Turning a Problem into an Asset? Education and Asset Ownership

An alternative measure of welfare gains from education for females in Nepal

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This thesis aims to measure the returns to education for females in Nepal. By using newly acquired household data from the Demographic & Health Survey of 2022, I examine how the household ownership of welfare goods increases with the number of years of education. In the absence of income data, I construct an alternative, demand-based index to capture welfare as a mean value of five welfare-improving measures. The index is based on a CES Utility Function and builds upon the assumption of low grades of substitutability. By employing the index using OLS Estimation, it is estimated that the general female population of Nepal receives low marginal welfare benefits per added year of education. The low estimated marginal gains are explained by observing that the respondents who receive little welfare from education weigh the estimations down such that they exhibit lower gains than the actual marginal benefits. At the same time there are a few respondents who gain more benefits from education. There exists more significant marginal gains from secondary and tertiary education than from primary respondents, suggesting that the relationship between education and welfare might be non-linear. This variation in educational gains can be attributed to provincial differences, age, and potentially husband's years of schooling. It is estimated that residents of Bagmati receive the most beneficial marginal gains, while residents of Sudurpashchim, Karnali & Madhesh receive the least marginal gains.

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Preface

This thesis marks the end of my 5-and-a-half-year journey at the University of Oslo. Attending such a prestigious university has been an honor. Writing this thesis has been a tough road, filled with obstacles to overcome, but it has also served as one of my greatest learning experiences. I have had the privilege of getting to know many great people without whom I could not have done this.

First and foremost, I would like to thank my supervisor, Halvor Mehlum, for his guidance and support throughout the writing process. Working with a leading economist of his caliber has been an honor, and I am very grateful for his input, suggestions, and advice. He has also been very supportive throughout my entire writing process and motivated me consistently.

I would also like to thank my family: Dad, & and my siblings Abdur-Rahman and Iqra for their support throughout my writing process. I also want to thank all my friends who I have shared many great moments with. A special thank you to my fellow peers and good friends Nora Jayaseela & Amalie Halle Christensen, for proofreading my thesis.

One special gratitude goes to my mother, who has always believed in me in good and bad times. I am eternally grateful for her unwavering support and words of wisdom.

Lastly, I dedicate this thesis to my late grandmother. Thank you for all the prayers, love and support you have given to our whole family.

Any eventual mistakes and errors in this thesis is my own responsibility.

Chapter 1

Introduction

Education is widely agreed upon as an essential building block in terms of national and social growth for an economy. Not only is this one of the most essential institutions in a person's life, but it also stimulates groundbreaking ideas, knowledge, and skills that a country will undoubtedly use to grow itself. Additionally, education has several welfare-improving repercussions that affect several aspects of a person's life. Education could give access to higher-paying jobs, valuable knowledge that provides valuable decision-making skills, and possibilities to positively impact their own and other's lives.

However, equal access to education is not given everywhere in the world. Females continue to suffer educational attainment shortages and may lack valuable opportunities and skill sets to acquire welfare-improving assets. This is especially prevalent in developing economies with limited funds and knowledge to provide sufficient education.

Several studies have showcased the effects of education, most of which measure the returns to education. Returns to investment in education have been established since the late 1950s and are a measure to empirically establish patterns in economies around the world (Psacharopoulos & Patrinos, 2004). One of the most widely used methods is the Mincerian earnings function, where one estimates the returns in terms of income by a marginal increase in total years of education. This method has been employed since the late 1950s and has been carried out in countries worldwide.

While the Mincer specification may provide some insight into the economic impact of education, it provides little regarding other welfare aspects for the

individual. Improvements in health and the general quality of life are not easily identifiable when assessing education returns. As such, other methods of estimating welfare have been used to evaluate the impacts of education. For example, measures based on microeconomic demand theory, such as the CES Utility Function and the Engel curve, have been used in developing economies to capture alternative measurements of poverty and welfare.

Nepal and its neighboring countries (India, Pakistan, Bangladesh, and Sri Lanka) have had low literacy rates. Nepal also faces lower female labor participation rates, lower estimated wages for females, and fewer possibilities to acquire education (UNICEF, 2018). As such, there is a need to improve the educational situation in Nepal and ensure they acquire the welfare goods they need to live an adequate lifestyle.

In this paper, I will attempt to bridge the gap between the estimation of education and welfare-based measures to study how increased education can improve the welfare of females in Nepal. The research question for this master's thesis is *"How can increased education affect female ownership of welfare goods in Nepal?"*. To do so, I construct an alternative welfare measure based on a CES Utility Function and its characteristics. This is a theory-based approach to estimating welfare by the possession of goods. I then employ this index on the newest survey data of Nepal from the Demographic & Health Survey (DHS) Program. By doing so, I show how female education can affect good ownership of households and examine visible patterns from these results. Following this, I will discuss what these results imply and assess the validity of the measures from this index.

Examining direct ownership can be a more efficient way to target direct consumption versus income-based measures from traditional returns to education measures. For example, it is possible to estimate proper levels of welfare better than with income-based measures, as they do not convey what welfare-improving goods the income is spent on. In this thesis, I also explore the ownership of durable goods, which can have more long-term welfare implications than monthly income data.

1.1 Literature Review

This subsection serves as a presentation of research that has been done to estimate the returns to education. This is to showcase what results have been derived earlier

from these methods. Little research has been done on alternate measures in Nepal. One possible explanation may be that its neighboring larger countries, such as India and Pakistan, are more attractive places to research.

Akanda (2010) has performed the most extensive study on the returns of education in Nepal. Using data from Nepal's Living Standard Survey from 1995/96, he estimated returns to education given the labor market. Using the Mincerian method mentioned above, he found that one additional year of schooling increased returns by 6%, which is lower than the world average at 10%. He also found that females, in total, earn less than men, yet the returns to education for females are significantly higher than for men. Furthermore, attending primary and tertiary education provided the most significant gains, according to Akanda.

In another attempt at estimating the returns to education, Lamichhane and Sawada (2013) also conducted a study of people with disabilities. Using survey data from the 2nd Round of the Living Standards Survey (2003/04) and data from their survey gathering, they studied individuals with visual, physical, and hearing impairments who are active labor participants. Their results indicate that their returns to education are substantially significant, estimated to be between 19.3% and 25.6%. This shows that education is a vital means of escaping poverty for people with disabilities.

In examining Nepal's educational and wage inequality, Yamamoto and Kaneko (2017) compared the gender wage gap in the urban and rural labor markets. Their findings suggest that the gender gaps in wages and working opportunities lag behind educational promotion for rural girls. It is difficult for females to find employment in rural areas, and for those that do, there is significant gender discrimination in wage settings. On the other hand, their findings indicate that additional years of education provide more significant marginal effects on finding regular employment, and increasing wages are higher for rural females, thus stressing the importance of investing in female education in rural areas.

As mentioned, there have been several measurements on the returns to education across South Asia. Farooq (2011) estimated the returns to education by comparing male and female results in Pakistan. This study differs from studies in Nepal because he also analyzes returns to schooling by which professional educational fields the workers attended in higher education. His results indicated that female years of schooling are a more critical determinant of their monthly income than years of work experience. The opposite holds for equivalent male

workers. On the returns to education for different fields, the returns to medical education were higher for females than for other categories, at 28.2%. Also, returns within the agricultural areas for female workers were 5.8% while they were only 1.8% for male workers, indicating a more substantial effect for females within this field.

Chapter 2

Background

This segment aims to give insight and a short context as to how the Nepalese schooling system works. Furthermore, challenges within educational attainment will be outlined, both general and female-specific challenges. Understanding the opportunities and challenges for females in Nepal might give critical insight as to why increasing education is essential. Lastly, I outline the motivation to increase women's ownership of welfare goods in light of the female-specific challenges faced in Nepal.

2.1 Structure of the Nepalese Education System

Nepal is located between India in the south and China in the north. As of 2021, it has a total population of over 30 million (World Bank, 2021). Nepal is a diverse country with a varied ethnic composition of different cultures and castes. The majority of the population (80.3%) lives in rural areas (Britannica, 2019). Nepal is also a young country, with 59,2 % of the total population aged 29 and below. Nepal is one of the poorest countries in the world. As of 2021, it had a GDP per capita of $1,208 (World Bank, 2021). The Human Development (HDI) measures central areas in an economy that contribute to a satisfactory life, for example, the years of education and life expectancy, summarized in a number from 0 to 1, with one being the most satisfactory. Nepal currently has a value of 0.602 (UNDP, 2022), ranking it among the bottom 25% of all countries. The Gini Coefficient measures how equal a country is based on its income distribution [0,1], with 1 being the most equal distribution. The value of Nepal's Gini Coefficient is 0.672 (World Bank, 2021).

Nepal has had a relatively short history of education, as it has suffered from much political turmoil. The first university in the country, the Tribhuvan Chandra Intermediate College, was established in 1918. It was the only university until Nepal became a democracy in 1951. By then, it had 310 primary and middle schools, which enrolled about 8,000 students, eleven high schools, two colleges, and one technical school. The literacy rate for the population was also shallow, at 5% (Akanda, 2010). During this year, the Nepalese government also established The Ministry of Education and Culture, which is responsible for the administration and supervision of all elementary and secondary education in the country (Britannica, 2019). Following some minor reforms, Nepal went through its most comprehensive educational reform in 1971, with the launch of the National Education System Plan, NESP for short. Thus, the new education system in Nepal was implemented, increasing primary educational institutions and making primary education mandatory for Nepalese citizens (Gurung, 2012). One of the most recent reforms in the educational sector, The Government of Nepal School Sector Reform Plan of 2009-2015, has aimed to improve the quality and provision of schooling around Nepal (Ministry of Education, 2009).

The educational progression in Nepal begins in early childhood, where child development centers and pre-primary playgroups offer one to two years of child care for children aged three to six. Primary education, the first official level of education, is a five-year program provided between the ages six to eleven. Thereupon, students go to secondary school, lasting for a total of 6 years. Secondary education starts with lower secondary from grades 6-8 for students aged 12-14 years. Then, secondary education from grades 9-10 lasts two years, and the higher secondary level, from grades 11-12, also lasts two years. Both primary and secondary schooling is provided for free by the Nepali government. An alternative school provision alongside the secondary level is non-formal education, offering three years of Technical Diplomas. After finishing secondary schooling, students may choose higher education, which lasts for three years, except for technical fields such as engineering or medicine, which lasts four years (Daly et al., 2019).

The provision of education has evolved substantially from the birth of the public education system till today. By the year 2000, there existed 25 927 primary schools, 7 289 lower secondary schools, 4 350 higher secondary schools, 1 430 higher education institutions, and 11 universities (Akanda, 2010). As of 2018, about 4,135,000 students are enrolled in primary education, while 3,337,000 are enrolled

in secondary education (World Bank, 2018). In higher education, 441,819 students are enrolled in higher education institutions, with about 75% of them attending Tribhuvan University (Gurung, 2012). Of 1000 participating students in primary education at Grade 1, 86.5% complete grade 5. However, only 70% completed Grade 8. Females tend to complete primary education on the same level as males. However, a more significant portion of girls drop out in secondary and tertiary levels of education, thus raising concerns about gender gaps, which continue to grow in higher levels of education.

2.2 Barriers to education in Nepal

Although public schooling has seen progress in the short time that Nepal has had public schooling, there are still several issues that plague the Nepali school system. Some of these are general issues within the whole schooling system, while others are gender-specific, with female students being disadvantaged due to several factors. These barriers can be classified into two main categories: those originating from the supply side and those stemming from the demand side.

2.2.1 Demand Side

Demand-side barriers consist of challenges that prevent the consumer, in this case, the student, from attaining higher education levels or even education at all. Such barriers may either stem from parental choices to send their children to school or more grown students who choose not to participate in schooling or higher education. As with the rest of South Asia, Nepal is affected by economic and cultural factors that halt educational attainment.

As mentioned above, Nepal is one of the poorest countries in the world. As a result of this, poverty is a significant contributing factor to the lack of educational attainment for the poorest families. Although the provision of primary and secondary education is free in the governmental sector, poorer families may find it challenging to finance school supplies such as books and writing equipment for their children. Another challenge, especially in the case of rural farm workers, pertains to the opportunity cost of sending children to education. Families operating farms are more inclined to let their children do a part of the labor to ease the stress from their parents. If these parents choose to send their children

to school, they no longer have the time and energy to help their parents at home. Thus, the resulting opportunity cost is that the parents need to work their children's labor share to reach the same level of productivity. Thus, they may choose not to send their children to school.

Another supply-based barrier to educational attainment for children is undernutrition as a result of being in poverty. In poorer areas, parents are unable to provide adequate food resources to ensure good learning for their children. When younger pupils do not get adequate food, their learning outcomes diminish as a result of not being able to absorb information correctly, and thus, is an obstacle to education. The following consequences are that these poor children become forced to drop out, as they are not able to learn.

For females, cultural barriers are especially prevalent in the South Asian Region, including in Nepal. Due to the caste system in place, there is a considerable variation between the highest-ranked castes and the bottommost castes, which are known as the Dalits (International Labour Office Nepal, 2005). The lower castes attend to more traditional values, which include gender roles. A common point of view in traditional communities is that the male husbands should be the ones earning money and providing for the family, while the female wife or daughter should stay at home, thus working and taking care of her children there. As such, women in South Asia can become expected to marry men with more education than them (Khan, 1980). Such views work as a barrier to female education as there may be some parents who do not wish to send their female children or unassign their attendance to work at home.

Another barrier in education pertaining to traditional values is the incidence of child marriages (Plan International, n.d.). An estimated 37% of all Nepalese women aged 20-24 are married by age 18, while 10% are married before age 15. Females who are married at an early age tend to be exposed to the traditional roles of mothers and homemakers, as mentioned above. This hinders educational attainment for the woman as she does not get time to acquire education. On the other hand, prolonging marriage has been shown to increase years of teaching, as shown in a study by Jafarey, Mainali & Montes-Rojas (2020). They estimated that each year's delay in marriage would increase female education by 0.2 to 0.5 years. As a result, investing in education may reduce incidences of young brides.

Another demand-based issue lies within the parents' willingness to send girls to school, especially over boys. This phenomenon arises due to the belief that men

should provide for the families while women should fulfill their role as caretakers. In a qualitative study on gender inequality in Nepal, one female participant stated that "family provides more support for a boy's education by enrolling him in private schools, while a girl mostly gets her education in a community school together with engagement in household work" (Danial, Joshi & Swanberg, 2022). This statement implies that male students receive a better education than female students, which can increase the gap between male and female learning outcomes. In other cases, sending female children to less good schools may interfere with their motivation to learn due to inadequate teaching, making them drop out instead of pursuing further education.

Another significant barrier to female education lies in the labor market, where women are discriminated against as opposed to their male counterparts. As of 2022, only 38.1% of all working-age women in Nepal were labor participants (World Bank, no Date). Most of these women work in informal settings, such as agriculture and construction, where they are more subject to exploitation. Such exploitation may be done in terms of underpaying and depletion of worker rights (International Labour Organization, no date). Females are also more likely to be discriminated against in wage settings, as they, on average, earn less than men for the same job. Women working in high-skilled jobs that require higher education, such as teaching, business, and civil service, are forced to work in lower positions than men (Yamamoto & Kaneko, 2017). This creates a gender dynamic where the men and women are separated. Such barriers may prevent women from wanting to pursue higher education due to the expectation that she has to work in lower-ranked positions, even with an adequate education, to pursue higher-paying positions. Women may also expect less career progress, making them more inclined to stay at home and take care of tasks there, thus depending on their husbands to bring income to the household.

2.2.2 Supply Side

Supply-side barriers in female education prevent women from attaining education due to problems with providing instruction. Such issues may, for example, stem from a lack of adequate teaching resources, such as having enough competent teachers. There may also be geographical challenges because it becomes difficult for females to travel to school. In other cases, satisfactory sanitation may be

unavailable for girls in schools.

Firstly, reports indicate that Nepal's education quality is subpar at best (Plan International, n.d.). This is due to a lack of adequate amounts of teachers competent enough to teach very well. As mentioned above, Nepal has many primary and secondary school institutions. In those schools, under 50% of the teachers were trained as of 1997-2003, meaning there were more untrained teachers than trained ones in schools nationwide (Bista, 2006). The lack of trained teachers may mean that students are not receiving an efficient education, and thus, they learn very little. Another issue stems from the need for more qualified teachers. Students attending schools with a high share of untrained teachers may perform worse in standardized tests, preventing future opportunities in higher education.

Another issue related to teaching is that only a small share of teachers in Nepal are female, which may lead to a lack of female role models. In schools, teachers are often seen as leading individuals in children's eyes and, as such, may be perceived as role models. Plan International also lists "low representation from marginalized groups" as a potential challenge Nepal faces. Such marginalized groups may, for example, be the Dalits, who, as mentioned above, are in the lowest rank of the caste system. These factors are perceived as challenges because there may be missing sources of inspiration and positive influences for female children. As such, the learning experience for students without such sources of inspiration might feel unfulfilled in pursuing education, and in the worst case, they may drop out. The least represented groups, for instance, a female Dalit, may be the most exposed to such phenomena.

Another area for improvement in educational supply might be that the school or university is geographically challenging to attend. Especially in rural areas, where Nepal has mountainous terrain, it might be difficult for girls to reach their school due to traveling such long distances in rough terrain. There may also be a lack of safe and affordable transportation measures, such as buses and the use of cars, in these areas. Such difficulties make the cost of attending education higher, as the student must traverse these conditions every day.

2.3 How ownership affects female welfare

Now that I have outlined the issues that girls and women face in educational attainment, I next turn our attention to how ownership of goods may be associated

with positive outcomes for female welfare in developing countries. Ownership of different assets, such as mobile phones, televisions, and houses, has positively impacted women's role in society and their status. It can put women in developing economies in better positions economically, culturally, and politically.

Women who own television sets may be influenced by providing information that affects the status of women. According to Jensen & Oster (2009), women in rural India who were introduced to television cable sets reported lower acceptability of spousal abuse, more autonomy, and lower fertility. The reasons that the introduction of cable television has affected women's status are mentioned as mechanisms. For example, television might affect fertility by providing information on family planning services. Another tool mentioned in the paper is that television programs expose rural households to urban lifestyles, values, and behaviors that are different from their own, thus making them adapt to such matters. This means that a woman who owns a television set gains access to information, which may help her change her norms in a way that positively affects her approach to her status.

Another means of transporting such information is by using mobile phones. Gaining access to a mobile phone may enhance women's access to information worldwide, which may help them change societal norms and female perceptions. She may also be able to communicate with other women, thus assisting in the community-making in developing societies. It may also streamline job and educational activities that require information gathering. For instance, for female business owners, the utility of a mobile phone in a developing is associated with validating their status as business owners (Chew, Ilavarasan & Levy, 2015). This may be attributed to more streamlined means of communication through the phone.

Another way a woman may benefit from ownership is by owning her own financial assets, such as a house or bank account. Being enlisted as an owner of such an economy has been shown to increase decision-making in the household between her and her husband (Pandey, 2010). As she owns her own house, she may be able to decide how to manage the house and, thus, has some autonomy. This notion may be extended to her being able to make more significant life decisions for herself, as purchasing a house is a costly investment.

Chapter 3

Data

This chapter will give an overview of the dataset explored in this thesis. I will also explain how this dataset gives insight into how the data can explain female welfare and educational measures. Additionally, potential shortcomings and challenges that may arise in this analysis will be discussed. Gathering the data, as well as cleaning and analyzing, has been carried out in the statistical software R.

3.1 The DHS Survey

The data source used in this thesis was extracted from the Demographic and Health Survey (DHS) Programme, conducted in low- and middle-income countries worldwide. These surveys collect representative data on various aspects of demographic and health-related topics, such as HIV, female status, and education measures. The survey data gathered for this thesis is the most recent round conducted in Nepal, which is the eighth round. The data was collected with the aid of the Nepali Ministry of Health and Population. The eighth round of the survey was conducted from January to June 2022, which may give us the most recent insight into the situation in Nepal (DHS, 2022). The dataset used for this analysis, which is the "individual" data for female respondents aged 15-49, was downloaded with permission from the DHS Program from https://dhsprogram.com/.

The DHS surveys are typically carried out using two-stage probability samples drawn from an existing sample frame. The sampling frame is a list of all sampling units that entirely cover the target population. The sampling frame is then divided into subgroups that are as homogenous as possible according to specific criteria,

a process which is known as stratification. These criteria are typically stratified by geographical regions and urban/rural areas within each region. Stratification contributes to reducing instances of sampling errors and making the data sample as representative of the Nepali population as possible. Within each stratum, the sample design specifies an allocation of households to be selected, typically around 25-30 households (DHS, no date).

Sampling weights are adjustment factors applied to each observation to adjust for the probability of selection and interview between cases in a sample. This is to ensure that the data becomes representative of the entire population (Nepal), or the subpopulation (provinces within Nepal). The samples are weighted either by region, rural/urban residency, and the women's response rate. The women's response rate is the ratio between completed individual interviews and the eligible number of women who were interviewed, as well as those who were not interviewed. In terms of the sample area, there are seven provinces in Nepal with a variety in population size. As the sample population in the data has a similar number of respondents in all regions, the data on smaller regions is overrepresented. There are also about twice as many residents in rural areas compared to urban areas in Nepal, making urban areas overrepresented in the dataset.

The survey data was gathered from a total of 13786 households through four main questionnaires, for each type of household member. Women in the said household were interviewed using the Woman's Questionnaire which includes data from females age 15-49. This data is derived from a hierarchy of households within one cluster, where the women were interviewed both on the household level as well as individually. It is the individual questionnaire that is the dataset we use in our thesis. The dataset contains a total number of 14845 respondents. However, 856 of those were not permanent residents in the household, which means that representative data on good ownership for these respondents were unavailable. This means that the total number of respondents that are examined is 13989.

In the following sections, the key variables used for this thesis is presented. Additionally, a presentation of how the data manipulation was carried out to match the research objective will follow.

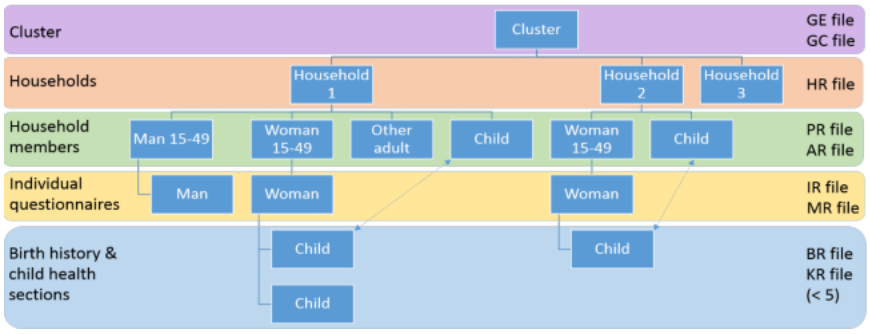

Figure 3.1: DHS Survey Household Hierarchy

3.1.1 Educational data

The measurement of education can be denoted in two different ways. The first measurement captures the highest educational level the respondent has completed, while the second one captures the total number of years of education. Below is a list describing both of these variables.

- *edulevel* shows the highest level of education the respondent has reached. Number 1 denotes the primary level, while level 2 denotes the secondary level. Lastly, level 3 is the tertiary level, which, as mentioned in Chapter 2, is all educational levels higher than secondary. This can be treated as a categorical variable to examine the differences in welfare gains for respondents who have completed primary, secondary, and tertiary education.

- *eduyears1*, which shows the total number of education the respondent has reached. It is a discrete variable that may hold the values $0 - 13$. The number of years of education maxes out at 13, meaning that even though one respondent has $13+$ years of education, they are still noted to have received only 13 years of education. Thus, it is more challenging to compare bachelor's, master's students, and above using this data. The reason higher education has not been categorized further might be due to a low response rate of respondents who have attended tertiary education.

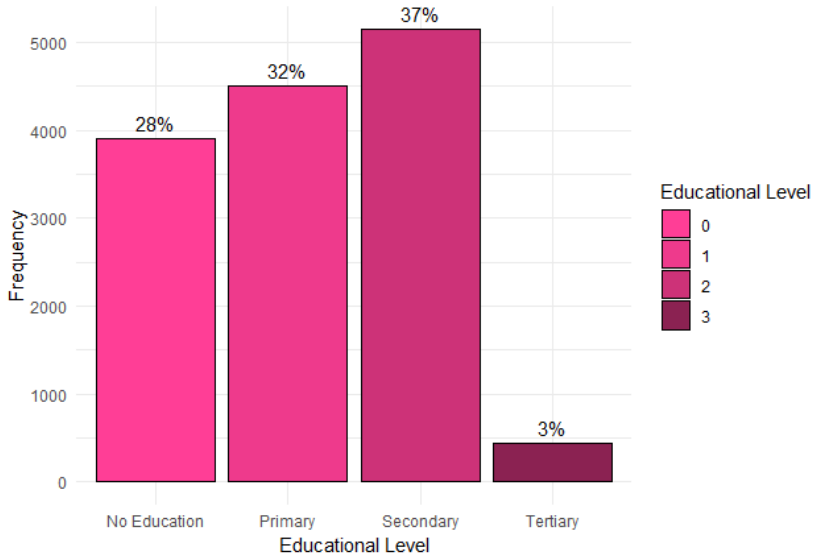

Figure 3.2: Histogram of Highest Level of Education Attended

3.1.2 Good Ownership Variables: Creating The Wealth Index

In this subsection, I present the data that is available in the DHS dataset for ownership of household goods. One fundamental assumption is that ownership in the household includes what the female owns. The women's questionnaire includes data on what goods the household owns. Due to limitations in the dataset, I chose all the ownership variables that are available to us to make the index as comprehensible as possible.

Some goods, such as electricity, refrigerators, and cars are binary (0 = household does not own good, 1 = household owns good). Meanwhile, other welfare measures, such as the household floor, walls and roof, are categorized by which material has been used to build each of these, ranging from shrubs and clay to solid wood and metal. To categorize these incidences, I transform each of the variables into binary variables, such that 0 becomes an undesirable trait, while 1 is a trait associated with better welfare. In the case of building materials, for example the floor, 0 = unimproved and inexpensive materials such as sand, earth and mud. Meanwhile, 1 = improved and expensive materials such as bricks, cement and wood planks. All non-binary variables have been transformed into binary ones using the Guide to DHS Statistics DHS-7.

I assume that each good satisfies some welfare condition, which improves

the living standard of the household. To allocate each good to different welfare improvements, I categorize these into five categories: Health, household goods, financial assets, housing improvements and transportation. Below is a list each of these categories, as well as an explanation for why these are grouped in this manner.

- **Health-Improving Goods**: These are goods that are assumed to lead to improvements in health conditions. These may either decrease the risk of bacteria spreading or improve health by being a safer option to consume. Clean cooking fuels are cooking sources that emit low levels of pollution. They may affect the household's health such that they receive less exposure to pollution. A sanitary water source, such as a clean spring, is necessary to minimize the risk of bacteria spreading through water gathering. Households with a clean toilet are often associated with being less exposed to illnesses and bacteria spreading as well.

- **Household Goods**: These are goods that can improve the conditions inside the household, either by providing entertainment and information or by making work at the home more manageable. Radios and televisions are both means of acquiring information through news programs and other informational outlets. They also provide entertainment for the household through television and radio shows. Refrigerators ease household consumption by making food products last longer, which may help the household to consume the food they want. Electricity is a necessary good that powers all household outlets.

- **Financial Assets**: These may affect the economic status of women, either through providing a wealth asset, or providing easier access to financial services. Ownership of a house can be seen as an asset, as it increases wealth through the possibility of its value increasing if one chooses to sell it. It can be seen as a tangible asset that provides a higher grade of economic stability. Owning a bank account provides access to more accessible means of saving and control over personal finances, and can, therefore, be seen as an important financial good. Both of these goods are specified to be owned by the individual, and are, as such, not treated as a household shared good.

- **Housing Improvements**: These are improvements in the housing structure

and require expensive materials to hold a safe, stable structure in the house. Unimproved floor materials include earth, sand and animal dung, while improved materials include bricks, stone and cement. Unimproved wall materials include dirt, straws and no wall at all, while improved walls may consist of cement, bricks and wood planks. Unimproved roofs may be made of cardboard, straw and grass, while improved roofs may consist of metal, wood and cement.

- **Transportation Goods**: Transportation goods are goods that can be viewed as either transporting people from point A to point B or as a means of transporting information to other people. Mobile phones are treated as a means of transportation, as mobile phones are often used to convey information and messages from almost anywhere to all corners of the world. Bicycles, motorbikes and cars are vehicles used to transport people and goods from point A to point B. However, a bicycle is less expensive than a motorbike, which is even less expensive than a car. Also, a car takes one and can take more people and goods from point A to point B in one go quicker than a motorbike, which is faster than a bicycle.

Another possible assumption is that some goods are more expensive and provide more utility for the household than others. For example, a household owning a car is often more expensive than a radio and can also provide more welfare for a consumer. Therefore, I set weight values to each good to create a relative measurement based on some level of the expected level of utility they provide. These weights are based on assumptions for how much welfare each good relatively provides. Below is a table summarizing the weights we assign to each good, as well as the consumption categories they belong to.

Category	Good	Weighted Value	Cumulative Value
Health	Clean Cooking Fuel	1	1
	Sanitary Water Source	1	2
	Safe Toilet	1	3
Household	Radio	0.25	0.25
	Television Set	0.75	1
	Refrigerator	1	2
	Electricity	1	3
Financial	House	2	2
	Bank Account	1	3
Housing	Improved Floor	1	1
	Improved Walls	1	2
	Improved Roof	1	3
Transportation	Mobile Phone	0.5	0.5
	Bicycle	0.25	0.75
	Motorbike	0.75	1.5
	Car	1.5	3

Table 3.1: Table of goods with weighted values

One point to note is that the maximum value each category can take is 3 for all categories. This is to hold a standardized measure for the harmonic mean, which will be further presented in Chapter 4.

As shown in Table 3.2 below, electricity is the most commonly owned good, while a house is the least owned good. Additionally, Table 3.3 shows descriptive statistics for grouped goods. The households in Nepal are primarily wealthy in health-related assets, with a mean value of 2.314. On the other hand, the category they are most lacking in is financial assets. This might be because many Nepalese women own their own bank accounts but acquiring housing is much more difficult.

Table 3.2: Descriptive Statistics of Welfare Goods

	Mean	SD	Min	Median	Max
Health					
Clean Cooking Fuel	0.342	0.474	0	0	1
Sanitary Water Source	0.978	0.146	0	1	1
Safe Toilet	0.994	0.078	0	1	1
Household					
Radio	0.195	0.396	0	0	1
Television Set	0.459	0.498	0	0	1
Refrigerator	0.225	0.418	0	0	1
Electricity	0.95	0.217	0	1	1
Financial Assets					
House	0.079	0.410	0	0	1
Bank Account	0.46	0.498	0	0	1
Housing					
Improved Floor	0.453	0.498	0	0	1
Improved Walls	0.522	0.500	0	1	1
Improved Roof	0.937	0.243	0	1	1
Transportation Goods					
Mobile Phone	0.786	0.410	0	1	1
Bicycle	0.368	0.482	0	0	1
Motorcycle	0.255	0.436	0	0	1
Car	0.049	0.216	0	0	1

Note: Descriptive statistics for a total of 13989 observations. The mean expresses the share of the data sample that owns the respective good.

Table 3.3: Descriptive Statistics of Categories in the Wealth Index

Statistic	N	Mean	St. Dev.	Min	Max
Health	13,989	2.314	0.514	0	3
Household	13,989	1.569	0.744	0	3
Financial	13,989	0.618	0.787	0	3
Housing	13,989	1.913	1.018	0	3
Transportation	13,989	0.750	0.584	0	3
Aggregated Index	13,989	0.741	0.627	0.022	3

3.2 Potential Limitations

While utilizing this measurement of female ownership may give some insight as to how increasing education affects female welfare in Nepal, it is by no means a perfect measurement. In this segment, I highlight some potential limitations.

One glaring limitation of this dataset is that certain explanatory variables are not present. Variables such as parental education and measurement of the quality of education could lead to one acquiring more years of schooling. Additionally, other variables such as income, worker skill, and profession could be explanatory in other aspects than education. This lack of explanatory variables can lead to omitted variable bias, which means that estimations for variables not included in the models are wrongly attributed to the variables that the model includes. This might mean that due to variables that are not available, the estimated values might be less accurate than what the values indicate. This is because the data used for this thesis contain limited information that might explain both education and welfare.

Another challenge posed in this thesis concerns the constructed measurement of ownership. As mentioned above, the variables are weighted according to how owning a given good increases welfare vs. not owning it. However, the accuracy of these estimates might need improvement, as they are not based on the real prices of these goods in Nepal. One possible way to solve for inaccurate estimates is to assign weighted values on goods according to the true cost of those goods. However, due to the limited availability of accurate prices on goods, this was not possible. Another point to note is that some of these goods, such as improved housing materials and bank account ownership, would be difficult to price quantitatively.

One particular issue that this dataset might pose is that it might not fully capture the scope of female wealth. While it does capture ownership of some essential goods, it would be possible to factor in the ownership of other goods that may lead to increasing welfare. Examples of goods that would be beneficial to have ownership data on would be certain types of furniture, educational materials, or computers. Including data on consumption would also provide health-related factors as a means of measuring welfare. Additonally, data on such non-durable consumption over time might also have been beneficial to provide a "real" proxy for how much the female spends on a month-to-month basis. If such variables were included in the dataset, this would enrich the index measurement.

Chapter 4

Theory

In this chapter, I present the theoretical foundation that will lay the groundwork to assess the aggregated ownership of females' ownership of goods and assets. To do so, I first explain the economic framework, which is intended to act as a benchmark for further analysis and provide our model specification. This framework is based on the Constant Elasticity of Substitution (CES) utility function. Its properties can be used to construct our ownership index, which I use as a proxy for welfare.

I introduce a general case of a CES Utility function and its properties. More specifically, I examine how the acquisition of the goods changes as different numbered values for the elasticity of substitution are set. Following this, I will present critical assumptions about the data I have used to determine what mathematical expression our CES Utility framework should take. Finally, I examine how earlier research has used CES Utility Functions to assess empirical data. I will also present how a framework with a similar scope of research, Engel Curves, has been used to measure poverty for comparison.

4.1 CES Utility Functions and the level of substitution

The Constant Elasticity of Substitution (CES) function is a commonly used form in both production and consumer theories in economics. This function satisfies necessary axioms such that it is possible to illustrate consumer choices and preferences: (1) Completeness, (2) transitivity, (3) continuity & (4) independence of irrelevant alternatives (Jehle & Reny, 2011, p. 5). It is called the CES Utility Function because it exhibits constant elasticity of substitution for all indifference

curves, such that the substitutability properties are equal for all optimal good combinations. One typical property the CES Utility Function exhibits is that it is non-linear.

To illustrate the properties of the CES Utility Function, I consider a general function Q, which denotes an indifference curve for some level of utility gained from consuming some number of goods x_i. x denotes one good, while i denotes the type of good ($i = 1$ denotes good 1 while $i = 2$ denotes good 2 etc.). A general CES Utility Function may be expressed as

$$Q = F * [\sum_{i=1}^{n} \alpha_i x_i^r]^{1/r} \tag{4.1}$$

Which exhibits a similar relationship between goods and elasticity of substitution as the specification of Dixit & Stiglitz (1977). This function gives the total utility Q of consuming quantities $x_1, x_2, ...x_n$ of n different goods. α_i denotes a weight parameter $[0, 1]$. F is the "scale factor, " a constant that scales the utility level. r is a substitution parameter that specifies the value of s.

The s denotes the elasticity of substitution. This s is defined as

$$s = \frac{1}{1 - r} \tag{4.2}$$

It is possible to transform s for r. This is done to plug in any given value of s such that finding the value of r is possible:

$$r = \frac{s - 1}{s} \tag{4.3}$$

One fundamental property of the CES Utility Function is that it is homothetic. This means that if one indifference curve[1] Q_1 is better than Q_2, then this also holds for any positive multiple. A homothetic function can be mathematically defined as a monotonic[2] transformation of a homogenous function. For illustrational purposes, one may treat the consumer's preferences in an ordinal[3] fashion, such that it is possible t assume that Q_2 has a more preferred utility level than Q_1. When the CES Utility Function is homothetic, one important implication is that the slope

[1] Illustraton of all possible combinations where the consumer receives a given level of utility

[2] A function is monotonic when it is between ordered sets that preserves or reverses a given order. In this case, it preserves an increasing order.

[3] Ordinal utility states that the utility the consumer receives can be ranked in order instead of measured quantitatively.

of the indifference curves is constant. Below is an illustration of isoquants with homothetic preferences, including a monotonic transformation h.

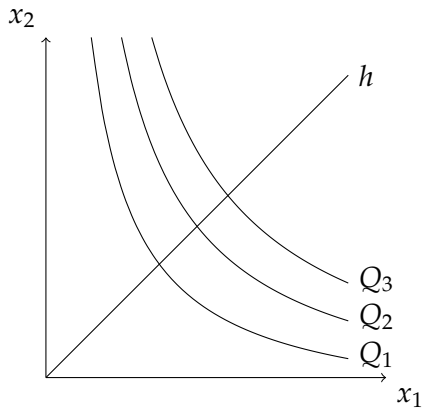

Figure 4.1: Indifference Curves Q_i exhibiting homothetic preferences

Depending on the value of r, the CES Utility function may exhibit different characteristics that define their level of substitutability. By setting the value of s, it is possible to show how r affects the CES Utility Function. I will explain cases where s takes on the values of 0, $\frac{1}{2}$, 1 & ∞[4]. By subsequently increasing the value of s, I examine how the consumer's level of substitutability between goods will increase with this parameter.

If I set that s is a positive number approaching 0, the substitution parameter can be calculated as

$$\lim_{s\to 0} r(s) = \lim_{s\to 0} \frac{0-1}{0} = \frac{-1}{0} = \infty+ \tag{4.4}$$

By plugging this value of r, the CES Utility Function exhibits the form

$$Q = [\sum_{i=1}^{n} \alpha_i x_i^{\infty+}]^{1/\infty+} \tag{4.5}$$

When the CES Utility Function exhibits an elasticity of substitution equal to zero, there is no substitutability between goods, or, in other words, perfect complementarity. The CES Utility Function represents Leontief preferences, where consumers prefer to consume each good in fixed proportions in conjunction with

[4]in some cases I have to set the mathematical limit of a function to avoid undefined results.

each other. This can be illustrated by drawing L-shaped indifference curves, where it is notable that the consumer consumes goods x_1 and x_2 in equal proportions. In the illustration below, I show that the consumer receives the highest level of utility for given budget lines B by consuming each good in equal proportions.

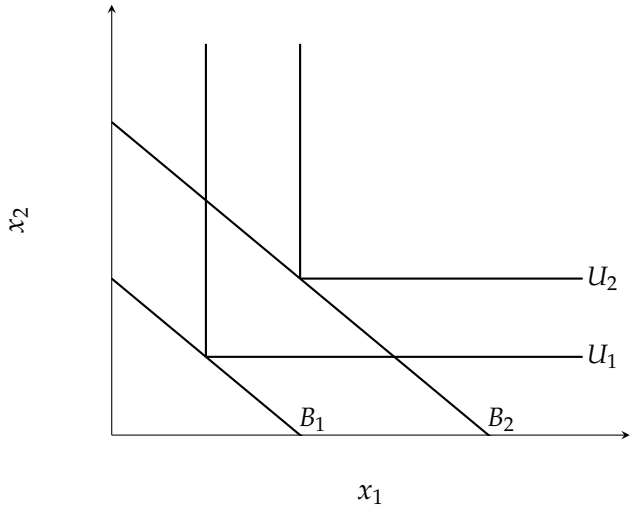

Figure 4.2: Two-good illustration of indifference curves with Leontief Preferences

If the elasticity of substitution is set to a somewhat higher level, for example, such that $s = \frac{1}{2}$, then r becomes

$$r = \frac{\frac{1}{2} - 1}{\frac{1}{2}} = -1 \tag{4.6}$$

Inserting the $r = -1$ transforms the CES Utility Function to

$$Q = [\sum_{i=1}^{n} \alpha_i x_i^{-1}]^{1/-1} = [\sum_{i=1}^{n} \frac{\alpha_i}{x_i}]^{-1} \tag{4.7}$$

In this case, there lies a moderate degree of substitutability. This implies that the consumer is willing to trade off one good for another to some extent but that there lies a limit to how she will substitute said good without giving up her given level of utility. To show this, one may observe from the indifference curves that if the consumer has a high level of consumption of good x_1 and the relative price of x_1 increases, she will substitute some level of x_1 by consuming a little more of x_2 to keep the same level of utility.

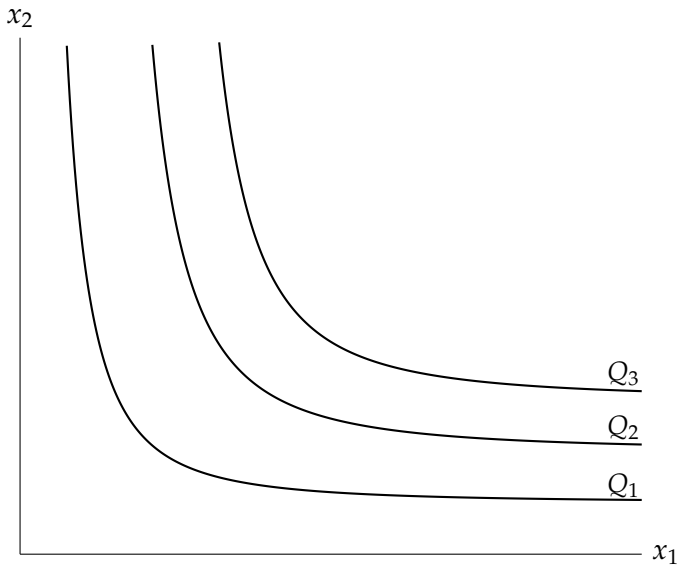

Figure 4.3: Indifference Curves with Moderate Levels of Substitution

In the following case, the s is further increased. Further increasing the elasticity of substitution such that $s = 1$ exhibits the substitution parameter as

$$r = \frac{1-1}{1} = 0 \tag{4.8}$$

When I insert the parameter r in our CES Utility Function, I get

$$Q = "[\sum_{i=1}^{n} \alpha_i x_i^0]^{1/0}" \tag{4.9}$$

Rewriting this expression for a two-good case with weights α & $(1-\alpha)$, as well as a constant A gives

$$Q = x_1^{\alpha} x_2^{1-\alpha} * A \tag{4.10}$$

The following form of the CES Utility function has been transformed into a Cobb-Douglas function. One characteristic is that this is typically a multiplicative utility function. Also, in this case, it is linearly homogenous, which is proven because the sum of each weight is equal to 1 ($\alpha + 1 - \alpha = 1$) for all α between 0 and 1. It is possible to illustrate the substitutability of the Cobb-Douglas specification. I can transform the Cobb-Douglas function above such that if

$$Q = \sqrt{x_1 x_2}$$

then q can be defined as

$$q = 2 \ln Q = \ln x_1 + \ln x_2 \tag{4.11}$$

It is possible to illustrate how the rate of substitutability changes by drawing the indifference curves for a Cobb-Douglas case where $s = 1$:

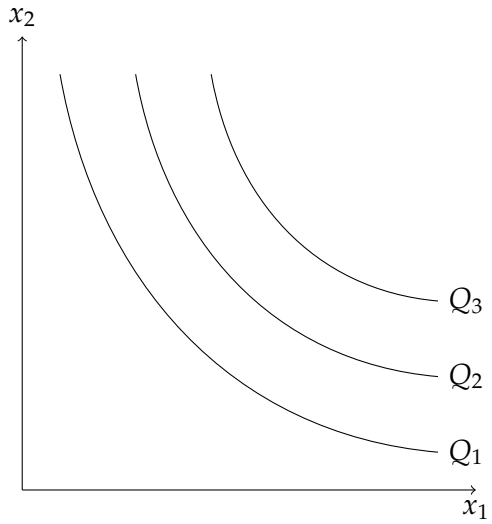

Figure 4.4: Indifference Curves for Cobb-Douglas function $Q = \sqrt{x_1 x_2}$

These curves showcase how the slopes differentiate from earlier cases. For Cobb-Douglas utility functions, the indifference curves get more rounded. This means that if the consumer has a high consumption of x_1, and the relative price for said good increases, she will substitute some consumption of x_1 by increasing the consumption of x_2 somewhat more to keep the same level of utility. This is similar to the CES Utility case where $s = \frac{1}{2}$, but the consumer is willing to substitute for more x_2 in this case.

One noticeable trait of the CES Utility Function that has been demonstrated and compared is that the level of substitutability increases with the value of s. This means it is possible to continue increasing the s to increase the relative consumption of one good x_i the consumer will substitute for x_j if the price

increases. But what happens when I increase the s to the highest level possible?

To do this, I set that s is a large number approaching infinity[5]. This, in turn, gives the substitution parameter r

$$\lim_{s\to\infty} r = \lim_{s\to\infty} \frac{s-1}{s} = \frac{\infty}{\infty} = 1 \tag{4.12}$$

Applying the substitution parameter transforms the CES Utility Function such that

$$Q = [\sum_{i=1}^{n} \alpha_i x_i^1]^1 = \sum_{i=1}^{n} \alpha_i x_i = \alpha_1 x_1 + \alpha_2 x_2 + ... + \alpha_n x_n \tag{4.13}$$

As opposed to all earlier cases, this shows a linear relation between the consumption of each good. An economic interpretation would be that this shows perfect substitutability, the opposite of the Leontief case above. Perfect substitutability means that when the relative price of good x_1 increases, the consumer will shift her consumption to x_2 equally as much as the price increases. To illustrate this, I draw indifference curves with perfect substitutability.

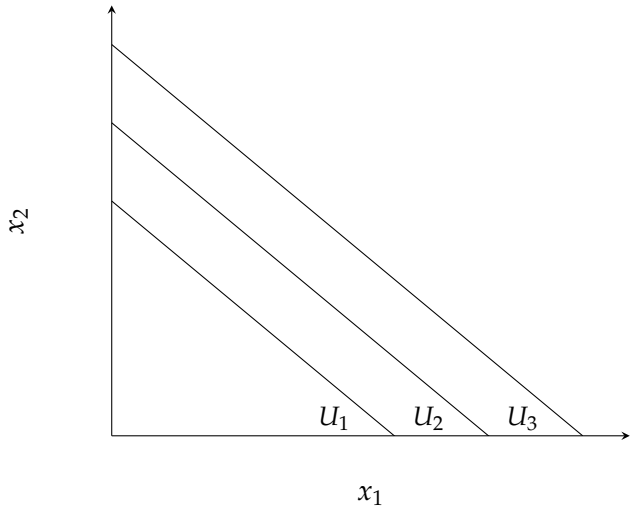

Figure 4.5: Two-good Indifference curves with Perfect substitutability

[5]Setting s as infinity would make r undefined.

4.2 CES as a theoretical framework: The Ownership Index

In this subsection, I apply the framework above to create a cardinal index that measures the ownership of goods in numerical order. To create this index, I make critical assumptions regarding our data, as explained in Chapter 3 above. When the assumptions have been set, I can set the parameters to calculate the ownership index, which is shown to follow a harmonic mean. The rationale for constructing an index by the harmonic mean will also be accounted for.

First, in isolation, I assume that if one female does not own a specific good (denoted by value 0), her utility is less than that of another female who owns the specific good. In other words, her utility is denoted by how many types of goods she owns, which is increasing by the number of goods owned. As long as this assumption holds, I can use our measurements as a proxy for welfare. That is also how I intend to denote the consumer's level of ownership such that it becomes possible to examine the returns to education.

Secondly, I assume the consumer's utility increases if she receives one good if she does not already have it, but not when she receives another one of said good. This means that consuming more of each good does not equal a higher utility and matches the available data because it does not provide information on the quantities of each good the household owns. Other characteristics, for example, what brand the car a household owns, are also not given in the data.

Following these guidelines, it is possible to assume which level of substitutability best fits the dataset. Because each grouped good is better to own than to not own, I can assume that the consumer wishes to own as much of them as possible. This means that for a given budget line, the consumer wants to maximize her utility by consuming the combination of grouped goods where the indifference curve is farthest to the right.

Since the consumer needs the grouped goods to live an adequate life, she is less willing to substitute her consumption of one good for another. If her substitution rate were, for example, $s = \infty$, she would be very willing to substitute away one grouped good if its price increased by equal levels of consumption. Therefore, the substitutability should be low. However, if $s = 0$, she must consume each good in conjunction with each other. This is not possible, as several respondents in our data consume different levels of all goods. Therefore, to capture the consumer's substitutability as well as possible, the level of substitution is denoted as $s = \frac{1}{2}$. As

shown above, this leaves the substitution parameter to become $r = -1$.

$$Q = [F * \sum_{i=1}^{n} \alpha_i^{-1} x_i]^{\frac{1}{-1}} \tag{4.14}$$

Next, I turn to setting our scale factors and weights. As mentioned in Chapter 3 above, the goods were grouped into five categories, signifying different ways to improve welfare. Each grouped good is treated as providing an equal amount of utility as each other. This is done such that I will not discuss how substitutability between each grouped good is related, but rather how the aggregated consumption of these goods works in conjunction with each other. This can be expressed by setting the scale factor f and weights α_i

- $F = 5$. I set this to denote the number of goods in our model. This also equates to $F = n = 5$, meaning that I aggregate each good into the five categories to simplify the model.
- $\alpha_i = \frac{1}{5}$. I set all α_i equal to each other to denote the weight of each group. The consumer treats each group of goods as equally important to each other.

Inserting these transforms the CES Utility Function to

$$Q = 5 * [\sum_{i=1}^{5} \frac{1}{5} x_i^{-1}]^{\frac{1}{-1}} = (\frac{1}{5}\frac{1}{x_1} + \frac{1}{5}\frac{1}{x_2} + \frac{1}{5}\frac{1}{x_3} + \frac{1}{5}\frac{1}{x_4} + \frac{1}{5}\frac{1}{x_5})^{-1} \tag{4.15}$$

The parentheses raised to -1 means that I have to solve the inverse of the current equation given inside the parentheses. This gives us

$$Q = \frac{5}{\frac{1}{x_1} + \frac{1}{x_2} + \frac{1}{x_3} + \frac{1}{x_4} + \frac{1}{x_5}} \tag{4.16}$$

The rewritten CES Utility Function returns a function that acts as the mean of the consumption bundle, or in mathematical terms, the "harmonic mean" (Investopedia, 2023). The harmonic mean function allows for equal weighting between the different grouped goods.

With a CES Utility Function denoted by the harmonic mean, I specify a few key characteristics to match the data I have for household ownership of different goods. The function is increasing with the number of goods acquired in the household. This is because, as mentioned above, each x_i is calculated as a number between 0 and 3, with 0 denoting no ownership and 3 denoting complete ownership in

the respective category. For each observation, I insert the value of each x_i in our equation to calculate the harmonic mean, which is also a value between 0 and 3.

To show how this index captures welfare, I assume that the consumer has a given level of income I she can spend on goods x_i. She wants to maximize her utility by choosing whichever indifference curve tangents with her budget line. Given this assumption, it is possible that she only consumes the good combination where she maximizes her utility. Using this logic, I can assume that her level of consumption shows her income level, which is spent on welfare goods. This assumption makes it possible to assess the level of welfare as her potential wealth level.

One key characteristic of this CES Utility Function is that it exhibits homogeneity of degree 1. This satisfies the general condition of homothetic preferences, such that all indifference curves exhibit the same shape and relation as each other for all goods. This means, for instance, that if one consumer doubles her consumption level, the index value would double, giving her double welfare. This is illustrated below for a two-good case, as it is currently impossible to draw a five-dimensional relation between goods.

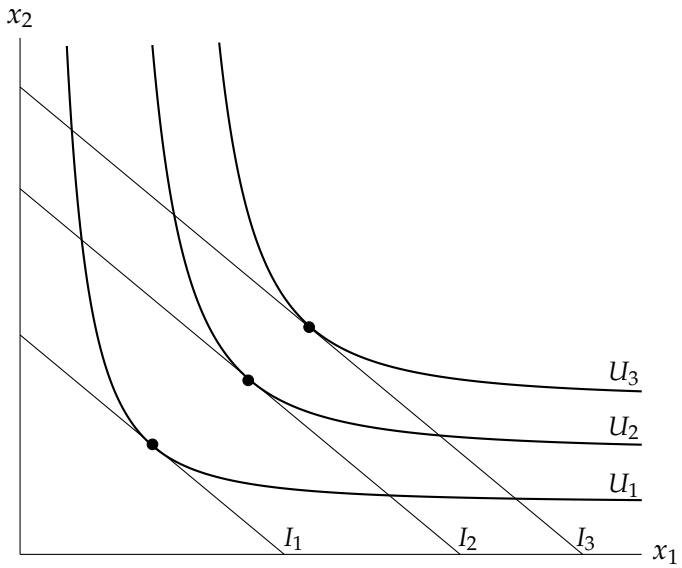

Figure 4.6: Tangency points between indifference curves & budget lines

4.3 CES and Welfare-based research

I now turn to present earlier studies that have utilized CES Utility Functions to assess empirical data. I compare earlier research to my index-based research to assess how this differs from other research objectives and microeconomic approaches.

CES Functions have been used extensively in different branches of research. Most notably, Arrow, Chenery, Minhas & Solow (1961) were among the first to develop a CES function specified to study the substitutability of capital and labor as production inputs. Dixit & Stiglitz (1977) constructed a similar CES function on the demand side to theoretically study various aspects of the relationship between market and optimal resource allocation. This is one of the first cases where a CES Utility Function has been constructed to assess some welfare phenomenon.

Merz & Rathjen (2014) applied a CES utility function to study multidimensional poverty in Germany using diary data. This research builds on earlier works measuring poverty across dimensions other than income alone. In this case, they evaluate poverty as a lack of well-being and utilize a CES well-being function to assess poverty by measure of multiple dimensions, time, and income. They found strong evidence to suggest a mutual interdependence between leisure time and income, which indicates that although one part of the earn enough above a specific poverty line, they are assigned to not substitute that income for leisure time, which makes them poor according to the time dimensions.

Another estimation of poverty has been developed around Engel Curves, which are an alternative theoretical approach to assessing how consumption changes depending on a given consumer's income. Almås, Kjelsrud & Somanathan (2019) have derived an alternative method to estimate poverty empirically in India. Hamilton (2001) pioneered studies on eliminating biases over time by studying consumer price indices. The research method that they utilized relates to studying how much of their income each consumer spent on food. Their method consisted of a demand system, highlighting how large their food budget share was. Their results indicate a more significant variation between prices and poverty across India, meaning that nominal price levels may not be the most accurate way to measure poverty and real income. Alternatively, they find that measuring poverty with the Engel method may better identify poverty by studying the consumption of cheap calories from cereals vs. expensive calories from oils.

Chapter 5

Empirical Application & Results

In this chapter, I turn to presenting the empirical strategy that will be utilized to answer my research question. For this thesis, I use Ordinary Least Squares to test the effect education has on ownership denoted by the aggregated index. I present the most basic OLS estimator as well as its results, then discuss these estimations. I subset my findings depending on demographic categories, such as province, whether the sample is taken from urban/rural areas, and age. Separating between such categories allows me to study whether certain demographic groups' ownership is more affected than others. Afterward, I expand my OLS model to include control variables to reduce omitted variable bias. Lastly, I implement robustness checks by introducing the sample weights to check if our data samples are representative of the whole population.

5.1 OLS Estimation models

This segment is meant to headline how I intend to use the ownership index to estimate welfare gains per year of education. As mentioned in Chapter 3, a given female's welfare is calculated by considering how much her household owns. Also, as mentioned in Chapter 4, the value of her ownership is treated as an ordinal measure of her aggregated welfare.

The Ordinary Least Squares (OLS) regression is a method used to estimate a regression line as close to the data as possible (Stock & Watson, 2020, p. 148). The estimated line is linear because OLS estimation is assumed to exhibit a linear relationship between the dependent variable, which is the variable affected by the

independent variable. In this case, it will used to estimate the effect each marginal number of years of education has on the ownership grade that the female in the household owns. The most straightforward OLS estimator used for this thesis can be expressed as a pooled regression equation:

$$Y_{ownership} = \beta_{intercept} + \beta_{eduyears} * X_1 + \epsilon \tag{5.1}$$

This equation estimates the consumption of the respondent based on her educational level. $Y_{ownership}$ is the dependent variable and expresses the estimated value of ownership without any years of education. $\beta_{intercept}$ is the estimated value of ownership without the additional effects of years of schooling. The coefficient $\beta_{eduyears}$ is the independent variable and calculates how much the ownership value increases for each X_1 year of education. For this thesis, this coefficient can be defined as the ordinal increase in welfare, as the higher the value, the higher the preference is. The ϵ is an error term, which follows the assumption that it is independent and identically distributed (iid), with an expected mean of zero (Stock & Watson, 2020, p. 145). If the predicted standard is not 0, the error term is an expression of residual variables that are not represented in the model. The residuals express the difference between the expected value of Y and the estimated value of $\hat{Y}$.

This regression model might have several weaknesses. The most notable is omitted variable bias, which would make the error term not i.i.d. and give the mean a number, not 0. To control for such effects, I extend the model by incorporating binary dummies for age cohorts between 15-25, 26-35 & 35-49, as well as a binary variable for urban respondents. I also introduce the husband's years of education as a potential control variable. While the dataset is limited in possible control variables, the variables above can explain some of the observed welfare gains. When the respondent is a wife, the husband may have some level of or all control over the household's finances, thereby choosing which goods should be purchased in the home. Additionally, suppose the respondent is of a higher age. In that case, a safe assumption might be that she is more likely to have a higher-paying job, which in turn gives her a higher probability of having high welfare.

To apply these variables, I first incorporate a dummy variable for X_2 denoting marriage status (0 = not married, 1 = married). If the respondent is married, the control variable X_3 accounts for the husband's years of education. Additionally,

X_4 denotes the respondent's age to control for these differences. To estimate differences in the welfare gained from education across regions, I incorporate dummies for each respective province that are not the baseline j. There are $n = 7$ provinces in Nepal, and b denotes the baseline region to which all other areas become relative. This OLS extension can be summed up as equation (5.2).

$$Y_i = \beta_{0b} + \beta_{1b}X_{1ib} + \sum_{j=1}^{n-1}(\beta_{0j} + \beta_{1j}X_{1ij}) + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \epsilon \quad (5.2)$$

To account for a potential non-linear relationship between years of education and level of ownership, I further extend the model by incorporating a squared term for the variable years of education. Incorporating such a term makes it possible to examine non-linear relationships in the data and will be incorporated for all X_{1i} from equation (5.2), such that the specification is denoted

$$Y_i = \beta_{0b} + \beta_{1b}X_{1ib} + \beta_{2j}Xji^2 + \sum_{j=1}^{n-1}(\beta_{0j} + \beta_{1j}X_{1ij} + \beta_{2i}X_{1ij}^2) + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \epsilon \quad (5.3)$$

5.2 Results in the simplest case

The most straightforward regression table shows the marginal welfare gained on ownership for all respondents in the dataset, not taking any demographic or geographic variables into account. These regressions are weighted by the sample weights to ensure that the samples are representative of the entire country.

At first glance, one may interpret the constant, which is the predicted value of ownership for the female without education, as having the value of 0.595. This implies that her predicted level of ownership is low. Furthermore, the expected marginal increase of ownership is 0.038, meaning that for every year of education the female receives, her predicted ownership value increases by that value. As an example, a female with ten years of education is expected to have a total ownership value of $0.595 + 0.038 * 10 = 0.975$. This is shown to be a statistically significant relation, meaning that there is a relation between added years of education and an increase in welfare. However, the increased education appears to have a modest

Table 5.1: OLS Regression with years of education as the only dependant variable

	Dependent variable:
	Wealth Index
Eduyears	0.038***
	(0.001)
Constant	0.595***
	(0.009)
Observations	13,989
R^2	0.070
Adjusted R^2	0.070
Residual Std. Error	643.498 (df = 13987)
F Statistic	1,052.210*** (df = 1; 13987)
Note:	*p<0.1; **p<0.05; ***p<0.01

estimated effect on the welfare of female respondents in Nepal, as ten years of education is shown to only increase the index value by 63%.

The coefficients from the regression above might be biased, as the current results suggest that there is a little to moderate increase in female welfare from acquiring education. A possible explanation for this might be that women with only primary education might receive less marginal benefits from schooling. It might be the case because while primary education is obligatory in the country, this level does not provide the skill set needed to acquire waged labor. In contrast, those who choose to pursue secondary and higher education might be more inclined to reap welfare benefits because of a higher probability of landing a job. In light of these assumptions, one plausible explanation could be that those who have only attended primary education have only done so because it was statutory.

To examine this notion, I only account for respondents who have attended at least secondary schooling, such that years of education are > 8, making each possible year of schooling range between 9 and 13. The part of the population who has not attended school, as well as those who have only participated in primary schooling, are, as shown in chapter 3, a large part of the dataset. Therefore, the total number of observations is reduced from 13989 to 5586. I run the same regression as above for this newly specified respondent group and compare the differences in

marginal returns.

Table 5.2: Regression with eduyears as only dependant variable for > 8 years of education

	Dependent variable:
	Wealth Index
Eduyears	0.169^{***}
	(0.007)
Constant Term	-0.791^{***}
(Impossible Value)	(0.071)
Observations	5,586
R^2	0.106
Adjusted R^2	0.106
Residual Std. Error	694.962 (df = 5584)
F Statistic	664.575^{***} (df = 1; 5584)
Note:	*p<0.1; **p<0.05; ***p<0.01

In comparison to Table 5.1, the most striking difference is that the marginal returns seem to be significantly higher. According to Table 5.2, the OLS estimates that respondents with at least 9 years of education receive an indexed increase of 0.169, which is a substantially higher coefficient than in earlier cases. The constant value of -0.791 is impossible because only those with at least 9 years of education are considered, making the least possible estimated index value $-0.791 + 9 * 0.169 = 0.73$. The initial value is relatively higher than several cases seen above but is by no means a high level of wealth. Estimating the gains from 9 years of education to 13 years of education yields an estimated increase towards $0.73 + 0.169 * 4 = 1.406$. In other words, the welfare gained from four years of at least secondary education is estimated to be 92.6%.

These estimates indicate that the returns from secondary and tertiary education are higher than from primary education. One potential reason for this might be that girls who attend secondary education might have better chances of getting jobs and, thus, might be able to purchase welfare goods. Another point to note is that all bachelor's, master's, and Ph.D. programs are gathered in 13 years of education, which might make higher education underrepresented. This, in turn,

might make these estimates biased because the estimated marginal returns to secondary education probably are higher than the actual returns to secondary education. At the same time, it is difficult to correctly interpret the welfare gained from tertiary education due to a lack of representative data.

Despite these simple results, both estimates are likely to be highly inaccurate due to several factors. Firstly, the R-squared[1] (R^2) and the adjusted R^2 values for both regressions are 0.07 and 0.106 respectively. These low values imply that the linear regression line does not give accurate estimation coefficients in the measurement of increased welfare per year of education. This could happen due to omitted variable bias. Explanatory variables such as other household members' years of education, mother or father's years of education, income, or other factors associated with higher welfare might give more explanatory power to the observed estimates. There also might lie geographical and demographical differences in the estimated effect of education on welfare.

Another possible observation is that the marginal relationship between the years of education and welfare might be non-linear, or in other words, increasing with the number of years of schooling. Non-linearity might explain the varying degrees of marginal welfare gained from those above the cutoff level and those below. Because of potential non-linearity, it could mean that linear regression does not become the Best Linear Unbiased Estimator (BLUE). This is something that will be accounted for below.

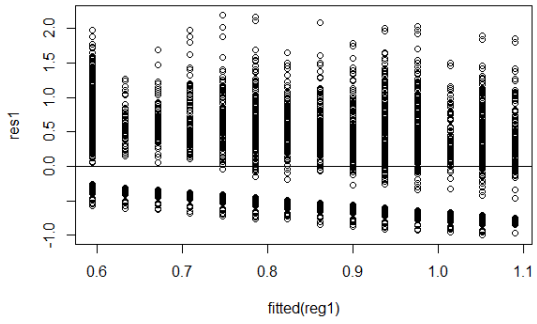

Figure 5.1: Fitted Residual Plot for OLS regression in Table 5.1

[1]The fraction of the sample variance of Y predicted by X (Stock & Watson, 2020, p.153). Used to measure how well the predictors fit the data.

By examining the residuals for both regressions, it is also possible to observe why the estimations do not fit the actual observations well. As mentioned above, the residual terms need to follow the Gauss-Markov theoretical assumptions for the estimations to be valid. Figure 5.1 shows the fitted residuals for the first OLS estimation. One critical observation is that most of the residuals avoid the point 0, which does not indicate a perfect fit between the estimations and actual observations. This implies that the actual marginal gains from education are either above or below what the estimated coefficient implies. There is a relatively large variance in how much each respondent earns per marginal year of schooling. Therefore, the key takeaway is that while some part of the population gains little from education, others gain much. The reason for this variance in welfare attainment will be discussed below.

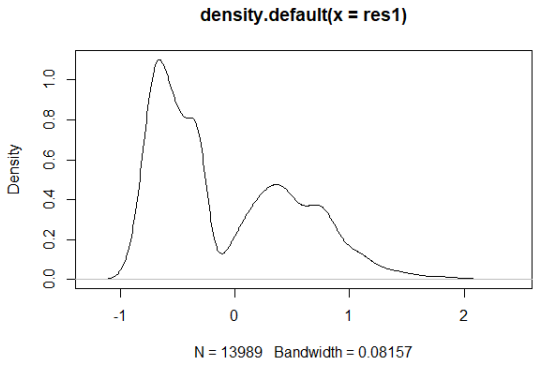

Figure 5.2: Density Plot of residuals for OLS in Table 5.1

By observing the residual density plot in Figure 5.2, there appear to be two density peaks: one that is below the value of 0, and one that is above. Around the value 0, there are very few observations that align with Figure 5.1. The residual distribution does not follow an i.i.d. curve, suggesting that Gauss-Markov assumptions are not satisfied. Additionally, the density peak below 0 appears to be larger than the one above 0, suggesting that the mean residual is below 0, which also does not satisfy Gauss-Markov assumptions. Because the mean residual term is below 0, the predicted index values are mostly less than the actual index values. It is, therefore, necessary to run alternative regressions such that it is possible to identify why these variations arise.

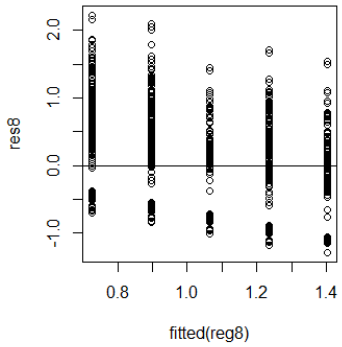

Figure 5.3: Residual Plot for estimations with at least secondary education

As a comparison, the residuals for the sample above the cutoff educational level seem to follow a similar pattern. The pattern observed in the second fitted residual plot below seems to indicate some overestimation. The estimated welfare values are overestimated heavily in lower levels of education but become less overrepresented with each increasing year of schooling. Another observation is that the spread varies with each representative year, which implies that the estimates are heteroskedastic. Similarly to Figure 5.2, the residual density plot for this regression has one peak below 0 and one above 0. However, the mean residual is closer to 0 than the case above, indicating that these estimations might be more accurate.

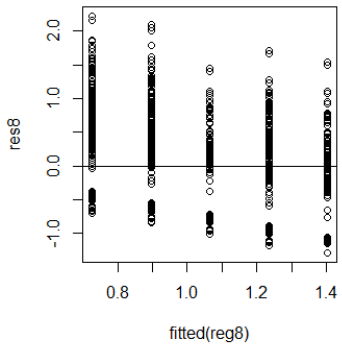

Figure 5.4: Residual Plot for estimations with at least secondary education

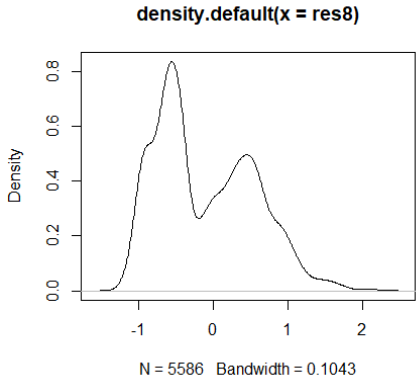

Figure 5.5: Residual Density Plot for estimations with at least secondary education

5.3 Extending the OLS Estimators: Non-Linearity and Controls

The current estimates do not give a very accurate image of the welfare returns from education, due to low R-squared values and apparent non-linearity. To account for a non-linear relationship, I extend my regression to include a squared measure of years of education $(eduyears)^2$. Incorporating this in conjunction with the regular *eduyears* allows for comparisons in measurement. Additionally, I add control variables to account for potential omitted variable bias. These controls are, as mentioned in Section 5.1, Age, Marriage and Husband's years of education if married, and province. I add interaction terms to the provinces to examine differences in marginal educational gain for different geographical areas. Estimating the differences between regions is interesting because it might provide insight into whether or not there are significant geographical differences. The sample size for each province is also relatively similar to each other. These extensions are expressed as equations (5.2) and (5.3), which will be used as the estimators.

Bagmati, which is the province that contains the capital city of Nepal, Kathmandu, acts as the baseline province[2]. The baseline is the province to which all other provinces will be compared, meaning that the estimates denoted Koshi,

[2]This is to avoid multicollinearity, which is a case where several independent variables are correlated (Stock & Watson, p.228).

for instance, is the difference between a marginal increase in province Bagmati and Koshi.

Table 5.3 summarizes the estimates based on the extensions mentioned above. One distinct pattern for the linear regressions (1) and (2) is that all regions are observed to yield lower levels of welfare per year of education. Bagmati has an estimated index value of 0.733 from equation (1), which is considerably more than a value that was observed in Table 5.1. Moreover, the marginal benefit from education is estimated to be around 0.048. By reconsidering the example of one woman who has had ten years of schooling, her estimated welfare in Bagmati would then be $0.733 + 0.048 * 10 = 1.1213$, or an estimated welfare gain of 65%. While she becomes more wealthy, this is still a modest increase in the welfare gained after education.

One possible explanation that respondents in Bagmati receive more total welfare returns from education might be that the residents in Bagmati live close to the best schools and universities in Nepal. For example, the leading University of Nepal, Tribhuvan University, is in Kathmandu. Attending the most prestigious universities might imply a higher income, which would lead to a higher ownership value. On the other hand, Sudurpashchim & Madhesh seem to have the lowest welfare returns, receiving about 0.03 less marginal benefit relative to Bagmati. Karnali is the poorest province in total, yielding around 0.3 to 0.4 less indexed wealth without education than Bagmati. However, the estimated returns to welfare are valued at around -0.022 less than the returns from Bagmati, which implies higher returns than Sudurpashchim & Madhesh.

The non-linear regressions are estimated in case (3), without binary controls, and (4), with binary controls. To illustrate an example estimation from these non-linear cases, consider a respondent from Koshi with 10 years of education. Because the *eduyears* variables for the interaction term Koshi are denoted in relation to Bagmati, it is possible to estimate it in the following way. For the estimator (3), her initial indexed welfare is 0.657[3]. In contrast, her expected total index value becomes 0.927, which would equate to a welfare increase of 41.1%. These estimates are lower than the estimated gains from the linear regressions above. For the estimator (4), it is possible to consider two cases. In the first case, she lives in rural Koshi with a husband with 0 years of education and is under 25 years old. In the second case, she lives in urban Koshi with a husband who has finished 10 years of schooling

[3]Calulations done by considering equation 5.3 and inserting coefficients from Table 5.2.

and is above the age of 35. For the first case, her initial index value with 0 years of education is 0.256, while her estimated index value with 10 years of education is 0.536, which would still make her total welfare low. For the second case, her initial index value without education but factoring all other dummies is 0.814, while her estimated index value with 10 years of education becomes 1.274. This equates to a total welfare increase of 56.5%, which seems to indicate that higher initial levels of welfare might make education more beneficial. However, these are still modest increases.

One implication of low potential increases in estimated gains may be that female education in Nepal might provide little incremental benefits to women's living standards. This is especially true in comparison to where she lives, as it is shown that residents from Gandaki and Bagmati reap more welfare benefits than other regions. Another possible explanation for why female education might not have such a profound effect might be because the husband's education may diminish the welfare effect the wife's education has on the household.

A noticeable pattern is that marriage works as a negative explanatory factor, while the husband's marginal years of education are increasing. One possible explanation for this phenomenon may be that while women who receive higher education may earn more and be able to buy more, they may also be more likely to marry a man with an equal or higher level of education. As mentioned in chapter 2, it is more likely for a woman with higher education to marry a man with an equal level of education. Thus, the husband's education. If the husband has a higher level of education, he is more likely to be able to purchase essential goods such as a house or car. However, if that becomes the case, the wife can spend less but still benefit from utilizing the household goods. Such an effect might be an indirect welfare benefit of acquiring education.

Table 5.3: Linear & Non-linear regression tables

	Dependent variable:			
	Wealth Index			
	(1)	(2)	(3)	(4)
Eduyears	0.048^{***}	0.061^{***}	-0.048^{***}	-0.014
	(0.003)	(0.002)	(0.009)	(0.009)
$(Eduyears)^2$			0.008^{***}	0.005^{***}
			(0.001)	(0.001)
Married (Dummy)		-0.091^{***}		-0.077^{***}
		(0.019)		(0.018)
Husband's Years of Education		0.02^{***}		0.021^{***}
		(0.002)		(0.002)
Urban (Dummy)		0.203^{***}		0.201^{***}
		(0.01)		(0.01)
Age Cohort 15-25		0.386^{***}		0.368^{***}
		(0.021)		(0.021)
Age Cohort 26-35		0.05^{**}		0.047^{**}
		(0.02)		(0.01)
Age Cohort 35-49		0.445^{***}		0.425^{***}
		(0.021)		(0.021)
Baseline (Bagmati)	0.733^{***}	0.348^{***}	0.864^{***}	0.436^{***}
	(0.022)	(0.031)	(0.025)	(0.033)
Koshi (Dummy)	-0.163^{***}	-0.153^{***}	-0.207^{***}	-0.180^{***}
	(0.033)	(0.029)	(0.037)	(0.033)
Gandaki (Dummy)	0.086^{**}	0.054	0.059	0.05
	(0.042)	(0.037)	(0.048)	(0.043)
Lumbini (Dummy)	-0.077^{**}	-0.026	-0.092^{***}	-0.042
	(0.031)	(0.027)	(0.035)	(0.031)
Karnali (Dummy)	-0.354^{***}	-0.307^{***}	-0.419^{***}	-0.376^{***}
	(0.041)	(0.036)	(0.044)	(0.04)
Sudurpashchim (Dummy)	-0.174^{***}	-0.159^{***}	-0.272^{***}	-0.222^{***}
	(0.036)	(0.032)	(0.039)	(0.035)

(continued)

Madhesh (Dummy)	-0.177^{***}	-0.057^{**}	-0.261^{***}	-0.135^{***}
	(0.027)	(0.024)	(0.03)	(0.027)
Eduyears∗Koshi	-0.018^{***}	-0.011^{***}	0.005	0.002
	(0.004)	(0.003)	(0.014)	(0.013)
$(Eduyears)^2$∗Koshi			−0.001	−0.001
			(0.001)	(0.001)
Eduyears∗Gandaki	-0.012^{**}	−0.004	0.02	0.01
	(0.005)	(0.004)	(0.017)	(0.015)
$(Eduyears)^2$∗Gandaki			-0.002^{*}	−0.001
			(0.001)	(0.001)
Eduyears∗Lumbini	-0.018^{***}	-0.012^{*}	−0.018	−0.008
	(0.004)	(0.003)	(0.013)	(0.012)
$(Eduyears)^2$∗Lumbini			0.001	0.0001
			(0.001)	(0.001)
Eduyears∗Karnali	-0.023^{***}	-0.009^{**}	−0.002	0.029^{*}
	(0.005)	(0.005)	(0.019)	(0.017)
$(Eduyears)^2$∗Karnali			−0.001	-0.003^{**}
			(0.002)	(0.001)
Eduyears∗Sudurpashchim	-0.033^{***}	-0.018^{***}	−0.021	−0.012
	(0.005)	(0.004)	(0.017)	(0.015)
$(Eduyears)^2$Sudurpashchim			−0.0001	−0.002
			(0.001)	(0.001)
Eduyears∗Madhesh	-0.028^{***}	-0.026^{***}	−0.017	0.005
	(0.004)	(0.003)	(0.013)	(0.012)
$(Eduyears)^2$∗Madhesh			0.0005	0.002^{*}
			(0.001)	(0.001)
Observations	13,989	13,989	13,989	13,989
R^2	0.134	0.325	0.161	0.335
Adjusted R^2	0.134	0.324	0.160	0.334

Note: *p<0.1; **p<0.05; ***p<0.01

It is worth noting that the explanatory variables also have some significance when interpreting marginal increases in welfare, as the coefficients above suggest. For instance, urban students might gain access to more developed schooling, as mentioned above, which might explain their higher welfare returns. Additionally, there seem to be substantial differences between the age cohorts. Younger respondents seem to have more aggregated welfare than older respondents. One possible reason for this might be that older respondents are more likely to be married, which would make her husband more likely to take the role of the "provider" in the household due to traditional values. Additionally, because the educational system in Nepal has seen numerous reforms, older women may have faced a less efficient education system while they were students, which would lower their skill attainment from education. Lower possibilities to partake in education could decrease her opportunities to earn substantial income. Another possible explanation is that these women might face labor discrimination, such as lower wages or lack of job opportunities, even with higher education.

All of these regressions exhibit higher R-squared values than those from Tables 5.1 and 5.2, which implies that they might predict the welfare gains from female education better. One key point of observation is that the R-squared values for regressions with the control variables are higher than the regressions without them. This might be because the sample size for married respondents is smaller than for all respondents. However, the regressions might fit the model better because the husband's years of education may be somewhat explanatory when estimating the welfare returns. Adding the *edusquared* terms increased the regression's fit towards the model but did so to a small degree.

Meanwhile, adding controls affects the fit of the regression to a more considerable degree. The regressions without control variables exhibit the R^2 values of 0.134 and 0.161, while adding the explanatory variables increases it to 0.299 and 0.307, indicating that the regressions fit the model better by adding the controls. In other words, the added controls have some explanatory power for increased household welfare, such that the *eduyears* coefficients in (2) & are more accurate than (1) & (3). The conclusion here would be that while the relationship between attended years of education and the welfare value might be non-linear to some degree, it is the addition of control variables that gives the most accurate estimates.

Assessing the accuracy of these two additional factors can be done by examining the residuals for equation (4). Figure 5.5 shows the fitted residuals for the non-linear estimation with all binary variables. One noticeable trait is that the residuals seem more aligned around 0, which suggests that the mean residual is closer to 0. This, in turn, suggests that the estimated values for educational welfare gains may be somewhat more aligned with the proper effect on welfare gained by education. The mean residual value is approximately -0.015, indicating that the estimated welfare gained is lower than the actual welfare gained from all independent variables.

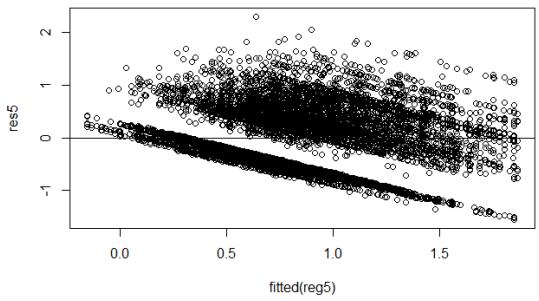

Figure 5.6: Plot of fitted residuals for non-linear equation (5.3)

Figure 5.5 shows the fitted residuals for the non-linear estimation with all binary variables. One noticeable trait is that the residuals seem more aligned around 0, which suggests that the mean residual is closer to 0. This, in turn, suggests that the estimated values for educational welfare gains may be somewhat more aligned with the proper effect on welfare gained by education. The mean residual value is approximately -0.015, indicating that the estimated welfare gained is lower than the actual welfare gained from all independent variables.

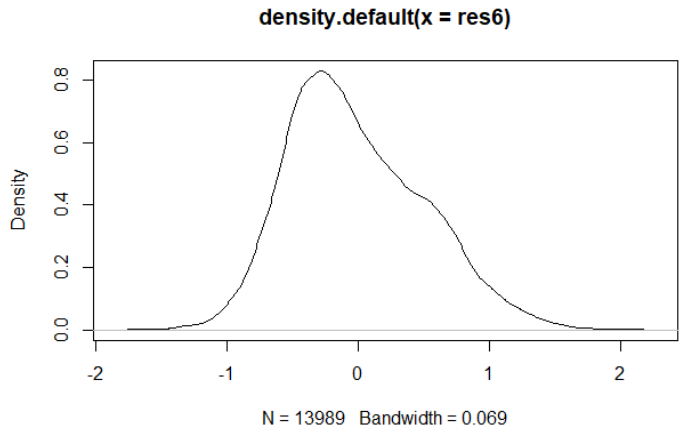

Figure 5.7: Residual Density for non-linear estimator with explanatory variables

Additionally, as evident from the density plot in Figure 5.6, adding the controls makes the residual distribution appear to be bell-shaped to some extent. There exists one peak that lies right below 0, but the right-hand tail is a bit longer than the left one. Additionally, there is a slight increase in residual values above 0. The shape of the bell curve suggests that the regression (4) is more in line with the Gauss-Markov assumptions by being i.i.d. The conclusion is that these estimations are, to a moderate extent, robust.

Chapter 6

Discussion

In light of the results derived above, discussing them and finding possible explanations for the observed patterns is necessary. Firstly, it is evident that most women in Nepal own very little, as observed by the indexed values. As Nepal is a developing country, it is expected that an average female would own little welfare goods. Another important finding is that education is generally estimated to yield incremental but small gains in welfare. There might be several reasons for this, such as labor discrimination against women, low educational skill attainment, and low labor participation rates for women in Nepal. These factors may contribute to low mean marginal returns from education, and researching differences in welfare returns might be possible in future research.

One other key finding is that the marginal returns to secondary and tertiary education seem to be substantially higher than the mean returns for females wit. One explanation might be that acquiring higher education gives women a higher chance to receive higher-paying jobs, which would increase their good ownership. However, these marginal returns are still moderate, which could be because of the challenges listed above. Another possible reason could be that because of the few job opportunities in Nepal, the women who have acquired the highest education and skill sets within Nepal have chosen to work in more developed countries.

A case could be made for existing reverse causality, meaning that the welfare level has impacted the attainment of higher education instead of vice versa. This could explain the pattern observed where some women earn more than others, even with the same educational level. For example, there could be cases where nepotism plays a role, where women from influential families with connections to

authoritative figures in the education sector could have sure chances of attending the best schools and universities. Because Nepal is separated in the caste system, this could happen in the Brahmmin and Chhetri branches. On the contrary, Dalit women, who are more likely to be oppressed, may have fewer opportunities to attend schooling because of discrimination. These differences could be studied further, but as the data available at hand had a considerable variation for each ethnic group, this would be difficult.

These findings align well with earlier income-based estimations in Nepal. As mentioned in the literature review above, Akanda (2010) found low returns to education for both male and female respondents in Nepal. As the indexed values imply low marginal returns to education, it is safe to assume that the wealth index does measure wealth in the same manner as income, which could confirm its validity as a welfare measure. It also measures an alternative dimension of welfare by

Despite this, because ownership is a simple measurement meant to capture improvements in welfare, it certainly has some flaws. Firstly, there might be some measurement errors in the weighting of each good. For example, according to the index, a house could be interpreted to be worth eight as much as a radio. One way to account for this would be to weigh each good by considering the average actual prices of each good, which would provide more accurate comparisons. On the other hand, the welfare value that a radio or bank account would give is difficult to capture at accurate prices because the enjoyment one consumer would gain from those goods is difficult to capture using accurate prices.

Lastly, assessing how the ownership index holds up against income-based measures is crucial. As mentioned above, the welfare returns to education seem to align well with earlier studies, which would seemingly prove its reliability. Additionally, it provides a more stable measurement as opposed to how much income one woman earns monthly, by capturing how many welfare-improving possessions she has. By measuring how many goods she owns, one can assess her welfare in a way that is not captured by income because income in itself does not tell what the consumer chooses to spend it on. However, the welfare-based index could also be used in conjunction with income to provide a more comprehensive analysis of what the consumer would choose to spend her income on as a measurement of wealth. By doing so, it is possible to give a more accurate and broad analysis of the true welfare returns to education.

Chapter 7

Concluding Remarks

In this thesis, I have estimated the returns to welfare for women in Nepal by using an alternative, demand-based measure. The indexed values were based on household ownership of welfare-improving goods and developed using a CES Utility Function to assess aggregated possession. This index was then applied to assess the marginal returns from female education in Nepal.

My findings indicate that respondents with primary education receive little welfare benefit from acquiring education due to low labor participation and low initial levels of welfare. Secondary and tertiary participants receive significantly higher welfare benefits, which can be attributed to it being non-compulsory and giving access to more labor opportunities. However, the total estimated welfare is low, even for highly educated females. This suggests that while education does provide some moderate gains in welfare, the benefits of female education in Nepal are not strong enough to provide significant lifestyle changes. Low marginal benefits from education may be attributed to factors such as low female labor participation, labor discrimination against women, or lack of access to quality education. There also exist provincial differences, which might be due to the close proximity to good schools and universities for those who receive the largest gains. Women from Bagmati are shown to receive the most extensive benefits from education, while the female population of Sudurpaschchim and Karnali receive the most minuscule gains.

Low levels of wealth and low levels of returns to welfare align well with earlier income-based measures, such as the returns to the Mincerian study of Akanda (2010). This could indicate that the CES-based Wealth Index is a valid way to

examine poverty and welfare. The index may also have other use cases than just measuring aggregated welfare, as it may also be used to examine ownership of certain welfare goods and how the substitutability of each good is related to each other. However, because this thesis aimed to measure welfare gained from education, I chose to examine the aggregated index values.

In future research, this index may be used as a replacement or supplement income-based studies. Using it as a supplement gives explanatory power to which goods a given consumer purchases with increased income. The index could also be expanded to include other categories and goods, such as clothing, technology, and furnishings.

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