number of children with the desired gender (sons) (Crehpa: 2007). Thus, I expect female autonomy to have a negative relationship with fertility.

As a measurement of female autonomy, I have chosen the variable labeled “Final say on visits to family and relatives”. In the questionnaire, the respondent is asked about who have the final say on the family’s visits to family and relatives. The alternatives given to the respondents are “respondent alone”, “respondent and husband/partner”, “husband/partner alone”, “someone else” and “other”. The different responses are coded as dummies.

The variable has limitations. For some families, the decision about family-visits can be irrelevant as a measurement for relative power. However, given the influence the man and the in-laws (in particular the mother in law) has in the average Nepalese family, I find it plausible to assume that in cases where the wife has the last say on visits, the women also has more power in general compared to the cases where the man has the last say.

Background variables, other Socioeconomic and Geographical Variables

Age

The independent variable age is expected to be positively related to number of children. The reason is twofold, as mentioned on page 41. Each woman gets children as her life evolves, and older women lived in a period where higher fertility was normal.

I have also included age-squared to account for non-linearity. There is a possibility that this could be positive, if the second effect of age on fertility is very strong, but this is unlikely. I

³⁴ 17 percent state that their husband wants more children than themselves, 7 percent want more children than their husbands. This corresponds with ideal number of children, which is slightly higher for men than for women (2.8 against 2.5).

expect this to be negative, indicating that number of children one gets is increasing but on a diminishing rate as age increases. The intersection between the first and second-order term should be somewhere after 49 years (the age of the oldest respondents), because I do not expect older respondents to have fewer children.

Marriage

Sex outside marriage is not socially accepted in Nepal and it is unheard of to get children without being married, and few do. Marriage duration is expected to have much of the same effect as age. I also include a second-order term for the same reason as for age. In addition to not getting children before marriage, it is usual to get children quite early after marriage. 14 percent get children during their first year of marriage, 36 percent in the second and 21 percent in the third. 38 percent are getting pregnant with their first child during the first year of marriage (giving birth between the eighth and twentieth month after marriage). Nepalese women also generally marry early. According to the DHS data, 85 percent of Nepalese women married before the age of 20. This is based on all respondents, from 15-49 years, so if this has changed the last 20 years, the data does not capture this change, but comparing with the 1996 dataset, there seem to be very little change.

The variable is expected to have a positive relationship with fertility and the squared-term to have a negative relationship. Women get children early, but many also stop getting children at an early stage. As contraception is getting more widespread, available and accepted, it is easier to stop getting children after reaching the desired number. This early stop will probably make the first and second order terms to intersect early.

Caste/Ethnicity

In Nepal, ethnicity is closely related with income, education opportunities and occupation. I expect that the lowest castes get more children than higher castes, but that the effect is related to indicators such as income and education and that some of it might diminish when this is controlled for.

The Muslims are outside the Hindu caste system but are regarded to be at a low level in the social hierarchy. I expect them to get more children than the non-Muslims, as is usual to find in comparable countries (Morgan et al. 2002). One hypothesis is that Muslims do not have the same access to contraceptives because of social constraints; it is not socially desired to use contraceptives. Bhalotra et al. (2010) suggests that Muslims have better maternal health, thus

lowering the risk for fetal death, hence potentially increasing number of surviving children, especially since they do not use contraception³⁵.

If castes show some significant effects it may be due to discrimination in the labor market. If low-castes do not expect their children to have any chances to enter the labor-market due to discrimination, the rate of return from investment in quality will be low. These parents will consequently have a relative lower demand for quality than other parents from other castes, all other things being. Another explanation could be that there are social structures and norms that make some groups getting more or fewer children than other.

I have sorted the ethnicity-variable in the original dataset into 8 dummy variables. These are:

- Brahmin and Chetri, high castes
- Hill Ethnic, Ethnic groups with origins from the Hill and Mountain zone
- Terai Middle, Middle and high castes with origins from the Terai zone
- Terai Ethnic, Ethnic groups with origins from the Terai zone
- Hill Dalits, low castes with origins from Hill and Mountain zone
- Terai Dalits, low castes with origins from the Terai zone
- Muslims
- Other

The reason for sorting the ethnicity in this particular way has to do with capturing the most interesting differences for my purpose, which is to test whether position in the hierarchy is a determinant for fertility. In the dataset, there are 75 castes / ethnic groups. Most of the groups have fewer than 100 observations. This means that many of the groups are impossible to use for statistical purposes without sorting, and the interpretation would be challenging. A more in-depth analysis of the differences between the ethnic groups in Nepal, would have called for a different approach. The sorting is done in accordance with Gurung (2006).

The sorting is made in this particular way to collect groups that are relatively similar. Dalits are low-castes, the ethnic groups follow, Middle castes are ranked higher and Brahmins and Chetris are the traditional highest castes. As commented in the background chapter, castes from the Hills and Mountains regard themselves as higher ranked than those from the Terai zone.

³⁵ 20 percent Muslims, compared to 45 percent total uses contraception (DHS Data 2006). Some underreporting should also be expected here, but there is some evidence that the usage is lower among the Muslims.

Urban/Rural

In a global and historical perspective, urban families are usually smaller than rural families. Families with farms will possibly face lower costs in raising children because children might contribute to the farm from a relative young age. In general, food is cheaper for farmers. This effect is likely to diminish when the farming industry is modernized. The expense of sending children to school might be higher for families in rural areas, as the population is less dense, and the travel-cost increases with distance to school³⁶. In this sense, rural families might at some level face higher costs of raising children (Becker 1991). Manual labor is still very important in Nepal's agricultural sector and I expect rural families to have more children than urban families.

The fertility rate is much lower in the urban areas than in rural³⁷. The effect of the rural variable is likely to be associated with occupational status. I also expect education and income to be lower in rural areas than in urban, and there can be different norms present in the different areas. However, it is likely that there are more traditional views on family and fertility in the rural areas. If attitudes regarding family are changing in Nepal, this change will probably take place earlier in the urban than in the rural areas. Thus, living in the rural area can be expected to have a positive relationship with fertility even when the other variables are accounted for.

In addition to the urban/rural distinction, I use a Terai-dummy. There *are* differences between the zones when it comes to number of children, so it is definitely worth testing. Are there characteristics with the geographical areas *in themselves* that make these differences, or are these differences are connected to differences in the other independent variables? One possible reason for households to get more children in the hills and mountains can be that it requires more labor to run the farms in the steep terrain, than in the flat Terai, and at the same time, the labor market is less developed. Also, expenses to schooling may be higher, due to higher transportation cost.

Occupation/Work

Nepal is an agricultural society. According to the DHS data, 73 percent of women are employed in the agricultural sector, and 41 percent of their husbands are the same. There are obviously differences within the agricultural sector. Some are large landowners, some are

³⁶ In transportation cost, time spent in getting to and from the school is included, as the children cannot take part in household activities or wage labor during this period.

³⁷ 3.3 in rural and 2.1 in urban areas (Ministry of Health and Population [Nepal] 2007a)

farm labor and others agricultural workers. In other words, it is difficult to make assumptions based on the agricultural sector variable alone. Families with a small farm might have a greater need for a big family if they need help on the farm or in the house. Females employed in other sectors might also face heavier losses when having children, especially if the wage is higher, hence higher opportunity cost for activities that includes being away from work, the same effect as higher education is expected to have. The variables used in the empirical analysis is coded as dummies for those (respondent/respondents husbands) working in agricultural sector, service sector, industrial sector, those who do not work and the cases where the respondent's job is not in any of the questionnaires categories.

Siblings

Siblings refer to the respondents' siblings, and I test whether respondent who have had/had more than 4 siblings get more children than others. It may be expected that women growing up in a big family are more likely to get many children themselves; hence I expect the dummy to be positive.

Family Planning and the Availability of Health services

I include two variables concerning family planning and health facilities. The first one regards respondents living in a district where the Family Planning Association of Nepal (FPAN)³⁸ had 6 or more projects in 2008. The argument behind including the variable runs like this: districts where an NGO such as FPAN is represented with many projects; information and knowledge about family planning should be easily accessible. I expect respondents in "FPAN districts" to have fewer children than others. However, the districts where FPAN are operating are probably not selected randomly. One possibility is that they choose districts with high fertility, where they are most severely needed. Another possibility is that they operate in regions that are easily accessible. Thus, this variable must be cautiously analyzed. Geographically, FPAN is most active in Terai and Hills zones, and in the eastern and central part, the parts of Nepal which is most densely populated. Variables controlling for regional differences are also being used, so if there still is a significant effect of the variable, this can indicate that family planning projects can have some effect. This variable is constructed by information gathered from the FPAN web-page and the 2008 report (which I got access to in Kathmandu). This is the only variable that is not in the original dataset.

³⁸ FPAN is one of the biggest family planning NGO's in Nepal, contributing to 25-30 percent of the family planning programs in Nepal.

Contraception usage is regarded as one of the main reasons behind the decline in fertility in Nepal. According to the three latest DHS surveys, contraception usage has increased from 28 percent to 48 percent³⁹ (Karki and Krishna 2008). Better access and more knowledge about contraception and family planning is without doubt an important tool to reduce the population growth *if* the population gets more children than they want. Historically, in most places, the fertility rate has been below the maximum reproduction possibilities. Without modern contraception, population has to some degree been controlled by people's preferences for fertility (Becker 1991). Accordingly, it is important not to exaggerate the effect of contraception itself, but in combination with changing norms and information, it can certainly be effective in helping people meet their desired fertility levels.

The other variable is respondents stating that the distance to the nearest health facility makes it "a big problem" to get medical help. My hypothesis is that the nearest health facility for most people will be where they seek advice on family planning. The price and effort to get information and treatment regarding family planning thus increases when the distance to the nearest health facility increases. It can have the effect that the newborns in the community get less medical attention, leading to higher mortality rate for children. Further, this could lead to increased fertility rate because of expectations of lower survival rate for the children. The female community health volunteers (FCHV) is an important source of information regarding family planning, and can effectively deliver information even if the distance to the closest health facility is far away⁴⁰. However, big distances can also make the working conditions worse for the FCHV, so how much they compensate for this is difficult to say. I expect that problems concerning the distance to the nearest health post to have a positive relationship with fertility.

Electricity

To some extent, electricity is accounted for, as it is included in the wealth-index. About half of the Nepalese population has electricity, a sharp increase from below 20 percent in 1996. Herrin (1976) investigates the link between fertility and electricity with the background that electrification boosts socioeconomic development. One possible effect of electricity is that it starts a modernization process leading to easier access to information and better health facilities. I would suppose that most of the electricity effect is controlled for by education and income and thus diminish when those variables are included. Electricity can however be

³⁹ Current usage.

⁴⁰ For information about the FCHV, see the Chapter 2.

introduced in a region or a village and then be provided to all inhabitants regardless of socioeconomic status. Thus, it can be an indicator of different norms, if having any significant effect. Another and less “academic” assumption is that families with electricity and light to a lesser degree participate in “child-producing activities”.

Testing the preference for boys as a natural experiment

The assumption

In Nepal, sons are in general preferred to daughters. One way to get an indication of the magnitude of this preference is to compare the average number of children if the two first born are boys (3.17) with the same number if the two first born are girls (3.93).

The testing of the boy-preference is done by including variables containing information about the sex of the first (two) born child (ren). The dataset will at the same time of course be reduced to contain only the families with at least one and two children, respectively. I expect to find that families who get a girl as their first child will get more children than those who have a boy as their first child. This picture will probably be even clearer for the families with girls as their two first born children. I use two dummies for the gender of the first born, and three for the two first born (two boys, two girls or one of each). These are *not* included in the regression with the all married sample, but in the two other samples.

Natural experiment

Natural experiments are “Situations where the forces of nature or governmental policy have conspired to produce an environment somewhat akin to a randomized experiment” (Angrist and Krueger 2001). In a random experiment, an effect is tested using two groups, one treatment group and control group (Wooldridge 2006). Testing the effect of a medication serves as a good example; among the participants of the test, one group is randomly assigned to get the real medicine, while the other gets a placebo (“false” medication). Only if there are significant better effects among the treatment group compared to the control group, can conclusions be drawn in the direction that the medication is effective. Such tests are usually not available for or applicable to economic research. It is impossible, or at least highly impractical, to construct two groups to be involved in an experiment where they are randomly given different income levels to investigate the effect of income on fertility. However, sometimes one is able to use exogenous phenomena from real life to approximate a randomized experiment. If a certain policy is implemented, one can use data from two random groups in the time *before* and the time *after* the implementation to find the effect of

the question in interest. For my case, the gender of the child born is a natural experiment. Those getting two girls first can be considered the randomly selected treatment group, while those getting two boys first are the control group. If preference for boys is present, the treatment group should get significantly more children than the control group. The advantage of natural experiments is that they are not affected by the other variables in the model. A discussion regarding causality and natural experiments is also done in chapter 5, as is the rest of my Empirical analysis, where the hypotheses above are tested.

5. Findings

The Regressions are based on the empirical model, using OLS and Poisson Regression. The estimation equations are found in the empirical methodology section. All models are presented in appendix 3, and the most interesting OLS results in table 4 below⁴¹.

Goodness-of-fit, the Models and the Presentation of the Results

The R-squared in the OLS analysis is between 0.42 and 0.55 (Table 4), indicating that around half of the variations in fertility can be explained by the variables in the model. The Poisson Pseudo R-squared is not reported with the survey-command, so regressions without the survey command are done to check the pseudo R-squared, giving results that range from 0.08 to 0.18 (Appendix 3c) These do not, however, necessarily correspond, but the low McFadden R-squared indicates that the model is inferior to the OLS model. A chi-squared test gives some indication that the Poisson distribution might be correct, and the Negative Binomial Regression gives indications of equidispersion⁴². There are no sign that the Negative Binomial Model should be preferred over the Poisson, in fact, since equidispersion is present, the Negative Binomial *is* an ordinary Poisson regression, as seen from equal coefficients (Appendix 3d).

Model 1 in Table 4 is the regression with the all married sample, Model 2 is the at least one child sample and Model 3 means the selection including only women with at least two children. The best model is probably Model 3. It does not have the largest R-squared, but intuitively, it has some advantages over Model 1 and 2. In Model 1, a large number of respondents are early in their part of life where they get children. This number decreases in model 2 and 3. All 3 models are used as my findings, as it is useful for the sake of comparison, but unless otherwise stated, the results are from Model 3.

The reasons for choosing to present the OLS results rather than the Poisson results are threefold. First, the R-squared issue already discussed, a large R-squared indicates that the model fits quite well. Perhaps the main reason is that the Poisson results can also be challenging to interpret, so the OLS results are more convenient for the sake of interpretation and discussion. Furthermore, the results are quite similar, so the discussion is not greatly

⁴¹ The occupation variables, geography dummies and the health facility is excluded, but is included in the models in the Appendix.

⁴² In the Negative Binomial Regression it is constructed an overdispersion parameter. This being equal to zero implies an equidispersed correct Poisson distribution. The parameter is *not* significantly different from zero.

affected by the choice of model. In addition, the assumptions behind the Poisson model seem too strong, especially those regarding independent and stationary increments. As Nguyen-Dinh (1997) points out, there is correlation between previous and succeeding births, however not systematically. He estimates the correlation between births by doing a regression analysis with number of births in previous age-intervals as independent variables. Births are according to his findings positively correlated for women younger than 34, but negatively correlated for older respondents. The normality assumption behind the OLS model probably also is too strong, so that the choice of model is by no means trivial. In the appendix, the Poisson Results are presented using Incident Rate Ratios (IRR). An IRR of 0.9 means that a one unit change in the independent variable causes the dependent variable to change with the ratio of 0.9. The OLS results are straightforward; a one unit change in the independent variable causes the dependent variable to change with the size of the coefficient.

Table 4: Summary of estimation results

Variables		Mean	Std. Dev	Whole Sample (Model-1)	At least one child sample (Model-2)	At least two children sample (Model-3)
Dependent Variables				Coefficients (Standard Error)		
Number of children (Model-1)	<i>childvar</i>	2,68	1,85			
Number of children >0 (Model-2)	<i>childvar_1</i>	3,02	1,68			
Number of children >1 (Model-3)	<i>childvar_2</i>	3,50	1,52			
Independent Variables						
First born child is a girl	<i>firstgirl</i>	0,45	0,50		0.314*** (0.035)	
The two first born children are one boy and one girl	<i>oneofeach</i>	0,63	0,48			0.269*** (0.044)
The two first born children are both girls	<i>girdummy</i>	0,18	0,39			0.711*** (0.049)
Age	<i>age</i>	31,12	9,10	0.115*** (0.025)	0.114*** (0.028)	0.115*** (0.031)
Age squared	<i>age2</i>	1051,08	591,75	-0.0019*** (0.0004)	-0.0016*** (0.0005)	-0.0016*** (0.0005)
Duration of marriage	<i>mardur</i>	13,84	9,35	0.205*** (0.011)	0.156*** (0.013)	0.096*** (0.016)
Duration on marriage squared	<i>mardur2</i>	278,88	302,62	-0.0023*** (0.0004)	-0.0014*** (0.0004)	-0.0001 (0.0005)
The second poorest wealth-quintile	<i>poorer</i>	0,19	0,39	-0.182*** (0.069)	-0.205*** (0.068)	-0.222*** (0.078)
The middle wealth-quintile	<i>middle</i>	0,19	0,39	-0.300*** (0.074)	-0.344*** (0.080)	-0.341*** (0.084)
The second richest wealth-quintile	<i>richer</i>	0,20	0,40	-0.350*** (0.078)	-0.394*** (0.084)	-0.386*** (0.089)
The richest wealth-quintile (Reference group = Poorest wealth-quintile)	<i>richest</i>	0,20	0,40	-0.478*** (0.094)	-0.509*** (0.100)	-0.506*** (0.097)
Has electricity	<i>electricity</i>	0,50	0,50	-0.129** (0.052)	-0.101* (0.056)	-0.143** (0.056)
No education, but can read	<i>edu00</i>	0,12	0,32	-0.218*** (0.050)	-0.220*** (0.046)	-0.223*** (0.045)
Primary Education	<i>edu1</i>	0,17	0,38	-0.159*** (0.046)	-0.179*** (0.047)	-0.220*** (0.048)
Secondary Education	<i>edu2</i>			-0,005 (0,049)	-0,136** (0,056)	-0,169*** (0,061)

*** p<0.01, ** p<0.05, * p<0.1

Table 4 (continued)

Variables		Mean	Std. Dev	Whole Sample (Model-1)	At least one child sample (Model-2)	At least two children sample (Model-3)
Higher Education (Reference group= No education, cannot read)	<i>edu3</i>			-0,048 (0,092)	-0,177* (0,097)	-0,277** (0,118)
Primary Educaion (husband)	<i>hedu1</i>	0,27	0,44	0.028 (0.055)	0.014 (0.053)	0.001 (0.049)
Secondary Education (husband)	<i>hedu2</i>	0,39	0,49	-0.056 (0.046)	-0.093* (0.048)	-0.124** (0.048)
Higher Education (husband) (Reference group= No education)	<i>hedu3</i>	0,09	0,29	-0.209*** (0.068)	-0.296*** (0.071)	-0.417*** (0.072)
Someone else has last say on visits to family and relatives	<i>elsesay</i>	0,21	0,41	-0.259*** (0.047)	-0.252*** (0.045)	-0.152*** (0.050)
Husband and wife have last say...	<i>jointsay</i>	0,25	0,43	-0.0504 (0.053)	-0.0881* (0.051)	-0.148*** (0.053)
Respondent (wife) has last say... (Reference group= Husband has last...)	<i>respsay</i>	0,23	0,42	-0.215*** (0.049)	-0.248*** (0.049)	-0.239*** (0.055)
Brahmin / Chetri	<i>BC</i>	0,36	0,48	0.0120 (0.093)	0.0366 (0.092)	0.0571 (0.090)
Hill Dalit	<i>HD</i>	0,09	0,29	0.161 (0.105)	0.191* (0.105)	0.243** (0.109)
Hill Ethnic	<i>HE</i>	0,24	0,43	0.094 (0.095)	0.111 (0.094)	0.195** (0.097)
Terai Dalit	<i>TD</i>	0,04	0,20	0.035 (0.098)	0.019 (0.102)	0.0140 (0.110)
Muslim	<i>MS</i>	0,03	0,18	0.482*** (0.136)	0.545*** (0.151)	0.591*** (0.157)
Terai Middle Caste (Reference group= Terai Ethnic)	<i>TM</i>	0,12	0,32	0.127 (0.078)	0.181** (0.079)	0.211*** (0.080)
Live in region with 6 or more FPAN projects in 2008	<i>projectdummy</i>	0,47	0,50	-0.043 (0.058)	-0.068 (0.059)	-0.111* (0.058)
Respondent has/had more than 4 siblings	<i>sibdummy</i>	0,43	0,50	0.066** (0.028)	0.062** (0.028)	0.082** (0.033)
	<i>Constant</i>			-0.736** (0.322)	-0.451 (0.366)	0.080 (0.447)
	<i>Observations</i>			8,140	7,412	6,083
	<i>R-squared</i>			0.546	0.502	0.424

*** p<0.01, ** p<0.05, * p<0.1

5.1 The Analysis

The analysis is divided into three parts, first presenting the results of the main research question. The gender-preference results and lastly the other variables follow.

5.1.1 The Money or the Autonomy – the Main Analysis

Wealth

From Table 4, it is observed that all wealth-quintiles are significantly different from the reference group on the 1 percent significance level. Wald-tests show that richer is also different from richest⁴³. The Wald-tests are ambiguous when testing the wealth-dummies against each other, but richest is different from the others, middle is significantly different from poorest, and richer is different from poorer. In other words, even though not all dummies are different from each others, the pattern that higher wealth equals fewer children is clear if one wealth-level is skipped (comparing poorest to middle, poorer to richer and middle to richest). From the OLS regressions above, we see that the richest have around half a child less than the poorest in every model. The Nepali households among the richest quintile get half a child fewer than the poorest, all other things being equal. The coefficients increases at a roughly constant rate as wealth increases, but there seem to be larger difference between the poorest and the second poorest, than between any other “neighboring” groups. In other words, the poorest group stands out as the group that differs most from the other. This could be interpreted in the direction that the poorest are unable to invest money in their children, hence demanding a high number, but as soon a certain living standard is met, being able to invest just something in the children, largely affect demand for quantity. When this threshold is met, the negative effect of wealth on fertility is still present, but with less magnitude.

Education

The educational dummies leave us with a somewhat unclear picture. Female education seems to have some effect on fertility, but mostly for low educational levels. All education levels are significant and negative relative to the reference group “no education, cannot read” variable (Table 4), but they are not different from each other (Appendix 4). The expected effect would be that higher education means possibilities for higher income, hence higher opportunity cost of getting children. This effect is only partly present. One reason for this unexpected result can be that most women (73 percent) are employed in the agricultural sector. In addition to

⁴³ See appendix 4.

those, 16 percent have no work. This means that only approximately 10 percent of Nepalese women are working outside the agricultural sector. This can be interpreted in a direction that job-opportunities for women are slim, *regardless* of education. From table 4 it is found that women with higher education have around 0.28 less number of children as uneducated, illiterate women in Model 3. The number is approximately the same for uneducated, *literate* women (0.22). Higher education is significantly different from the reference groups on the five percent level, while uneducated literate, on the one percent level. The *level* of education seems to be irrelevant, while the ability to read/or just to have some education has an effect. This corresponds to some degree with the effect of wealth, where the effect was relatively most notable on low levels.

Regarding men's education (here, the reference group is simply *no education* as no literacy test is available), both positive and negative relationship could be argued to exist. The opportunity-cost effect is not present for men, so they might have higher demand for both quality *and* quantity. I would, however expect higher education to be negatively correlated with number of children for men as well. This is also what is observed from the regressions, but while women's education was only significant for low levels, the husband education variables show a different pattern. They're significant for intermediate and higher levels, but *not* for low levels. This is an indication of preference for higher-quality children from families with high-educated parents, as predicted through the Quality-Quantity trade-off effect. As seen in Table 4, women whose men have higher education get between 0.2 and 0.42 fewer children than women whose men are uneducated. Secondary education is also significant in Model 2 and 3. Men's higher education is actually more important than women's⁴⁴. This is probably related to the relatively limited job-opportunities for women with higher education. Men's higher education, compared to the reference group, is nearly as important as the highest wealth-level, and is among largest coefficients in the analysis. This raises some questions related to the later discussion about power-relationships in the household as well. My interpretation of the importance of men's education is that higher demand for quality (relative to quantity) is highly correlated with men's education. This also seems to be *more* important than the opportunity-cost effect, though a more detailed analysis of the relationships with the labor market should be done to draw this conclusion.

⁴⁴ Note: The reference groups are slightly different.

Female Autonomy

There is a negative relationship between number of children and the wife in the family having the last say on visits to family or relatives, compared with families where the husband have this power. Females with higher level of autonomy are in my opinion more likely to have more bargaining power in issues regarding family size and contraception. Family Planning issues are often discussed in mother-groups in villages, without the presence of men. I believe that more autonomous women are more likely to i) use contraception (i.e. get sterilized) without the husband's knowledge or ii) pursue the husband to agree that one of them use contraception. "Someone else having the last say" is also significantly different and lower than "husband having last say". In Model 3, all variables are significant. "Someone else" is probably either the respondents own family or the in-laws, most likely the mother in law. The question is then whether the mother in law's interests is the same as the respondents'. The strong negative correlation with fertility, compared with where the husband has the last say, leaves an impression that *any* female power in the family is more important than *which* female in the household has the power. The main conclusion drawn is that in families where the husband has the last say, there are more children. The differences between the other variables are difficult to say something clear about. The effect is as large as -0.24 in Model 3, larger, for example, than female higher education. The variable is significant on the one percent level

5.1.2 The Gender variables - a Natural experiment

In Nepal, like its neighboring countries India and China and other Asian countries, the gender inequality has more severe consequences for the population and individuals than in most developed countries. The following shows that there is a strong preference for boys over girls among Nepalese parents.

Table 4 gives a clear picture; the gender variables are significant. The second OLS model shows that families getting a boy as their first child get on average 0.31 children fewer than families having a girl as their first child. Moreover, families having two boys (and no daughters) get 0.27 children fewer than those having one of each sex. Families where both their first and second born is a girl get 0.71 children more than in families with two boys. This is an indication that supports the impression I got from my interviews. When I asked the

FCHV what advice they usually gave to families regarding family size, the usual answer was: “Get at most two, but it’s OK to try once more if you have gotten two daughters”.

These data clearly shows that gender preferences to a large extent affect family size and fertility behavior in Nepal. Affecting the perception that boys are more “worth” than girls might be an instrument to further decrease the fertility. There is a normative aspect to this as well; gender equality is a goal in its own matter, regardless of the population issue and the preference for boys can have serious social consequences. This will be further discussed later.

5.1.3 The other Socioeconomic Variables and the Background Variables

Age and Marriage Duration

Both age and marriage duration is both significant at the 1 percent level. Furthermore, their respective second-order terms are mostly negative. However, the values of the coefficients for age have an “unwanted” property;

$$y = 0.115age - 0.0016age^2 \Rightarrow \frac{\partial y}{\partial age} = 0.115 - 0.0036age = 0 \Rightarrow age \approx 36$$

This should imply that women get more children until they are 36 years, from which age they begin to get fewer children. This seems unlikely, and I do not see any good reasons women older than 36 should have fewer children than those younger than 36. But the marriage duration variable has to be accounted for in the interpretation. If two respondents have been married the same number of years, but one is older than the other, the oldest of them will have fewer children. If the marriage duration variable is removed, the age-variable acts in the expected manner. Another point of interest is that the second-order term of marriage duration is insignificant in model 3. This implies a linear connection between marriage duration and number of children for women with at least two children.

Job/Occupation

The discussion about women in the Nepalese job-market was introduced in the interpretation of the education coefficients, stating that few women are employed outside the agricultural sector. The Job/Occupation dummies are found in Appendix 3.

The reference group is respondents working in the agricultural sector. The only significant variable is the service-sector variable and it gets less important from Model 1 to Model 3. By far the largest group in this dummy is “traders/business man”, followed by “teacher” and “private entrepreneurs/proprietors” (the three groups accounting for approximately 75 percent

of the service-sector employed). Women employed in the service sector probably have higher wages than those employed in agriculture and they certainly have higher level of education. This supports the quality-quantity-tradeoff, but since the coefficient is quite small, it is difficult to conclude regarding occupation's effect. Service sector employed might be significant because of young women working in the service sector have been exposed to urban values. The young respondents working in the service sector might have better jobs than older respondents in the same group, and that could be the reason why the coefficient is getting smaller and less significant. The women employed in "not specified" sectors is significant in the "at least two" sample, but this is based on only 4 respondents.

Husbands work is not significant. The only exception is husbands without work, but the group is too small for the results to be reliable⁴⁵. As with education, I would expect that women's occupational status is more important than men's. However, men should contribute in the same way when it comes to providing food to the family, but evidence from the models indicate that this effect is not present. Another reason could be that since men in general are more important contributors to the family economy, the effect of income is accounted for through the wealth-variables.

Caste/Ethnicity

The reference group is Terai ethnic group, ethnic groups with origins from the Terai region. This group is normally below the Terai middle caste-group, but above the Hill Dalit's in the caste-hierarchy. As observed, the only significant variable in Model 1 is the Muslims, while all groups except Brahmin/Chetri and Terai Dalit are significant in Model 3.

The first is in accordance with my expectations; all other things being equal, Muslims get more children than other ethnic groups. The Wald-tests also show significant differences between Muslims and *all other* groups. In my own interviews, many of my respondents pointed to the Muslims as a group that they would expect to have "more children than themselves". Unfortunately, I was not able to interview any Muslims myself, hence I did not get any personal experience regarding their own reflections about what seems to be a clear pattern; Muslims in Nepal get significantly more children than other Nepalese. Muslims get over half a child more than the reference group in all models in Table 4.

⁴⁵ Fewer than one percent of the respondents has husbands without work.

Regarding the other significant Caste-dummies, the interpretation is somewhat challenging. Difference in living standard and education is accounted for, so differences between castes can best be explained by different norms across ethnic groups. Two of the significant groups, Terai Middle and Hill Ethnic, is regarded by many as higher in the system than the reference group, while Dalits (often referred to as “untouchables”) is below the Ethnic groups, but they have the same sign, and the coefficients have almost similar size (TM=0.21, HE=0.2 and HD=0.24) compared to the reference group. In other words, to say that “lower castes get more children” would not be correct, controlled for other variables. Removing the wealth-indicator does not change the results. To interpret the results (apart from the Muslims), the groups of ethnicity should be split to find out more accurately which groups that are the reason for the results. The focus should perhaps be moved towards the reference group. The results show that the Terai Ethnic groups get fewer children than most other groups. The Terai Ethnic groups consist of over 85 percent Tharu⁴⁶ people. The result is somewhat surprising, as my own impression was that Tharu’s were regarded as one of the groups that actually got more children than others. Why these groups get fewer children than other groups is difficult to say. Perhaps special programs have been implemented aimed toward particular ethnic groups, for instance the Tharu’s.

The number of siblings

The dummy for being from a large family is positive and significant on the 5 percent level. This being significant indicates that coming from a large family gives preferences towards having a large family yourself. It is not a very large effect, but it indicates that norms and traditions affect choices, which is hardly a controversial statement.

Electricity

Electricity is also significantly negative. Electricity can work through multiple mechanisms. Firstly, it can be an indicator of economic status that is not taken account for through the wealth-variables. As well, electricity can say something about the general development level in the community and it can have an effect in itself. Women living in households with electricity have (depending on the model) 0.1 to 0.15 children less than families without electricity.

⁴⁶ One of the largest ethnic minorities in Nepal.

Family Planning and Health Facilities

The Family Planning variable is significant, but only in Model 3. This is intuitively reasonable, as I would expect the impact of family planning initiatives to be more visible for families that already have children. As I have already discussed, the selection of regions where FPAN is present might not be random, so the variable is not unproblematic. However, inhabitants in the FPAN-regions do use more contraception than others (54 percent against 38 percent). Another point of interest might be that the country average for living in a region with at least 6 FPAN projects is at 47 percent, while 80 percent of the Terai Ethnic groups lives in such an area. It is difficult to draw conclusion based on these results, but I cannot from the data presented *reject* the possibility that family planning projects can have an effect on households' fertility-choices.

The distance to health-facilities dummy is not significant in any of the models.

Other Control Variables

The regressions in the Appendix 3 show no significant difference between the geographical zones and between respondents living in urban or rural areas. There are differences in fertility between regions; the survey shows an average total fertility rate (TFR) of 2.1 in urban regions compared to 3.3 in the rural. As well, in the mountain zone, the TFR is 4.1, while being 3.0 in the hills and 3.1 in Terai (Ministry of Population and Health [Nepal]:2007a). The difference between zones could relate to the fact that in the Mountains and Hills, harder conditions for agriculture would lead to higher demand for quantity relative to quality. Apparently, the differences between zones and urban/rural is explained by the other variables in my analysis. There are probably different educational levels and living standard between geographical areas. I would expect that some costs (i.e. housing.) regarding children and family size in the city that are not captured by the other variables would show some effect, but they don't.

5.2 A Discussion about Causality, Endogeneity and Natural Experiment

In my main model, endogeneity issues can arise. How is income affected by family-size? Do women choose not to get further educated as a consequence of pregnancy? Does a mother lose some of her bargaining power (or choose not to use it) if she has many children? The causality of most of my variables is uncertain. The sibling dummy cannot be affected by fertility, and for the variables regarding the ethnicity and age (but not marriage), the causality is clear and work in the direction *from* the independent variable *to* number of children. For the other significant variables, number of children can have an effect on the independent variable,

reversed causality can be present. The problem that might arise is known as simultaneity, the dependent variable and the independent variable is jointly determined.

Education

This is potentially the variable with highest degree of reversed causality. It is likely to assume that women might end their education if they get pregnant. This is, however, not necessarily a widespread issue. Some women might also go back to school. Even though the causality *could* work in the opposite direction, I believe that in most cases, level of education is a determinant for fertility decisions, not the other way around.

Wealth

Decisions that might affect the living standard of the family, including participation in the labor market and fertility are probably affected by numerous factors. A family having many children might choose to work less than a family with fewer children. However, I find it reasonable to assume that families make fertility-decisions based on their income, wealth and their own perceptions of the economic consequences of getting children.

Job/Occupation

These are not statistically significant anyway, but have basically the same problems as the two sets of variables above.

Female Autonomy

The measurement of female autonomy is a measurement of the relative power in the household. Many children might lead the mother in the family to lose power, for example to the mother in law. However, more autonomous women will be more likely to use contraception after their desired number of children is met

In general, the coefficients should be thought of as relationships, and not causes, as the causality in some respect is difficult to establish.

The Gender Variables

When testing for boy-preference, the problem of endogeneity is absent, because the sex of the first child is a natural experiment. The results of this test can be interpreted “without caution”, as is not the case of the other results. The causal direction is obvious; Nepalese parents with girls as their first born child (ren) want more children *because* of a preference for sons.

5.3 Summary of the Findings

As the analysis indicates, household wealth is highly correlated with number of children. Furthermore, education seems to correlate with fertility although the association here is somewhat weaker. One explanation why households with higher wealth tend to get fewer children is that they can afford to invest in their children and therefore prefer to have few children with high quality and education, rather than many children. This is in accordance with theory. The Quality-Quantity Model further emphasizes the opportunity-cost of women to get children. The cost for the household to get children is affected by the mother's wage rate. However, almost the entire female workforce in Nepal's is employed in the agricultural sector, and few get higher education. Thus, the opportunity cost effect is perhaps not very relevant. The relatively low effect of women's higher education is probably due to the limited job opportunities for Nepalese women.

As discussed in both the theoretical and empirical chapters, there are several reasons for why women might demand fewer children than their husbands. As observed from the data, families with low levels of female autonomy get more children than the others. This is indeed an interesting finding, and level of autonomy could be an important alternative to analyzing income opportunities, especially in countries where such measures has restricted relevance. Furthermore, this pattern indicates that empowering women is an instrument that can be used to decrease fertility.

Evidence from the natural experiment is clear: Nepalese parents have strong gender preferences. The underlying motive is related to the household economy, as well as traditions and norms. It should be in the interests of policy makers to take the issue seriously, as discussed in the next section chapter.

Another point of interest is the Tharu people. This group gets significantly *fewer* children than most other ethnic groups in Nepal. Being unable to give a clear-cut answer to this puzzle, it remains a highly interesting case. The sibling-dummy indicates that fertility behavior is affected partly by norms and traditions, while the family planning variable implies some effect of family planning programs although this effect is weak.

6. Discussion and Policy Implications

Further Research

An interesting question to test more specifically is the effect family planning initiatives have on the fertility rate in Nepal. Hania Zlotnik, leader of the UN Population Division, claimed on the forum “The World in 2050”, held at Berkeley in January 2009, that most countries have experienced a 50 percent decline in the funding to family planning projects⁴⁷. This opens up for more research, both into the effect of these projects, the consequences of cancelled projects and the reason for the drop in funding.

A more sophisticated analysis of the relationships between fertility behavior, education and labor market participation would also be of interest. This could give more insight into the relations between men and women’s decisions regarding education, work and family formation, including power relations within the households. Especially lack of data on income for each household member is a weakness in this thesis. More detailed data would therefore enable a more in depth analysis on these questions. Further, the measurement of female autonomy can be questioned, and the relationship between female power and the other socioeconomic variables are important issues⁴⁸.

Policy Implications

According to the last estimates at the CIA World Factbook, the fertility rate in Nepal is down to 2.5⁴⁹. This leaves me with two immediate conclusions: The fertility problem in Nepal is solved, at least to a certain degree. Karki and Krishna (2008) suggests that the decline can be explained by increased contraception use. It is difficult to argue that this is wrong, but I find it plausible that increased female autonomy and knowledge regarding reproductive health and related issues has accommodated the increased use.

The second conclusion regards the preference for sons. In my opinion, this is an issue that has to be dealt with and taken seriously. As the fertility rate is declining, more parents want only one or two children, thus the gender of the first born child are getting more important. More reliable, cheaper and easier-to-use technology for determining the gender of the child is on its

⁴⁷ Webcast of the Forum found on PRB (2009). Zlotnik’s comment is about 1 hr 40 min into the first session, day 1 (PRB 2009) .

⁴⁸ See e.g. Mason (1987) for a discussion about the use of female status in demographic research.

⁴⁹ CIA (2010)

way⁵⁰. As long as ultrasound is the only way to find out the gender of the unborn child in Nepal, it could be possible to try to regulate the use. However, evidence from India proves that ultrasound is frequently used to determine whether the family should keep the child or not, and the technology is readily available in most part of the country. This trend is likely to move across the border into Nepal at some time or another. The consequences of the rapidly declining fertility and the possibility of easily being able to predict the gender of the child has consequences, both individually and for the society as a whole.

Mothers

They are as mentioned under considerable pressure by their husbands and in-laws to give birth to a boy. Abortions are subject to risk and it could be a threat to maternal health. Abortion is also often connected with guilt and psychological problems for the mother. The existence of products that can determine the gender can of course itself increase the pressure on the mother, both from herself and her surroundings.

Sons

Indian and Chinese villages filled with bachelors and no brides should be a sufficient sign of warning of what might happen when daughters are undesired. Their status above girls is likely to be of minor importance for them when they grow up without opportunities to get a wife.

Daughters

The girls will probably face serious challenges if they are becoming a minority. Rape and prostitution should be natural concerns that increase with a highly biased gender-ratio. Significant pressure is probably also put on daughters regarding their marriage.

Society

With heaps of frustrated single men without hope of getting a wife; crime rates and alcohol and drug usage could be expected to increase⁵¹. On the local scale, strange population compositions can be the result when large proportions of generations are unable to reproduce. However, the fertility rate is still high enough for the problem not to be of great importance, and the gender-composition at birth is still normal. Also, the trend seems to be slowly changing toward more normal sex-ratios in India and China (Das Gupta et al 2009). Neither ultrasound nor other technology is so far accessible to the degree that it should pose a large

⁵⁰ Home-test with 80 percent accuracy in the tenth week of pregnancy is available in the west.

⁵¹ A study of the relationship between sex ratios and crime rates in China, found a positive correlation between excess of boys and crime (Edlund et al. 2007).

threat. As mentioned earlier, the norms are also starting to change, exemplified by former Prime Minister Koirala's funeral, where his daughter lit the funeral pyre. It is important that opinion leaders and public figures take action to counter the notion that boys are more important than girls. The habit of bringing dowry is a tradition that in my opinion has to be questioned. Improving the labor market opportunities, education opportunities and the general status of women are slow-running processes that should have focus, both because equal rights for women should be implemented for its own sake, and to reduce the chance of a situation with a gender biased population.

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Appendix 1: Questionnaire used in Interviews during the fieldwork.

CMI-Questionnaire, Fall-2009

Fertility preferences in the Eastern
Terai

VDC-ward:

Date: _____ Name-respondent: _____

Caste/ethnic code: _____

Three largest castes/ethnic groups in VDC, name and code:

A: _____ B: _____

C: _____

Minutes of travel to main market (include
name): _____ Mode: _____

Facilities in the village:

Electricity:

Bus-service:

Caste codes: 1=hill B/C, 2=terai-middle/high-caste, 3=hill-janajati, 4=terai-janajati, 5=muslim, 6=hill-dalit, 7=terai-dalit

Family members and main occupation during the last 12 months

Name	Relation	Gender	Age	Completed education	Occupation	Occupation code	Work-location	Household member?	Daily wage (incl. in-kind)	Monthly salary

Relation: 1=household-head, 2=wife/husband, 3=children, 4=grandchildren, 5=parents, 8=siblings

Education: 1=no schooling, 2=class 1, 3=class 5, 4=class 9, 5=SLC, 6=intermediate, 7=higher

Occupation: 1=self employed agriculture, 2=self employed, 3=daily wage labor agriculture, 4= daily wage labor, 5=employed private, 6=employed public

Location: 1=VDC, 2=Morang, 3=Nepal, 4=India, 5=Middle East, 6=Malaysia, 7=Other

Children / marriage

<p>When you decided to get your last child, what was the reason that you wanted another child?</p>	
<p>Let us repeat, how many children do you have?</p>	
<p>How many more boys do you want?</p>	
<p>Why?</p>	
<p>How many more girls do you want?</p>	
<p>Why?</p>	

<p>In your caste how many children is it normal to have?</p>	
<p>Why do you want more/fewer children?</p>	
<p>How many children is it normal to have for other castes (select from page 1)?</p>	
<p>Why different from your caste?</p>	
<p>Write any other important comments the respondent</p>	

had.	
How many children did your mother get?	
Why do you want more / fewer children than your mother?	

Family Planning

Can you get advice on family planning in the village?	
Have you received advice?	
Where?	
Are you using family planning methods?	
What type?	
If not, have you used before?	
Why stop?	

Plots of land

Land in kattha	Own the plot?	Main crops	Value/kattha	Annual rent if rented out, or rented in

House	Circle or write:
Do you own the house you live in?	Yes - 1 No - 2
If no in Q1, what is the housing arrangement?	Rented - 1 Owned by relatives - 2 Other
Type of house wall (main material)	Bamboo & mud - 1 Wood - 2 Bricks - 3 Other:.....
How many floors?	Number:.....
Type of house roof	Dry grass - 1 Zinc/Tin - 2 Tiles - 3 Other:.....

Other assets			
Asset	How many	Total sales value (Rs)	Comments
Motorbike			
Bicycle			

Television			
He-buffalo			
She-buffalo			
Oxen			
Cows			
Goats			

Appendix 2: Variable List, Descriptive statistics

The following variables are used in my analysis. The Dummy=1 column gives the number of respondents who belongs to the corresponding group.

Variable	Obs	Mean	Std. Dev.	Min	Max	Dummy=1	Description
childvar	8693	2.68768	1.845601	0	12		Number of born children that are either alive or have survived his or hers fifth birthday
childvar_1	7731	3.022119	1.679078	1	12		Childvar>0
childvar_2	6266	3.494893	1.516198	2	12		Childvar>1
age	8693	31.11757	9.098833	15	49		Respondents Age
age2	8693	1051.082	591.7531	225	2401		Age squared
mardur⁵²	8640	13.83542	9.352482	0	39		Duration of current marriage
mardur2	8640	278.8775	302.6216	0	1521		Mardur squared
Poorest*	8693	.2138502	.4100459	0	1	1,859	Belongs to the poorest quintile based on the wealth indicator.
poorer	8693	.1924537	.3942501	0	1	1,673	Poorer quintile
middle	8693	.1876222	.3904327	0	1	1,631	Middle quintile
richer	8693	.2030369	.4022829	0	1	1,765	Richer quintile
richest	8693	.2030369	.4022829	0	1	1,765	Richest quintile
electricity⁵³	8211	.4987212	.5000288	0	1	4,095	Respondent has electricity
edu0*	8693	.6215346	.4850324	0	1	5,403	Respondent has no education
edu00	8693	.1175659	.3221119	0	1	1,022	Respondent has no education, but is not illiterate.
edu1	8693	.1700219	.3756736	0	1	1,478	Primary education
edu2	8693	.1800299	.3842345	0	1	1,565	Secondary education
edu3	8693	.0284137	.1661611	0	1	247	Higher education
hedu0*	8693	.2483608	.432087	0	1	2,159	H=husband
hedu1	8693	.2711377	.4445726	0	1	2,357	
hedu2	8693	.3854826	.4867371	0	1	3,351	
hedu3	8693	.0903025	.2866312	0	1	785	
serv	8693	.0796043	.2706952	0	1	692	Respondent works in service sector

⁵² 53 respondents are married, but have not performed *gupta*; moved into their husbands family.

⁵³ 576 respondents are not de jure residents in the household

Agri*	8693	.7308179	.4435603	0	1	6,353	Agricultural sector
nowork	8693	.1613942	.3679153	0	1	1,400	Has no work
indust	8693	.0276084	.1638575	0	1	240	Industrial sector
notspec	8693	.0005752	.0239773	0	1	5	Job not specified
hserv⁵⁴	8665	.3431044	.4747734	0	1	2,973	H=husband
Hagri*	8665	.4060012	.4911131	0	1	3,518	
hindust	8665	.2208886	.4148695	0	1	1,914	
hnotspec	8665	.0214657	.144939	0	1	186	
hnowork	8665	.0085401	.0920225	0	1	74	
Husbsay*	8693	.3178419	.4656645	0	1	2,763	Husband has last say on visits to family and relatives
elsesay	8693	.2078684	.4058055	0	1	1,807	Someone else has last say
jointsay	8693	.245945	.4306709	0	1	2,138	Husband <i>and</i> respondent has last say
respsay	8693	.2276544	.4193425	0	1	1,979	Respondent has last say
Hill*	8693	.383527	.4862728	0	1	3,334	Lives in the hill zone
Terai	8693	.4830323	.4997408	0	1	4,199	Terai
Mountain*	8693	.1334407	.34007	0	1	1,160	Mountain
Rural	8693	.7363396	.4406426	0	1	6,401	Lives in urban area
Urban*	8693	.2636604	.4406426	0	1	2,292	Rural area
BC	8693	.3627056	.4808085	0	1	3,153	Brahmin/Chetri
HD	8693	.0924882	.2897306	0	1	804	Hill Dalit
TE*	8693	.1103186	.3133045	0	1	959	Terai Ethnic
HE	8693	.2367422	.4251072	0	1	2,058	Hill Ethnic
TD	8693	.0399172	.1957759	0	1	347	Terai Dalit
MS	8693	.0331301	.1789866	0	1	288	Muslim
TM	8693	.1167606	.3211533	0	1	1,015	Terai Middle
projectdummy	8693	.4663522	.4988952	0	1	4,054	Respondent lives in a district with more than 5 FPAN projects in 2008
healthfac	8693	.403313	.4905908	0	1	3,506	Respondent states that distance to health facility is a “big problem” when getting medical help for herself.
sibdummy	8693	.4270102	.4946723	0	1	3,712	Respondent has more than 4 siblings

⁵⁴ 28 missing observations. Unknown reason, probably not reported for some of the respondents who has not performed *gupta*.

firstboy	8693	.4505924	.4975815	0	1	3,917	First born child is boy
firstgirl	8693	.4456459	.4970654	0	1	3,874	First born child is girl
boydummy	8693	.1881974	.3908922	0	1	1,636	Two first born children are boys
girldummy	8693	.1810652	.3850944	0	1	1,574	Two first born children are girls
oneofeach	8693	.6307374	.4826329	0	1	5,483	Two first born children are one girl and one boy.

*= Reference group (Only the Terai zone is included in the Analysis, so people living in Hills or Mountain is the reference group)

Appendix 3: The Regression Models

Appendix 3 a: The OLS-Models

VARIABLES	Whole Sample (OLS, Model-1)	At least one child sample (OLS, Model-2)	At least two children sample (OLS, Model-3)
firstgirl		0.314*** (0.0350)	
oneofeach			0.269*** (0.0435)
girldummy			0.711*** (0.0491)
age	0.115*** (0.0246)	0.114*** (0.0279)	0.115*** (0.0311)
age2	-0.00185*** (0.000422)	-0.00164*** (0.000461)	-0.00155*** (0.000480)
mardur	0.205*** (0.0106)	0.156*** (0.0126)	0.0963*** (0.0156)
mardur2	-0.00227*** (0.000390)	-0.00138*** (0.000434)	-0.000114 (0.000455)
poorer	-0.182*** (0.0691)	-0.205*** (0.0679)	-0.222*** (0.0783)
middle	-0.300*** (0.0737)	-0.344*** (0.0804)	-0.341*** (0.0841)
richer	-0.350*** (0.0778)	-0.394*** (0.0837)	-0.386*** (0.0893)
richest	-0.478*** (0.0943)	-0.509*** (0.0999)	-0.506*** (0.0974)
electricity	-0.129** (0.0521)	-0.101* (0.0561)	-0.143** (0.0558)
edu00	-0.218*** (0.0504)	-0.220*** (0.0459)	-0.223*** (0.0446)
edu1	-0.159*** (0.0455)	-0.179*** (0.0465)	-0.220*** (0.0484)
edu2	-0.0466 (0.0490)	-0.136** (0.0553)	-0.169*** (0.0613)
edu3	-0.0480 (0.0922)	-0.177* (0.0971)	-0.277** (0.118)
hedu1	0.0283 (0.0551)	0.0143 (0.0528)	0.000978 (0.0488)
hedu2	-0.0560 (0.0460)	-0.0931* (0.0483)	-0.124** (0.0478)
hedu3	-0.209*** (0.0675)	-0.296*** (0.0709)	-0.417*** (0.0717)
serv	-0.173** (0.0690)	-0.179** (0.0725)	-0.117* (0.0679)
nowork	0.00246	-0.0141	0.00801

	(0.0460)	(0.0464)	(0.0544)
indust	-0.0467 (0.123)	-0.0298 (0.130)	-0.0339 (0.147)
notspec	0.0337 (0.141)	-0.119 (0.128)	-0.245* (0.125)
hserv	0.0192 (0.0451)	0.0113 (0.0458)	-0.00387 (0.0488)
hnowork	-0.301** (0.148)	-0.430** (0.200)	-0.576** (0.266)
hindust	0.0126 (0.0440)	-0.0171 (0.0458)	-0.0759 (0.0483)
hnotspec	-0.0525 (0.105)	0.00162 (0.101)	-0.0287 (0.114)
elsesay	-0.259*** (0.0465)	-0.252*** (0.0453)	-0.152*** (0.0497)
joinsay	-0.0504 (0.0531)	-0.0881* (0.0513)	-0.148*** (0.0528)
respsay	-0.215*** (0.0489)	-0.248*** (0.0489)	-0.239*** (0.0548)
terai	0.0247 (0.0790)	0.0660 (0.0795)	0.0356 (0.0811)
rural	0.0553 (0.0507)	0.0330 (0.0525)	-0.00348 (0.0504)
BC	0.0120 (0.0927)	0.0366 (0.0922)	0.0571 (0.0903)
HD	0.161 (0.105)	0.191* (0.105)	0.243** (0.109)
HE	0.0940 (0.0951)	0.111 (0.0941)	0.195** (0.0967)
TD	0.0346 (0.0984)	0.0186 (0.102)	0.0140 (0.110)
MS	0.482*** (0.136)	0.545*** (0.151)	0.591*** (0.157)
TM	0.127 (0.0782)	0.181** (0.0787)	0.211*** (0.0798)
projectdummy	-0.0434 (0.0583)	-0.0678 (0.0589)	-0.111* (0.0583)
healthfac	0.0643 (0.0414)	0.0606 (0.0426)	0.0431 (0.0494)
sibdummy	0.0657** (0.0279)	0.0621** (0.0278)	0.0815** (0.0328)
Constant	-0.736** (0.322)	-0.451 (0.366)	0.0798 (0.447)
Observations	8,140	7,412	6,083
R-squared	0.546	0.502	0.424

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix 3 b: The Poisson Models

VARIABLES	Whole Sample	At least one child sample	At least two children sample
	(Poisson, Model-1)	(Poisson, Model-2)	(Poisson, Model-3)
firstgirl		1.107*** (0.0122)	
oneofeach			1.085*** (0.0146)
girldummy			1.222*** (0.0174)
age	1.049*** (0.0114)	1.041*** (0.0107)	1.036*** (0.00943)
age2	0.999*** (0.000157)	0.999*** (0.000151)	1.000*** (0.000132)
mardur	1.127*** (0.00649)	1.082*** (0.00559)	1.043*** (0.00487)
mardur2	0.998*** (0.000150)	0.999*** (0.000143)	1.000*** (0.000121)
poorer	0.939*** (0.0204)	0.938*** (0.0184)	0.944*** (0.0187)
middle	0.906*** (0.0216)	0.900*** (0.0219)	0.914*** (0.0194)
richer	0.888*** (0.0230)	0.886*** (0.0227)	0.903*** (0.0204)
richest	0.857*** (0.0291)	0.852*** (0.0282)	0.870*** (0.0226)
electricity	0.954** (0.0181)	0.967* (0.0176)	0.960** (0.0152)
edu00	0.935*** (0.0165)	0.937*** (0.0138)	0.940*** (0.0121)
edu1	0.947*** (0.0187)	0.942*** (0.0167)	0.935*** (0.0144)
edu2	0.950** (0.0228)	0.920*** (0.0215)	0.929*** (0.0186)
edu3	0.869*** (0.0443)	0.848*** (0.0316)	0.865*** (0.0313)
hedu1	1.013 (0.0174)	1.009 (0.0154)	1.004 (0.0125)
hedu2	0.987 (0.0156)	0.978 (0.0144)	0.969** (0.0123)
hedu3	0.919*** (0.0265)	0.898*** (0.0236)	0.879*** (0.0194)
serv	0.945** (0.0266)	0.942** (0.0251)	0.964* (0.0202)

nowork	1.018 (0.0197)	1.003 (0.0170)	1.007 (0.0168)
indust	0.982 (0.0489)	0.991 (0.0457)	0.983 (0.0438)
notspec	1.027 (0.0499)	0.977 (0.0469)	0.915** (0.0335)
hserv	1.016 (0.0170)	1.009 (0.0151)	1.001 (0.0138)
hnowork	0.831** (0.0648)	0.864** (0.0596)	0.868* (0.0636)
hindust	1.013 (0.0168)	0.997 (0.0149)	0.980 (0.0135)
hnotspec	1.009 (0.0459)	1.014 (0.0398)	0.999 (0.0359)
elsesay	0.895*** (0.0178)	0.915*** (0.0144)	0.957*** (0.0140)
joinsay	0.979 (0.0172)	0.970* (0.0149)	0.960*** (0.0135)
respsay	0.936*** (0.0146)	0.929*** (0.0135)	0.936*** (0.0140)
terai	1.005 (0.0303)	1.023 (0.0281)	0.998 (0.0171)
rural	1.027 (0.0208)	1.011 (0.0194)	0.999 (0.0152)
BC	1.009 (0.0365)	1.016 (0.0317)	1.014 (0.0247)
HD	1.058 (0.0415)	1.064* (0.0362)	1.067** (0.0305)
HE	1.029 (0.0382)	1.034 (0.0329)	1.051* (0.0264)
TD	1.006 (0.0380)	1.005 (0.0343)	1.008 (0.0323)
MS	1.191*** (0.0467)	1.187*** (0.0483)	1.174*** (0.0476)
TM	1.053* (0.0291)	1.063** (0.0257)	1.066*** (0.0231)
projectdummy	0.985 (0.0203)	0.977 (0.0186)	0.973** (0.0132)
healthfac	1.020 (0.0151)	1.019 (0.0136)	1.013 (0.0137)
sibdummy	1.031*** (0.0107)	1.026*** (0.00953)	1.027*** (0.00965)
Constant	0.437*** (0.0694)	0.683*** (0.0959)	1.079 (0.145)
Observations	8,140	7,412	6,083

seEform in parentheses

*** p<0.01, ** p<0.05, * p<0.1

*Appendix 3 c: Pseudo R-squared for the Poisson Regression*⁵⁵

Model	Mc Fadden's Pseudo R²
Poisson-1	0.1837
Poisson-2	0.1320
Poisson-3	0.0782

⁵⁵ From Poisson regressions without the survey-command, as Pseudo-R2 is not reported with the survey-command.

Appendix 3 d: The Negative Binomial Regression⁵⁶

VARIABLES	At least two children sample (Negative Binomial, Model -3)	alpha (Dispersion Parameter)
oneofeach	1.086*** (0.0189)	
girdummy	1.227*** (0.0238)	
age	1.029* (0.0155)	
age2	1.000* (0.000206)	
mardur	1.048*** (0.00833)	
mardur2	0.999*** (0.000186)	
poorer	0.942*** (0.0205)	
middle	0.908*** (0.0223)	
richer	0.897*** (0.0253)	
richest	0.850*** (0.0299)	
electricity	0.960** (0.0194)	
edu00	0.940*** (0.0210)	
edu1	0.950** (0.0221)	
edu2	0.943* (0.0284)	
edu3	0.895 (0.0679)	
hedu1	1.005 (0.0178)	
hedu2	0.970 (0.0196)	
hedu3	0.911** (0.0353)	
serv	0.958	

⁵⁶ This analysis is done without the survey-command.

	(0.0298)	
nowork	0.993	
	(0.0254)	
indust	0.991	
	(0.0433)	
notspec	0.913	
	(0.291)	
hserv	0.995	
	(0.0190)	
hnowork	0.889	
	(0.0861)	
hindust	0.987	
	(0.0196)	
hnotspec	0.992	
	(0.0575)	
elsesay	0.966	
	(0.0248)	
joinsay	0.971	
	(0.0179)	
respsay	0.940***	
	(0.0194)	
mountain	0.996	
	(0.0219)	
rural	0.993	
	(0.0191)	
BC	1.010	
	(0.0254)	
HD	1.051	
	(0.0331)	
HE	1.037	
	(0.0275)	
TD	0.993	
	(0.0402)	
MS	1.172***	
	(0.0496)	
TM	1.062**	
	(0.0308)	
projectdummy	0.982	
	(0.0160)	
healthfac	1.024	
	(0.0155)	
sibdummy	1.024*	
	(0.0142)	
Constant	1.154	1.22e-60
	(0.252)	(0)
Observations	6,083	6,083

seEform in arentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Likelihood-ratio test of $\alpha=0$: $\text{chibar2}(01) = 0.00$ ⁵⁷

⁵⁷ The test shows that the null that the variance equals the mean cannot be rejected.

Appendix 4: Wald Tests of difference between dummies of difference

test poorer=middle

(1) poorer - middle = 0

F(1, 143) = 4.37

Prob > F = 0.0383**

test poorer=richer

(1) poorer - richer = 0

F(1, 143) = 5.98

Prob > F = 0.0157

Prob > F = 0.4143

test richer=richest

(1) richer - richest = 0

F(1, 143) = 4.88

Prob > F = 0.0287**

test middle=richest

(1) middle - richest = 0

F(1, 143) = 6.96

Prob > F = 0.0093***

test edu00=edu1

(1) edu00 - edu1 = 0

F(1, 143) = 0.00

Prob > F = 0.9741

test edu00=edu2

(1) edu00 - edu2 = 0

F(1, 143) = 0.71

Prob > F = 0.4010

test edu00=edu3

(1) edu00 - edu3 = 0

F(1, 143) = 0.19

Prob > F = 0.6604

test edu1=edu2

(1) edu1 - edu2 = 0

F(1, 143) = 0.95

Prob > F = 0.3320

test edu2=edu3

(1) edu2 - edu3 = 0

F(1, 143) = 1.09

Prob > F = 0.2972

test serv=indust

(1) serv - indust = 0

F(1, 143) = 0.93

Prob > F = 0.3360

test nowork=serv

(1) - serv + nowork = 0

F(1, 143) = 4.55

Prob > F = 0.0347**

test MS=BC

(1) - BC + MS = 0

F(1, 143) = 12.07

Prob > F = 0.007***

test MS=HD

(1) - HD + MS = 0

F(1, 143) = 4.27

Prob > F = 0.0314**

test MS=HE

(1) - HE + MS = 0

F(1, 143) = 6.70

Prob > F = 0.0106**

test MS=TD

$$(1) - TD + MS = 0$$

$$F(1, 143) = 10.03$$

$$\text{Prob} > F = 0.0019***$$

test MS=TM

$$(1) MS - TM = 0$$

$$F(1, 143) = 5.91$$

$$\text{Prob} > F = 0.0163**$$

test respsay=elsesay

$$(1) - \text{elsesay} + \text{respsay} = 0$$

$$F(1, 143) = 2.60$$

$$\text{Prob} > F = 0.1090$$

test respsay=jointsay

$$(1) - \text{jointsay} + \text{respsay} = 0$$

$$F(1, 143) = 2.94$$

$$\text{Prob} > F = 0.0887*$$

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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