Kobe University Repository : Kernel

PDF issue: 2026-10-14

Labor Market Entrants and Food Consumption Patterns by Agricultural Households in Malawi: Econometric Application of Agricultural Household Models

Kawabata, Hiroshi

(Degree)
博士（経済学）

(Date of Degree)
2012-03-25

(Date of Publication)
2012-04-16

(Resource Type)
doctoral thesis

(Report Number)
甲5590

(URL)
https://hdl.handle.net/20.500.14094/D1005590

※ 当コンテンツは神戸大学の学術成果です。無断複製・不正使用等を禁じます。著作権法で認められている範囲内で、適切にご利用ください。

KOBE UNIVERSITY

Labor Market Entrants and Food Consumption Patterns by Agricultural Households in Malawi:

Econometric Application of Agricultural Household Models

by

Hiroshi Kawabata

PhD Dissertation

A dissertation submitted in partial fulfillment of
the requirements for the degree of

Doctor of Economics

KOBE UNIVERSITY

Graduate School of International Cooperation Studies

Copyright © 2011 by Hiroshi Kawabata

All rights reserved

Labor Market Entrants and Food Consumption Patterns by Agricultural Households in Malawi:

Econometric Application of Agricultural Household Models

by
Hiroshi Kawabata*

Abstract

This paper seeks to explain Malawi rural farm households' behavior to commodity price and wage changes. The modified estimating strategies to calculate shadow wages (on-farm work wages) and income for agricultural households are employed so as to evaluate on/off-farm labor opportunities and to test market imperfection. Agricultural Household Model through Linear Expenditure System (LES) is applied to estimate labor supply elasticities of rural farm households for farming activities, and casual and

* Graduate School of International Cooperation Studies, Kobe University, Japan
E-mail: kawabata.economist@gmail.com

permanent employment. Then Linear Approximate Almost Ideal Demand System (LA-AIDS) Model is also used to derive a complete array of price and income elasticity of food demand among eight primal food item groups.

Estimated shadow wages and income through new and conventional methodologies revealed that wage rates of on-farm work (average hourly rate of MK10.3) are much lower than those of casual and permanent jobs (average hourly rate of MK33.6 and MK23 respectively), which could explain why poor farm households prefer to supply more labor to casual work. The common understanding of this phenomenon is that since there are limited income diversification options, rural households may end up selecting low-risk and low-return portfolios that presumably lower the risk of hunger, which is known as “risk-averse”; however, the truth is that the farm households merely select casual work due to its higher wage than that of on-farm work. Unfortunately the wage rates for on-farm work are even lower than government set minimum wage (MK22 per hour for urban areas and MK18 for rural areas). The rate of return to school reveals the importance of education for greater agricultural income through promoting efficiency on both human capital and technology. In addition, rates of return for farmers (benefit of education from agriculture) are found to be greater than those of wage earners. The theory of non-reparability in rural households in Malawi is also verified having lower shadow wages than market wages and rejecting null hypotheses in Benjamin and Jacoby tests. This supports the market imperfection that restrains rural households from free entry into the labor market.

Estimated cross/own price and wage elasticities of on-farm, casual and permanent labor supply unveils that the household susceptibly responses to changes in permanent job wage and market purchased good prices since changes in other conditions do not motivate the households to change their labor supply patterns much. Wage rate changes in on-farm and casual work provide less opportunity to change their behavior. Interestingly when there is a wage increase in casual work, the household find time

from on-farm work hours for casual work rather than shrinking leisure time whereas labor supply to farming in the case of on-farm wage change is adjusted through casual work and leisure time. As the wage of a permanent job increases, the households are much more willing to increase working hours for a permanent job by giving up some hours to work for both on-farm and casual work, then some of the deducted hours may be allocated to leisure time. Own-production price change slightly motivates the households to work for part time but relatively greater effects are observed for on-farm and permanent work. Market commodity price increase has serious and immediate effects on the household, thus they are more likely to compensate the loss by either increasing casual work or producing more agricultural products for higher income. Finally increase in their income is more likely to discourage the households to work on the farm and part-time at the market but less likely for the permanent job, which may be because the hours to work is nearly fixed for the permanent employment based on the long term contract. This reason can also explain why the households are discouraged to change hours to work for permanent jobs (inelastic permanent labor supply elasticities).

The price elasticities of basic foods confirm that maize and cassava are necessary food items for Malawi households and possibly they are substitutes; moreover maize is the integral item of the household diet. An increase in household income will induce substantial increase in demand for rice and wheat among food crops, as well as all protein food items (beans, meats and milk) but consumption of these food items will be down when household size grows, thereby these items are found to be luxury goods. Finally meats are found to be a complement to all food items.

Within this paper, there are several policy suggestions to the Government of Malawi to fight against poverty based on experimental findings. Having the empirical results of lower farm shadow wages, policies to improve their wages are suggested. In addition to this, any attempts to narrow imbalance in knowledge and information between farmers and mediators (traders) are inevitable to correct market distortion for appropriate farm

gate prices. Specific proposals made in the paper are inducing use of technologies for improving agricultural outputs and substituting labor supply, gate price intervention, promoting market clearing, rectification of information asymmetry, empowerment of farmers, establishment of trading centers at local levels, extending and making available of credit markets to the farmers, and so forth.

The findings of inelastic household responses to the permanent job market suggest the importance of government intervention to reduce entry costs into the labor market, especially for long-term contract jobs. Since higher entry costs are incurred by some entry barriers, such as skills, qualifications and other requirements, transforming the Malawi education strategy from quantity education to quality education is proposed for increasing educated and skilled labor force to remove the barriers. The efforts to improve agricultural productivity and production are suggested as well to reduce entry costs for labor market. Specific approaches to improve agricultural efficiency are construction of irrigation systems, subsidizing fertilizers, investing in R&D for seed selective breeding, and providing quality education.

The households' labor supply patterns and food consumption patterns figured out in this paper insist on a government effort to lower or stabilize inflation on commodities that the farm households consume, more importantly prices of subsistence foods, such as maize and meats, be kept low. Since the farmers are suffering a lot from high inflation resulting in poor human capital, taking inflation control measures to lower those prices can be considered thorough, 1) providing sustainable and sufficient amount of maize and meats to the market so that its prices are kept low by maintaining the longstanding input subsidy program, reducing transaction costs for trading at markets, increasing storage capacities and so forth, 2) maintaining tax exemption on these commodities to avoid unnecessary inflation pressure on the essential food items, and 3) introduction of a forward contract, futures contract, or put option for hedging food supply and price risks. The school feeding program and any other strategies to increase

relative and real household income are another option since it induces positive income effects of the households, and solves malnutrition and uneducated labor issues. Finally food diversification promotion through increasing production of rice and wheat is suggested since it improves rural households' nutrition, health and income status.

Key words: Agricultural Household Model, Shadow Wages, Shadow Income, Rate of Return to School, Linear Expenditure System, LES, Labor Supply Elasticity, Almost Ideal Demand System, AIDS, Food Demand Elasticity, Malawi, Rural Farm Household

Acknowledgements

Though only my name appears on the cover of this dissertation, a great many people have contributed to its production. I owe my gratitude to all those people who have made this dissertation possible, but I am definitely the only person responsible for errors in the dissertation.

My deepest gratitude should go to my academic advisor, Professor Terukazu Suruga. I have been amazingly fortunate to have an advisor who gave me the freedom to explore on my own, and at the same time the great support was given even while I have been out of schooling for work in Malawi.

My co-advisor, Professor Motoki Takahashi, who has always been there to listen and give advice, I am deeply grateful to him for the long discussions that helped me sort out the technical details of my work.

My sincere gratitude also goes out to Dr. Koji Kawabata for his insightful comments and constructive criticisms at different stages for my research in order to improve my dissertation, and to Mrs. Shalom Ghambi for the correction of grammatical and linguistic errors in English and for carefully reading and commenting on countless revisions of this manuscript.

I am also indebted to colleagues of JICA Malawi and the Government of Malawi, especially Ministry of Development Planning and Cooperation, with whom I have interacted during the course of my graduate studies and work as an economic advisor.

Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of the dissertation.

19th December 2011

Table of Contents

Abstract ..... **i**

Acknowledgements ..... **vi**

1. Introduction **1**

2. Country Background and Context of the Study **5**

2.1. Basic Information 5

2.1.1. Geography and Climate 6

2.1.2. History 7

2.1.3. Politics 9

2.1.4. Education 10

2.1.5. Agriculture 12

2.2. Macroeconomic Status 14

2.3. Fiscal Policy 20

3. Estimating Shadow Wages and Income, and Separability Test **25**

3.1. Introduction 25

3.2. Theoretical Framework 28

3.2.1. Model Specification 28

3.2.2. Conventional Estimation Strategy 33

3.2.3. Alternative (Le) Estimation Strategy 34

3.3. Separability Test 39

3.3.1. Conventional Test 40

3.3.2. Modified Test 41

3.4. Empirical Analysis 43

3.5. Concluding Remarks 52

4. Decision Making in Labor Market Entrants **55**

4.1. Introduction 55

4.2. Theoretical Framework 58

4.2.1. Household Model Specification 58

4.2.2. Estimation Strategy 63

4.3. Empirical Analysis 69

4.3.1 Estimation Results 69

4.3.2 Labor Supply Elasticity 71
4.4. Concluding Remarks 75
5. Food Consumption Decisions 79
5.1. Introduction 79
5.2. Theoretical Framework 81
5.2.1. Model Specification 81
5.2.2. Estimation Strategy 84
5.3. Empirical Analysis 86
5.3.1 Estimation Results 86
5.3.2 Elasticities 88
5.4. Concluding Remarks 93
6. Conclusion 95
6.1. Overview 95
6.2. Further Issues 101
6.2. Discussions 101
References 103
Appendices 111

List of Tables

Table 1: Average Temperature and Rainfall for Lilongwe Area 7
Table 2: Description of Variables 43
Table 3: Results of Estimated Cobb-Douglas Production Function 44
Table 4: Rates of Return to School 46
Table 5: Parameters Estimated through Alternative Method 46
Table 6: Estimation Results of Shadow Wage and Income 47
Table 7: Separation Tests (Based on Benjamin Test) 50
Table 8: Separation Tests (Based on Jacoby Test) 51
Table 9: Description of Variables 69
Table 10: Estimated Parameters of Linear Expenditure System 70
Table 11: Result of Estimated Profit Function 70
Table 12: Labor Supply Elasticity (Substitution Effect) 72
Table 13: Labor Supply Elasticity (Income Effect) 73
Table 14: Labor Supply Elasticity (Total Effect) 74
Table 15: Descriptive Statistics 86
Table 16: Likelihood Ratio Test of the AIDS Restrictions 87
Table 17: Parameter Estimates of Demand System (AIDS Model) 88
Table 18: Parameter Estimates of Other Variables 88
Table 19: Marshallian Price Elasticities 89
Table 20: Marshallian Own-price & Income Elasticities 89
Table 21: Hicksian Price Elasticities 91
Table 22: Impact of Family Composition on Demand & Budget Share 92

List of Figures

Figure 1: Cycle of Rain, Maize and Tobacco Production, and Food Scarcity..... 7
Figure 2: Malawi Education System 11
Figure 3: Pass Rates of Qualified Exams 11
Figure 4: GDP by Sector of Origin..... 14
Figure 5: Trend of Exchange Rate for Selected Currencies 16
Figure 6: Trend of Consumer Price Index (CPI) 19
Figure 7: Budget Categorization Comparison..... 20
Figure 8: Trend of Government Expenditure 21
Figure 9: Trend of Government Revenue..... 22
Figure 10: Nominal GDP and Tax Revenue as Percentage of GDP..... 23
Figure 11: Breakdown of Tax Revenue 24
Figure 12: Optimal Labor Supply in Perfect Market..... 31
Figure 13: Optimal Labor Supply Under Presence of Market Imperfections 32
Figure 14: Distribution of Shadow Wage 48
Figure 15: Distribution of Shadow Income 49
Figure 16: Distribution of percent difference between the two methods 49

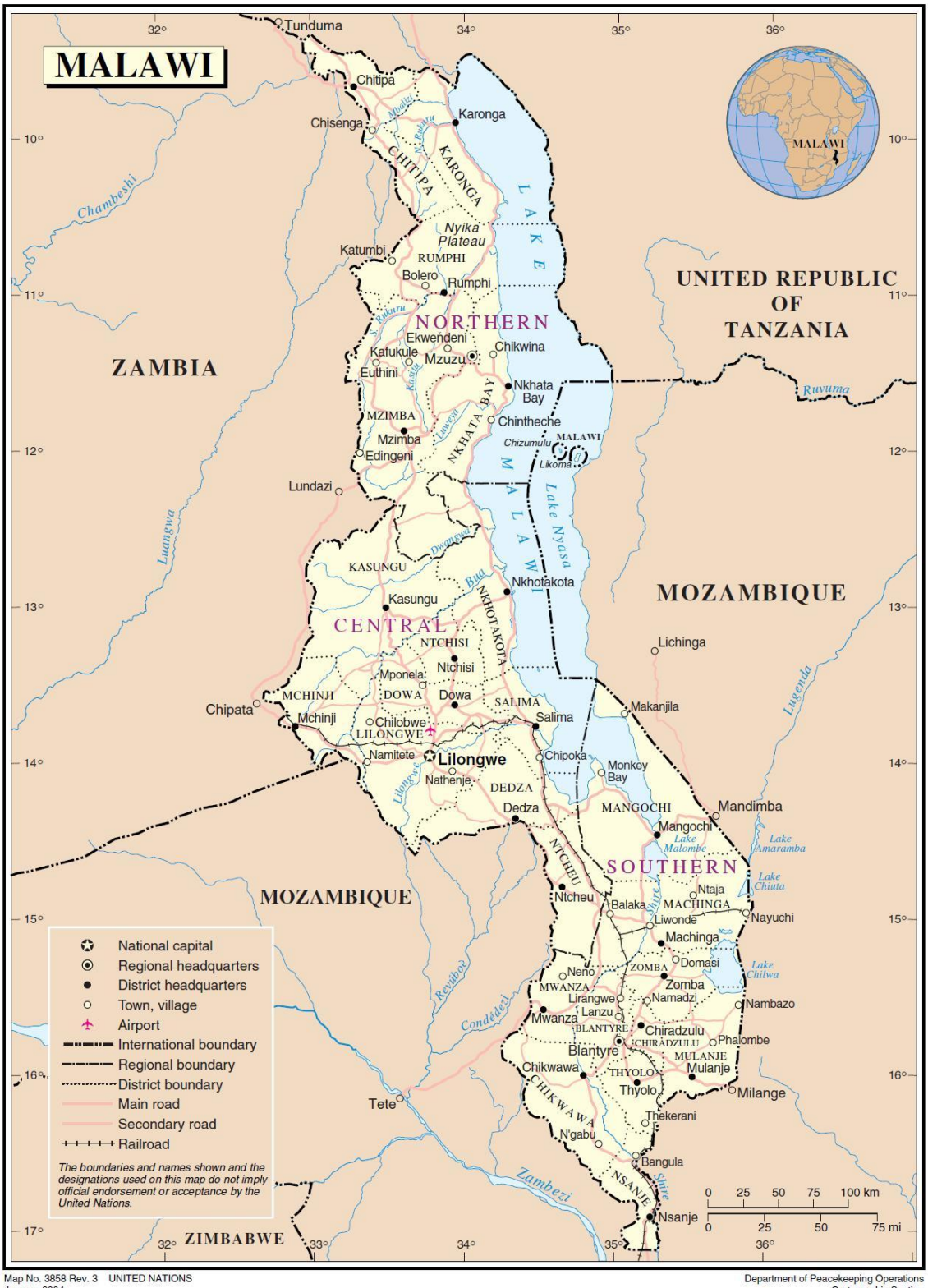
List of Appendices

Appendix 1: Basic Facts about Malawi Household based on IHS-2.....111
Appendix 2: List of Occupations and Average Wages 112
Appendix 3: Elasticities Estimated through Linear Expenditure Systems.....114
Appendix 4: Descriptive Statistics for Rainfed Crop Production.....116
Appendix 5: Descriptive Statistics for Food Consumption by Households.....117

Acronyms and Abbreviations

Abbreviation		Meaning
ADMARC	:	Agricultural Development and Marketing Corporation
AfDB	:	African Development Bank
AIDS	:	Almost Ideas Demand System
ALDSAP	:	Agricultural and Livestock Strategy and Action Plan
BoP	:	Balance of Payment
CPI	:	Consumer Price Index
DEVPOL	:	Development Policies
ECF	:	Extended Credit Facility
EMIS	:	Education Management Information System
FDI	:	Foreign Direct Investment
FSP	:	Fertilizer Subsidy Programme
GBS	:	General Budget Support
GDP	:	Gross Domestic Product
GOM	:	Government of Malawi
IHS	:	Integrated Household Survey
IMF	:	International Monetary Fund
ISI	:	Import Substitution Industrialization
JCE	:	Junior Certificate of Examination
MANEB	:	Malawi National Examinations Board
MCC	:	Millennium Challenge Corporation
MDGs	:	Millennium Development Goals
MGDS	:	Malawi Growth and Development Strategy
MRA	:	Malawi Revenue Authority
MSCE	:	Malawi School Certificate Examination
NFRA	:	National Food Reserve Agency
ORT	:	Other Recurrent Transaction
PE	:	Personal Emolument
PSLCE	:	Primary School Leaving Certification of Examination
PTCE	:	Primary Teachers Certificate of Education
R&D	:	Research and Development
RBM	:	Reserve Bank of Malawi
SPP	:	Starter Pack Programme
SWAps	:	Sector Wide Approaches
TTC	:	Teacher Training Collage
UEE	:	University Entrance Examination
VAT	:	Value Added Tax
WDI	:	World Development Indicators

Map of Malawi



Chapter 1

1. Introduction

Poverty is one of the major international issues confronting self-employed farmers in marginal areas of developing countries. Most people in developing countries who highly depend on agriculture for their livelihood are much poorer than those working in other sectors of the economy. They are even more vulnerable to price variation in their yields, consumption goods, and market wages. Unlike typical good producers, agricultural producers cannot easily adjust, in short term, inputs and outputs (supply) with respect to changing market demand and prices which result in having their income

fluctuating depending on exogenous shocks such as weather, prices and so forth. In addition, suppose prices in consumption goods increase (a case of inflation), their relative income automatically drops. In this regard, finding ways to foster income growth for two-thirds of the world's poor, living in marginal areas is the key to achieve the Millennium Development Goals (MDGs). Recent studies in development economics literature show that the importance of off-farm income in rural areas is to improve their well-being as observed in countries like El Salvador, Ecuador, and Mexico (The World Bank 1998). Extra income from off-farm employment, apart from their agricultural yields, allows their family members to improve quality of life by having higher education and health care assistants. Even though off-farm employment is an alternative strategy and has an opportunity to obtain financial, health insurance and other benefits, it is not easy to have them employed at labor markets since its market is not working optimally, in other words there exists a Pareto sub-optimal allocation of resources.

Poverty is more concentrated among farm households in developing countries. In this regard, understanding their behavior is a primary concern in any poverty alleviation strategy. The study of farm household theory has long been explored and obtained a prominent position in development economics. Analysis of farm household models is quite unique in the sense that since typical household models involve analysis only on the consumption side (income is assumed to be constant), farm household models need to consider both their agricultural production as income and consumption as expenditure into the models. It is thus not easy to capture their behavioral responses to income, commodity prices and subsidies. Besides the modeling difficulties, data deficiencies, such as absence of wages and income information for self-employed farmers and so forth, have limited empirical applications.

This paper primarily addresses rural farmers' behavior in Malawi with respect to price and wage changes by estimating price and income elasticity through various methodologies, which decides how much to consume and how much labor to supply.

Furthermore, the paper attempts to derive farmers' shadow wages and income and to verify if there is market imperfection (separability) using modified estimation methods. The second Integrated Household Survey (IHS) data for Malawi was used to estimate these figures, because the author has a specific period of working experience for the Malawi Government during his assignment between 2008 and 2011. The paper is organized in six chapters including the introduction in Chapter 1. In Chapter 2, Malawi's social and economic situation is described using some statistical data before going into in-depth microeconomic and econometric analysis. Within the following chapters, shadow wages and income of Malawi rural farm households are estimated to see farmers' wage and income distributions, and labor market imperfection is tested in Chapter 3. The rates of return to education in agriculture are derived as well in the same chapter as a byproduct of estimating an agricultural production function. Labor supply functions and price/wage elasticities of labor demand are computed by estimating Linear Expenditure System equations in Chapter 4 to evaluate off-farm labor opportunity. Household consumption patterns within eight food item groups are assessed by Marshallian and Hicksian price elasticity using Almost Ideal Demand System (AIDS) model in Chapter 5. Finally, all these chapters are wrapped up in Chapter 7.

This paper attempts several new challenges that have never been tackled before which are as follows: 1) the shadow wages and income for Malawi's self-employed peasants have never been estimated and thereby wage rates between permanent, casual, and on-farm work have never been compared. 2) The imperfect labor market has never been statistically confirmed. 3) Estimation of rates of return to education in agriculture has never been attempted although those for wage earners have already been done by some studies. 4) It may also be the first attempt to apply shadow wages into the farm household model analysis. 5) Cross-price elasticities of permanent, casual and on-farm work have never been estimated. 6) Cross-price elasticities of major food items have

never been estimated. 7) Finally no paper has attempted to estimate a complete household model for Malawi's rural farm households that considers both production and consumption activities simultaneously.

Within chapters, there are several policy suggestions to the Malawi government based on empirical results. The paper thus helps the Malawi government identify problems of rural farm households and in policy decision making for any development targeting the poor.

Chapter 2

2. Country Background and Context of the Study

2.1. Basic Information

Malawi's flag is designed with the risen sun on the center and of the Pan-African flag layout that comprises the colors red, black and green whereby these colors represent the blood that unites all people of Africa and was shed for independence, black

people who exist as a nation, and the land of Africa respectively.

The Chewa tribes constitute roughly 90% of population in Central region while Nyanja, Tumbuka, Ngoni, and Yao mostly constitute people in Southern region, Northern region, Central South region, and South East region respectively. According to the Second Integrated Household Survey (IHS-2), 52 percent of Malawi population lives under a dollar per day.

General Indicators

Head of state	DR. Bingu Wa Mutharika
Land Area	118,484 km^2 (equivalent to sum of Hokkaido and Kyusyu)
Population	13,077,160 (2008 Census), Growth rate (2.8%), Urban Pop (15.3%)
Capital	Lilongwe: 1,897,167 (2008)
Main Cities (Population)	Blantyre: 999,491 Mzuzu: 853,305, Zomba: 670,533 [2008 Cencus]
Independent	6th July 1964
Climate	Tropical (cooler in highlands)
Language	Common Language: Chewa(57.2%), Official Language: English Others: Chinyanja (12.8%), Chiyao (10.1%), Chtumbuka (9.5%), Chisena (2.7%), Chilomwe (2.4%), Chitonga (1.7%), Other(3.6%) [1998 Census]
Religion	Christian: 79.9%, Muslim: 12.8%, others: 7.3% (1998 Census)
Literacy rate	64.1% (HDI 2007/08)
Life Expectancy	46.3 (HDI 2007/08)
HIV Prevalence Rate	14.1%(15-49), 3.4%(15-24 male), 9.6%(15-24 female) (WDI 2007)
Currency	Kwacha
Time	GMT +2

2.1.1. Geography and Climate

Malawi being a land locked country is situated alongside the Great Rift Valley in South-East Africa neighbored by Tanzania, Mozambique, and Zambia. Its area is 118,484 km^2 which is equivalent to the sum of Hokkaido and Kyusyu, and 20 % of the area is occupied by Lake Malawi which is the third largest lake in Africa. The land forms a thin strip between and Mozambique protruding from north to south, and can be divided into three regions namely undulating land with higher population density in north, fertile plain with highest population in central, and hilly land with lower

population density in south. The Shire River flows from Lake Malawi through the Zambezi River into the Indian Ocean.

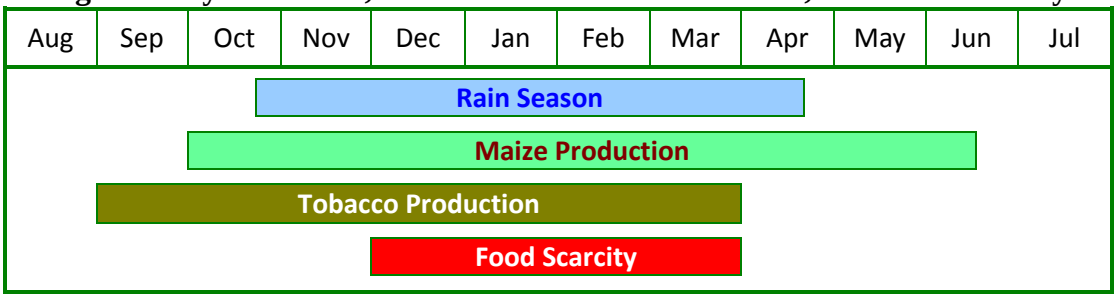
Malawi as a tropic country has two main seasons, a rainy season that runs from end October to mid April and a dry season for the rest of the year. Agricultural activities mostly planting and harvesting maize are peaked around and within the rainy season, whereas in some regions irrigation systems are established and can allow for maize production in the dry season. The high lands in the northern region are cool throughout the year with temperatures that can get as low as four degrees Celsius, while the southern region is quite hot especially during the rainy season with the temperatures reaching as high as thirty nine degrees Celsius.

Table 1: Average Temperature and Rainfall for Lilongwe Area

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)		259	203	155	38	1	1	3	1	1	11	54	174
Temperature	Max	26.9	27.1	27.2	26.4	25.9	24.3	23.8	25.8	28.1	30.2	30.3	27.9
	Min	18.3	18.0	17.7	15.5	12.0	9.8	9.6	10.8	13.6	16.4	18.2	18.9

*Data Source: Statistical Yearbook 2007, NSO.

Figure 1: Cycle of Rain, Maize and Tobacco Production, and Food Scarcity



*Data Source: Author

2.1.2. History

Malawian history can be traced back to the Stone Age 100 thousand years ago. The Bantu tribes began settling around Lake Malawi in 3 BC. In the 16th century, the Chewa tribe built the Maravi Empire near the southern part of the lake, and the Yao tribe built

an empire around Blantyre and Zomba. Lake Malawi became popular when the Scottish pioneer missionary, David Livingstone discovered it in 1859. Since then, Arab slave traders and British immigrants were actively moving into Malawi, which decayed Maravi Empire. Modernization in Malawi began when British consulate was first stationed in 1883. Around the time Malawi was under tension against Arab slave traders and Portugal force was about to reach Malawi. Thus British protectorate Nyasaland was established in 1891. In 1953, natural resource rich country North Rhodesia (Zambia), manufacturing country South Rhodesia (Zimbabwe), and labor endowment country Nyasaland (Malawi) formed a semi-independent state, the Federation of Rhodesia and Nyasaland to take comparative advantages of each country to produce effective outputs for the faster economic development. Although this federation existed for a decade, Nyasaland left the federation in 1963 because there was less merit from labor endowment by lowering wages. On the 6th July 1964 Malawi proclaimed its independence. Hastings Kamuzu Banda (1898-1997) became the first President of Malawi and declared Malawi a one party state under the Malawi Congress Party (MCP). The former President Kamuzu Banda exchanged a treaty of commerce with the Republic of South Africa and actively linked with Taiwan and Israel for economic development while neighboring countries fell into communism. Because of the economic downturn in the early 1990's and criticism on his violation of human rights, his life Presidency ended. Following this event, presidential and parliamentary elections were held and Bakili Muluzi – a Chairman of the opposition party, United Democratic Front (UDF) – replaced Banda. The former President Bakili Muluzi took an office for two terms and even tried to win the third term by changing the Constitution, which was disapproved by Parliament. He therefore appointed Bingu wa Mutharika as his successor, however soon after Mutharika took power, he formed a new party called Democratic Progressive Party (DPP). He emphasized on anti-corruption campaigns against the Muluzi regime but lacked a parliamentary majority in his first term. He

finally won a second term with a parliamentary majority.

2.1.3. Politics

Malawi adopts republic and a single-chamber system. According to the Constitution of the Republic of Malawi, the President is Head of State and Government and the Commander-in-Chief of the Defense Forces. The Running Mate for the Presidential election becomes First Vice President and the second Vice President can be appointed from other parties if necessary but it has only happened once in the past. Anyone can be appointed as a Minister by the President (it does not require one to be a Member of Parliament). Parliament is a democratically elected body consisting of 193 members with a five year term. In the 1995 the Constitution allowed to establish an upper house; however, this clause was removed by the Act No.4 in 2001. The independent legal system in Malawi consists of magistrate courts, high courts, supreme courts, and constitutional court.

Like its neighboring countries, Malawi is in the process of decentralization with support from foreign donors, which began with the introduction of the multi-party system in 1994 as part of the poverty reduction strategy through democratic development initiative. The objectives of the decentralization are 1) to create a democratic environment and institutions for governance and development, 2) to eliminate dual administration for more efficiency and cost effectiveness, 3) to promote accountability and good governance, and 4) to mobilize the masses for socio-economic development (the National Decentralization Policy 1998). The national assembly was established by article 46 of the 1995 Constitution and had taken over the functions performed by deconcentrated units of central government at district level. The established Decentralization Policy and Local Government Act in 1998 include devolution of rights, power, functions, responsibility, and budget. It has been a decade

now but unfortunately there has been less progress made since the decentralization movement began due to strong opposition from the central government and Parliament.

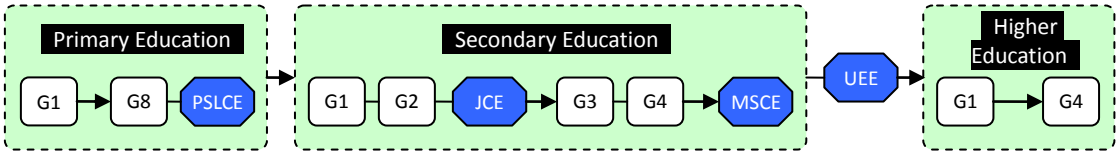
Currently, the Malawi government administration system is implemented through a mixture of devolution and deconcentration system[1].

2.1.4. Education

Malawian Schools constitute of primary school for 8 years, secondary school for 4 years and university for 4 years, which is known as 8-4-4 system. Unlike the Japanese education system, primary education is not compulsory. The Malawi government introduced free primary school in 1994 to achieve 100 percent net enrolment rate while gross enrollment rate currently surpasses 100 percent (116% in 2007). As Figure 2 outlines Malawi education system, there are three qualifying exams – Primary School Leaving Certification of Examination (PSLCE), Junior Certificate of Examination (JCE) and Malawi School Certificate Examination (MSCE). At the completion of the primary education, students need to sit for PSLCE to qualify for secondary education. There is JCE between grade two and three at secondary school, and then MSCE, at the end of grade four, is required for one to sit for a University Entrance Examination (UEE). All these exams are administered and managed by Malawi National Examinations Board (MANEB) except for UEE which is administered by the University of Malawi. According to MANEB, 76% of PSLCE examinees and 53.4% of JCE examinees passed in 2008 while 71.5% and 71.9% pass rates respectively for 2007.

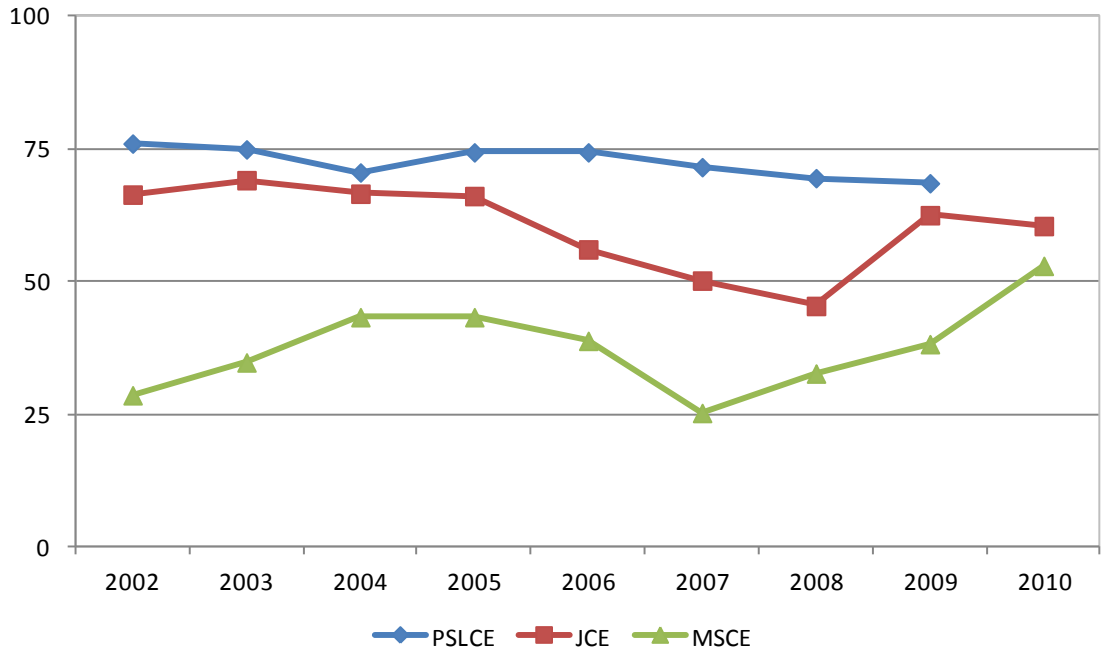
[1] Deconcentration (or Administrative Decentralization) can be defined as "a transfer to lower-level central government authorities, or to other local authorities who are upwardly accountable to the central government (Larson 2004 and Ribot 2002)" and Devolution (or Political Decentralization) is "The transfer of rights and assets from the centre to local governments or communities. All of these processes occur within the context of national laws that set the limits within which any decentralized or devolved forest management occurs (Sayer et al.)".

Figure 2: Malawi Education System



To become a qualified teacher for primary education, one has to have an MSCE certificate and needs to complete a two year course at a Teachers Training Collage (TTC) and has to pass Primary Teachers Certificate of Education (PTCE). Since the introduction of free primary education, the number of teachers cannot meet the exponential growth of students. To combat the problem of inadequate number of teachers, an MSCE holder is temporary allowed to teach, which comprised about 50% of total teachers. The government is envisaged to reduce the share of unqualified teachers down to 10% by 2012. Being a secondary school teacher requires a university granted diploma or degree.

Figure 3: Pass Rates of Qualified Exams



*Data Source: EMIS 2006, 2007 and 2010

2.1.5. Agriculture

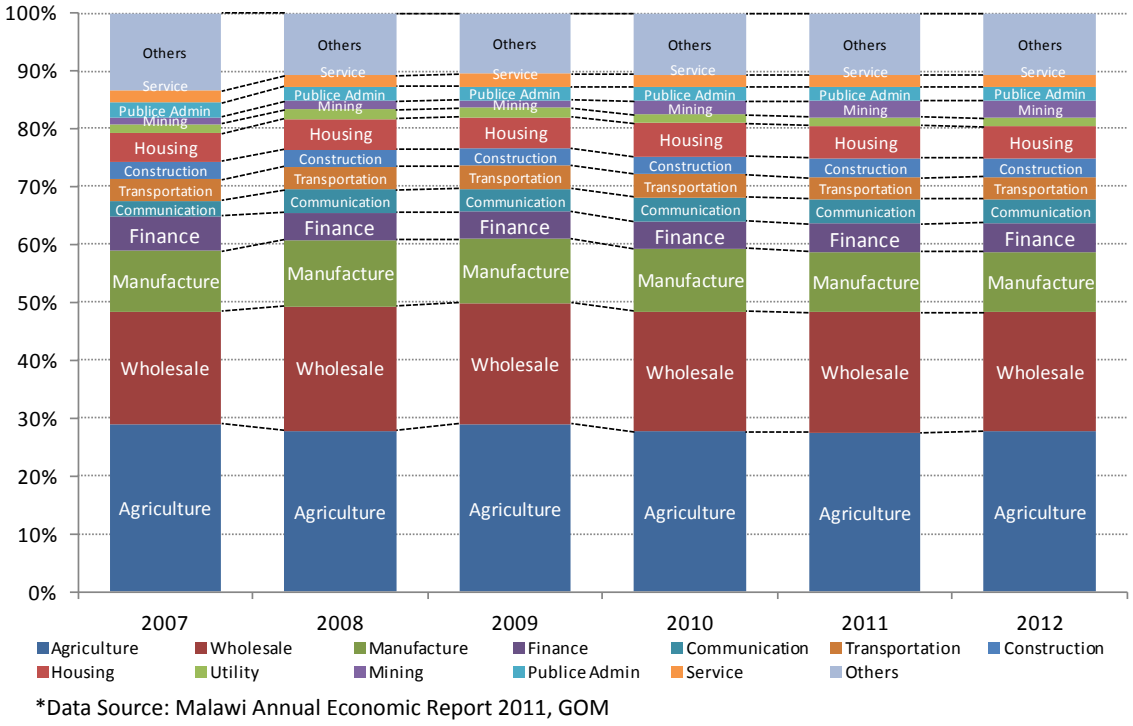
Agriculture is the major industry and the foundation of Malawi's economy contributing approximately 30 percent of GDP, 84.5 percent of the country's workforce, and 82.5 percent of export earnings[2]. About 90 percent of Malawi's population consists of subsistence farmers and their major productions are maize (dominant staple food), beans, rice, cassava, tobacco (important cash crops), and groundnuts generating 63.7 percent of rural income. The fisheries industry is also active around Lake Malawi. The agricultural policy in Malawi can date back to the independence period with dualism policy in which estate and customary land (smallholder farming) existed[3]. Since then, several policies – Development Policies (DEVPOL), Agricultural and Livestock Strategy and Action Plan (ALDSAP), and Malawi Growth and Development Strategy (MGDS I)– were put in place. The policies that are currently effective are Vision 2020 and MGDS II. There were structural reforms implemented as well, reforms such as the establishment and reconstruction of the state marketing parastatal – Agricultural Development and Marketing Corporation (ADMARC) , maize stocking agency – National Food Reserve Agency (NFRA), and so forth. Since maize production is heavily reliant on the water resources, farmers have been suffering from dry spells and water floods quite a lot. The agriculture in Malawi is seasonal and has several months that remain idle in a given year in the dry season. The farmers thus need to find alternative ways to generate income for their survival during the dry season. In this regard, the Malawi Government has invested aggressively in constructing irrigation systems and taking flood control measures. Together with the risk management strategy, the government introduced longstanding input subsidy and maize market intervention policies. Having donor supports, the first strategies to promote agricultural productivity, equity and food security were universal fertilizer subsidy, subsidized smallholder credit

[2] Malawi Economic Growth Strategy Main Report (2004), MoEP&D
[3] There was no land reform or land redistribution upon independence.

and controlled maize prices from the mid 1970s to the early 1990s. Then, the Starter Pack Programme (SPP) began between 1998 and 2004 and Fertilizer Subsidy Programme began in the year 2005. Statistics show that the subsidy program had a greater impact on productivity which resulted in doubled maize production in 2006 and almost tripled in 2007.

2.2. Macroeconomic Status

Figure 4: GDP by Sector of Origin



*Data Source: Malawi Annual Economic Report 2011, GOM

The Malawi economy for the past five years has been stable even after the credit crunch in 2010. Malawi registered a GDP of US$ 3.3 billion and per capita GDP of US$ 280 (Current US$: AfDB), and is one of the countries that have delayed in development. Although Malawi is quite rich in natural resources such as farming land, water and uranium, they have not contributed to the wealth creation. The major industry in Malawi's economy is agriculture and its share is about 30% of the GDP (refer to Figure 4). Amongst all the agricultural activities, tobacco production is most active and the most important source of foreign currency earnings – 60% of total export volume. Since some regions had unusual short rainfall, growth of agricultural sector was only 2% in 2010, whereas the increase of housing construction led to the total GDP growth of 6.7% in the same year. The second major industry is wholesale and retail trade, which does not have a satisfactory trend because most of commodities traded at this sector are

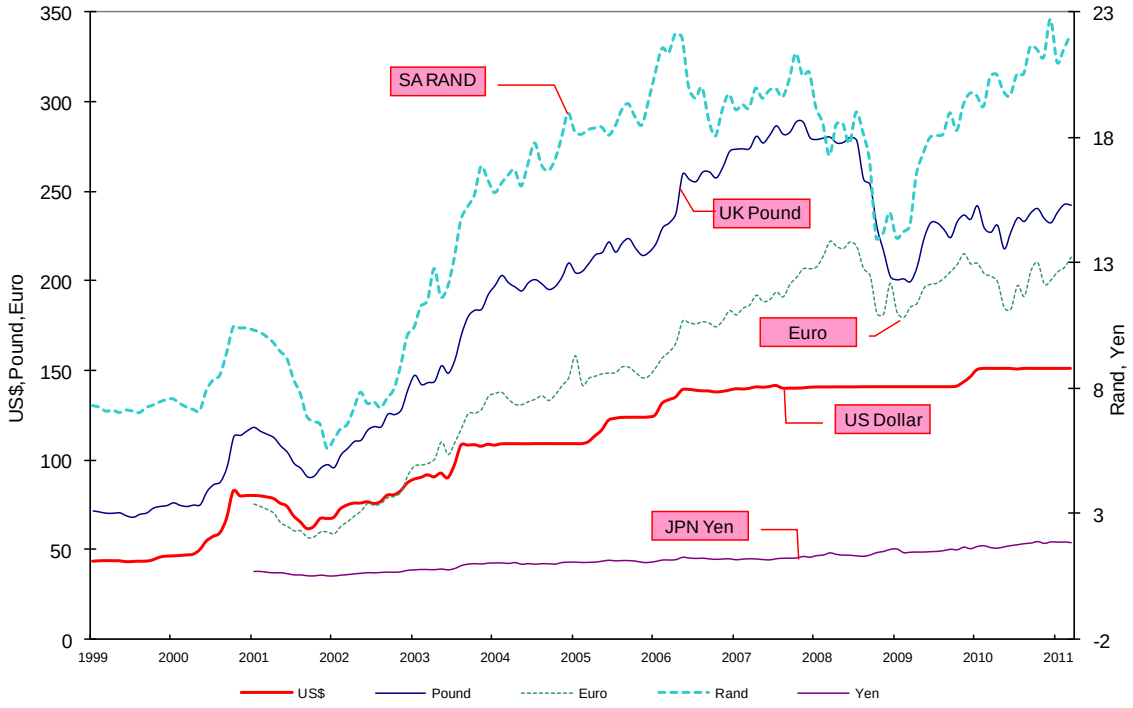
imported goods such as computers, second hand cars, clothes, consumption goods, and so forth, since Malawi does not have much capacity to manufacture them.

Even if the macroeconomic indicators show the positive perspective for Malawi, there are several factors to be concerned about in the future:

1. Continuous exchange policy of US dollar peg
2. Widening Balance of Payment (BoP) deficit and decreasing demand of exporting commodities at global market
3. Frequent Fuel Crisis
4. Insufficient Energy Supply
5. Political Instability

Malawi officially adopts the laissez-faire policy of foreign currency exchange that lets the market decide the Forex rates based on its demand and supply since its transformation into a multi-party system in 1994: However, the Kwacha to the US dollar seems to be exempted from the policy. Figure 5 confirms the dollar peg regime begun in mid 2003. Since then, the adjustment of exchange rate has only been made several occasions when its reserves have run out. Because of this policy, there exits two parallel markets besides commercial banks– namely Forex bureaus licensed by Reserve Bank of Malawi (RBM) and black market. As of July 7th 2011, the average exchange rates against US dollar at commercial banks, money bureaus, and black market are (Buy: 155/ Sell: 162) , (Buy: 180/ Sell: 193) and (Buy: 190/ Sell: N/A) respectively. The black market in Malawi is more active than official markets since RBM imposes several restrictions, such as upper limit of daily exchange, on exchange to the commercial bank and money bureau to keep the targeted rate. The reason of the trading restrictions is to ease Balance of Payment (BoP) imbalance on the current account, which will be explained in the following paragraph. This exchange control entails less foreign reserves, which has led to political and economic uncertainty.

Figure 5: Trend of Exchange Rate for Selected Currencies



*Data Source: Reserve Bank of Malawi

The BoP issue is the most serious challenge in Malawi since it affects many sectors. As mentioned, almost all industrial goods and electronic products traded in Malawi are imported. The domestic demand for those luxury goods rises as the GDP goes up and automatically it increases the volume of import. Unfortunately Malawi export cannot grow as much as the import does because the major contributing factors of the Malawi GDP growth are wholesale and retail trade, and housing construction that requires a lot of imported goods. Moreover, international growing demand for the major exporting commodity tobacco cannot be expected since many countries passed tobacco control acts to regulate tobacco products and protect public health. Thus the BoP balance in Malawi has been deficit for a long period which increases pressure on the Malawi Kwacha causing it to depreciate, and three month import cover reserve of the IMF target cannot be maintained. However, as Figure 5 above depicts, the trend of US$ exchange rate does not follow that path due to rigid exchange control by RBM. Why does Malawi

need an exchange control? The reason is quite simple and agreeable that because the Kwacha depreciation accelerates the domestic inflation and it has a huge negative impact on the poor since they are most sensitive in relative price change. The exchange control strategy is one of the import substitution industrialization (ISI) strategies as a means to initiate the structural transformation. Maintaining the Kwacha appreciation theoretically works to give higher-priced or premature domestic producers enough time to buy necessary machinery, to learn the business and to achieve the economies of scale in production for lowering unit costs and prices; however it did not even happen in a decade from the policy introduction. The reason of failure is not on the ISI strategy itself, but rather missing parallel or complementally policies to the ISI strategy. In most successful countries where the ISI has been used have put a wide variety of supporting policies to promote domestic industrial growth. For instance, setting time span on the policy to stress the domestic industry for growth and putting trade barriers like protective tariffs or quotas and promoting foreign direct investment (FDI) to create new industries that will be complementary to the exchange control policy.

The fuel crisis in Malawi first emerged around 2008. The around that time, the frequency of fuel crisis in which no or less fuel is available at filling stations was just once a year. In the subsequent years, the international crude oil price hike, Kwacha depreciation pressure, poor logistics, and increasing fuel demand by the rise in the number of car owners made this crisis occur more frequently and civilians began to become concerned about problems in the President Bingu wa Mutharka regime. Malawi's oil reserve capacity is officially two weeks taking into account that the country only uses underground tanks at the filling stations. It is, thereby, said there is no policy for an oil storage system or could be said no national security, which could drive people more worried. To combat these issues, the Malawi government is planning to build an oil pipe line that will connect to a port in Beira in Mozambique and to have structural reforms.

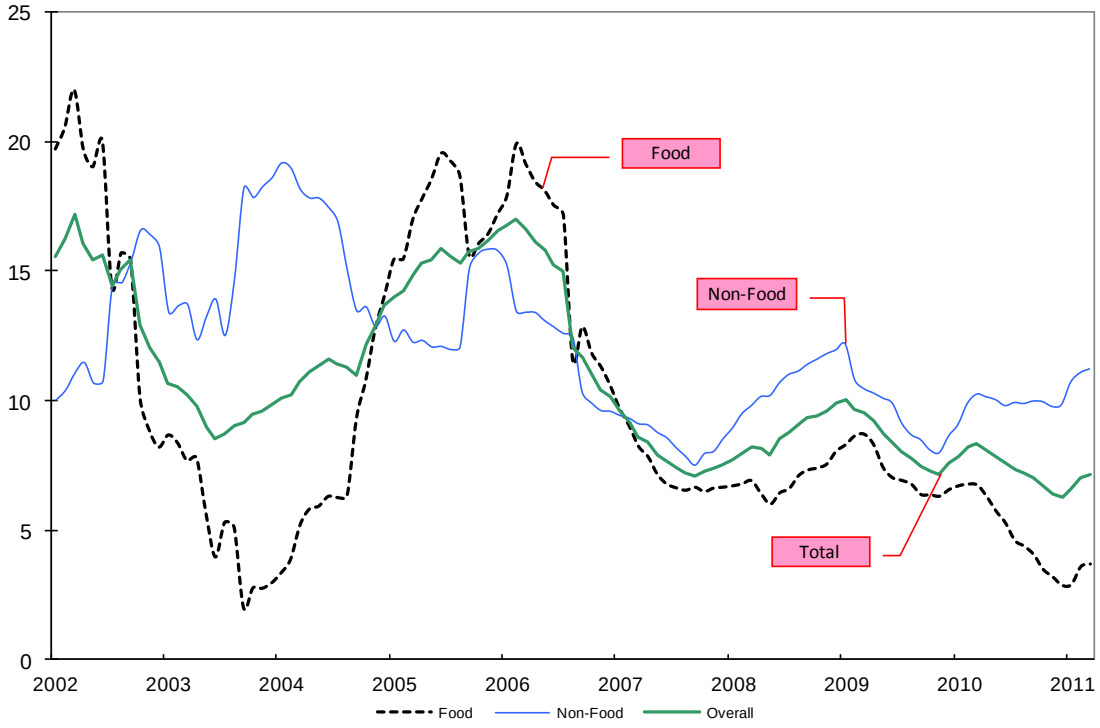
97% of present energy supplied in Malawi is produced with hydro turbines. Even though planned or non-planned power failure is common throughout the county, according to the Malawi government, adequate water resources will allow meeting the increasing demand of power as far as the required number of turbines is equipped. Officially electricity in Malawi is 230 volts, but the average voltage at power points has been between 170 and 220 volts. The causes of this might be two factors – 1) higher fraction of energy lost or 2) inadequate electricity supply. Malawi statistics show that the overall energy loss in the grid is about 19% and some aid donors like Millennium Challenge Corporation (MCC) are now planning to invest in this area.

Unlike the first term, the second term of Mutharika regime does not have much support from civilians. The primary reason of this comes from the constitution that defines his/her term as "The President, the First Vice-President and the Second Vice-President may serve in their respective capacities a maximum of two consecutive terms, but when a person is elected or appointed to fill a vacancy in the office of President or Vice- President." The previous President, Bakili Muluzi once tried to amend the constitution for his third term but failed with strong oppositions. As history of Africa indicates that when the President is in a final term, it is more likely that he or she spend much more energy on amending its constitution, seeking its successor who is acting as his/her puppet, seeking asset accumulation and such. The President Mutharika might be one of them as well since he is trying to appoint his brother Peter Mutharika as the next President, and to step down his popular running mate Joyce Banda. The disgruntled civilians are against dismissal of the Vice President and current economic confusion such as dollar pegged Forex, fuel crisis, and foreign affairs have masterminded demonstrations several times and unfortunately one of them incurred casualties.

Malawi's inflation rate is well managed to lower since 2006. The recent five years have achieved single digit inflation due to decreased price in domestic products; however, non-food prices are still maintained at a higher level which is driven by prices

of imported products. This moderate level of inflation could be explained by the present exchange control. The RBM operates its exchange control based on the three principles: 1) maintenance of a sustainable balance of payments position, 2) attainment of stable domestic prices, and 3) attainment of growth in real income (Simwaka 2006). According to an analysis that I did in the past, exchange rate and inflation rate are negatively correlated and the exchange control indeed works well on lowering inflation rate rather than controlling money supply. Thus solving the BoP issue implies solving domestic economic structure, inflation and poverty.

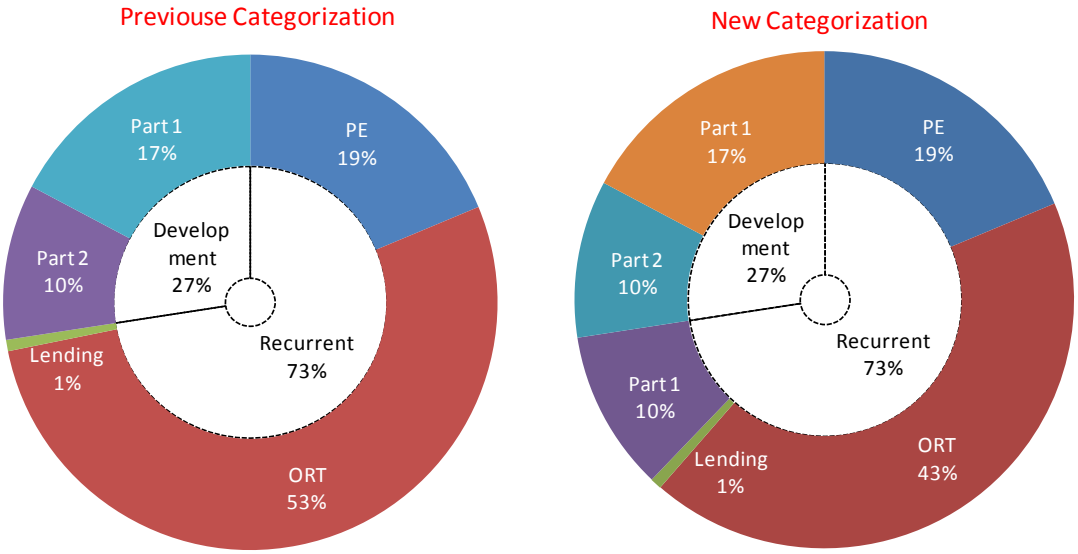
Figure 6: Trend of Consumer Price Index (CPI)



*Data Source: Reserve Bank of Malawi

2.3. Fiscal Policy

Figure 7: Budget Categorization Comparison[4]



*Data Source: Financial Statement for 2011-12 Financial Year, GoM

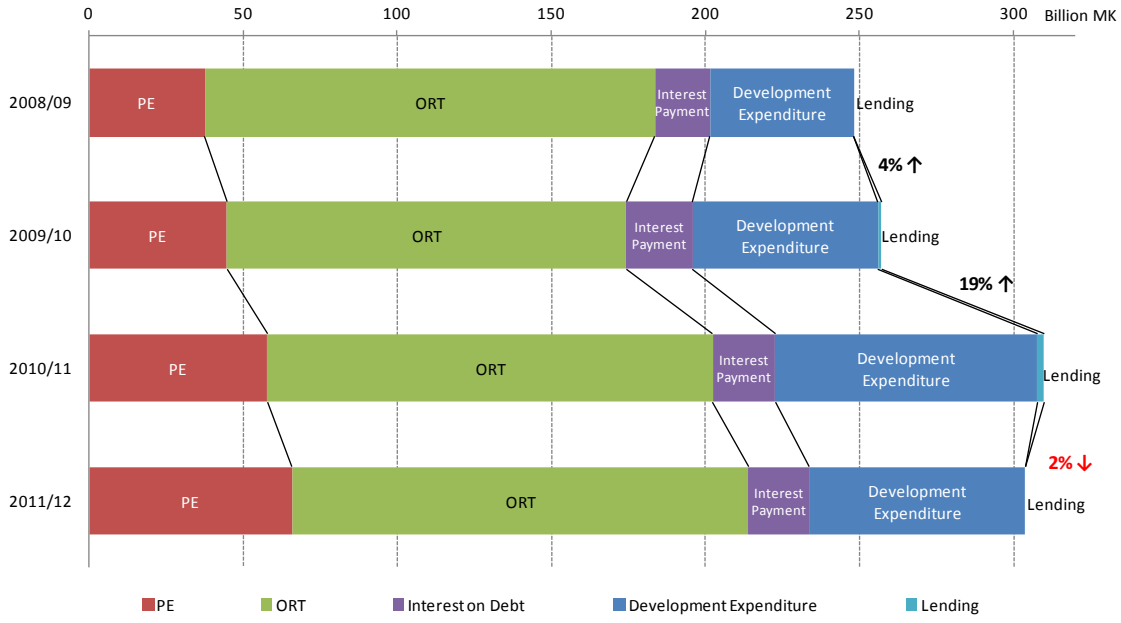
The Malawi government starting in the 2011/12 fiscal year introduced a so called Zero Deficit Budget, with primary intension to maintain the primary balance in the recurrent expenditure that excludes the aid donor support. To achieve this, it is necessary to clarify and categorize the budget by source of revenue – domestic revenues including tax and non tax revenue and donor supported revenue including General Budget Support (GBS) and SWAps pooled fund. This initiative came after there was diplomatic chaos in 2010 where both ambassadors in Malawi and UK were declared *persona non grata* when the cable of the British ambassador stated that Mutharika was becoming "ever more autocratic and intolerant of criticism" was leaked. Following these actions, some bilateral donors like EU and Germany had stated to either stop or decrease the budget support to Malawi. The Malawi government has therefore had this initiative to minimize the risk of external shocks. According to my observations, the

[4] PE and ORT stand for Personal Emolument and Other Recurrent Transaction. Part 1 and Part 2 imply budget financed by donor resources and domestic resources respectively.

Zero Deficit Budget has the followings advantages: 1) high opportunity to reduce fungibility and fiduciary risk by coloring money of budget support, and 2) higher continuity even if donors withdraw support to Malawi.

Figure 8 depicts how government revenue changes over time. Data of 2008/09 and 2009/10 is the actual outturn, 2010/11 is approved, and 2011/12 is estimated. The Personal Emolument (PE) and Other Recurrent Transaction (ORT) grow as inflation rate rises. Decline in 2011/12 total budget comes from deduction of donor disbursement and buy back of domestic debt more than issuing.

Figure 8: Trend of Government Expenditure



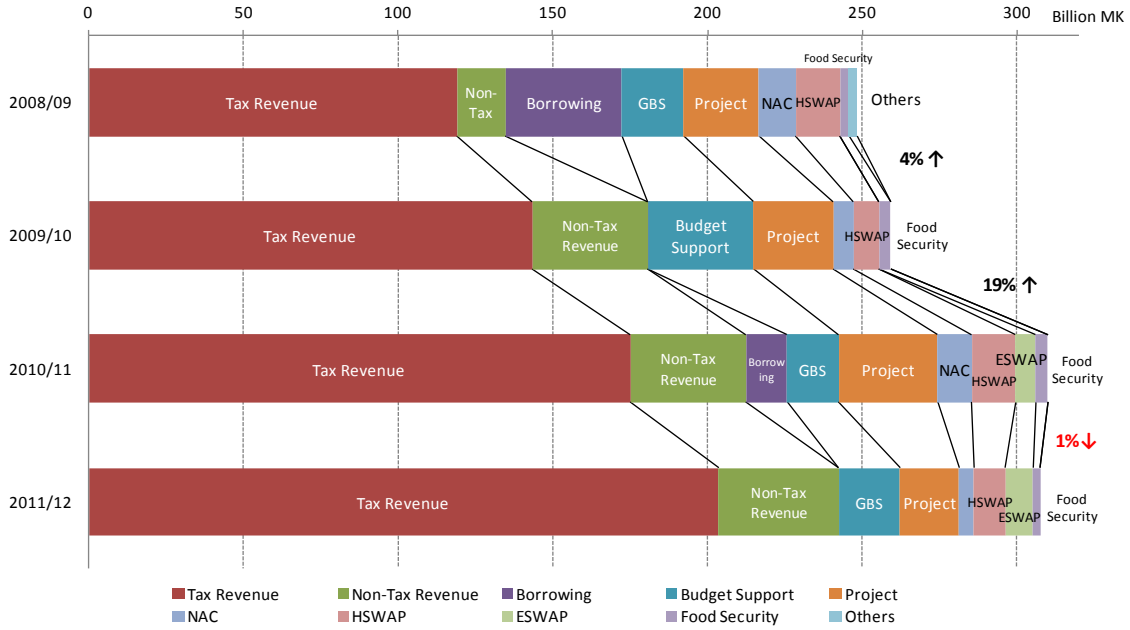
*Data Source: Financial Statement for 2011-12 Financial Year, GoM

Up to the 2010/11, the revenue has been increasing at a greater rate than that of GDP growth. But that trend ended in 2011/12 fiscal year budget because of the decline in donor aid. The reason of the donor decision is that IMF suspended Extended Credit Facility (ECF) to Malawi due to discontent of conditions[5] by Malawi government. Figure 9 confirms the steady growth of tax revenue as GDP goes up. Malawi Government has implemented some tax reforms. One of them is removing items from

[5] The broken conditions may be exchange control issue, corruption, or basic human rights.

VAT exemption list[6], but it is not certain if the impact of the reform is considered in this revenue projection.

Figure 9: Trend of Government Revenue



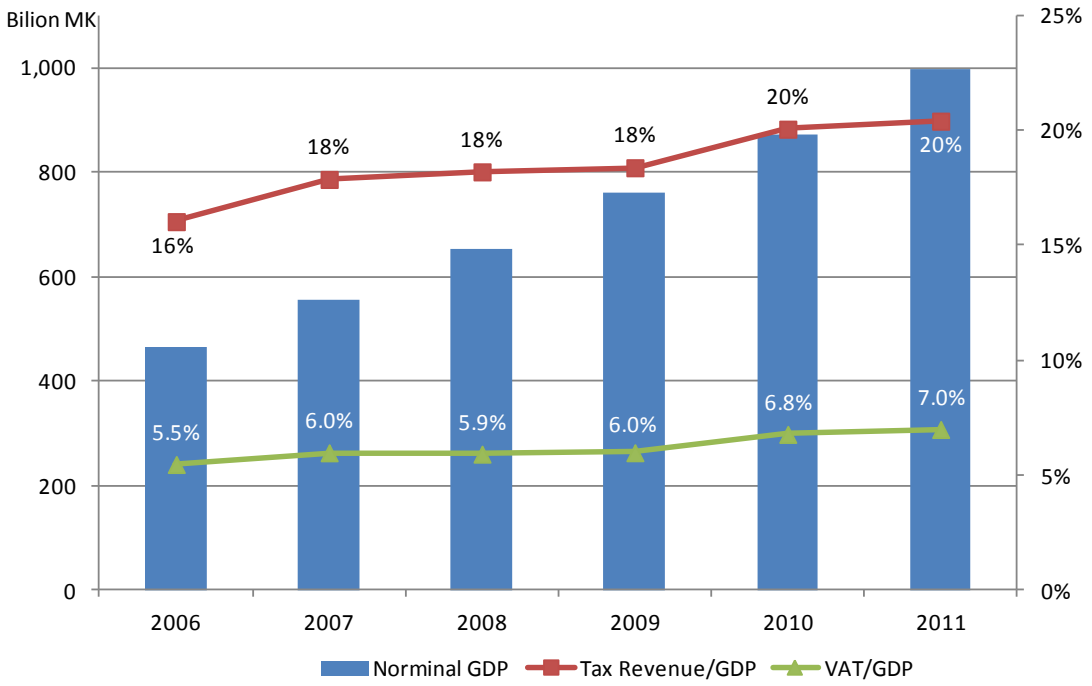
*Data Source: Financial Statement for 2011-12 Financial Year, GoM

The tax revenue as percentage of the GDP is an indicator for efficiency of the tax collection or tax administration. The tax collection rate for both total revenue and VAT in Figure 10 shows the gradual increase, which means the performance of Malawi Revenue Authority (MRA) is getting better every year. The VAT tax collection rate for 2011 is projected 7%. Comparing this figure with other countries like Republic of Poland[7] that performs between 7% and 8% of the collection rate, Malawi tax administration can be rated quite well.

[6] Those items exempted from VAT are water supply, ordinary bread, meat and edible meat offal, milk and dairy products, residues and waste from food industries, saw dust and wood waste newspapers, hessian cloth, machinery and mechanical appliances and spare parts, and fees, charges, commissions, and discounts on financial services (2011/12 Budget Statement).

[7] VAT rate in Poland is 22% (2010) and that of Malawi is 16.5%. Thus this comparison is bit optimistic.

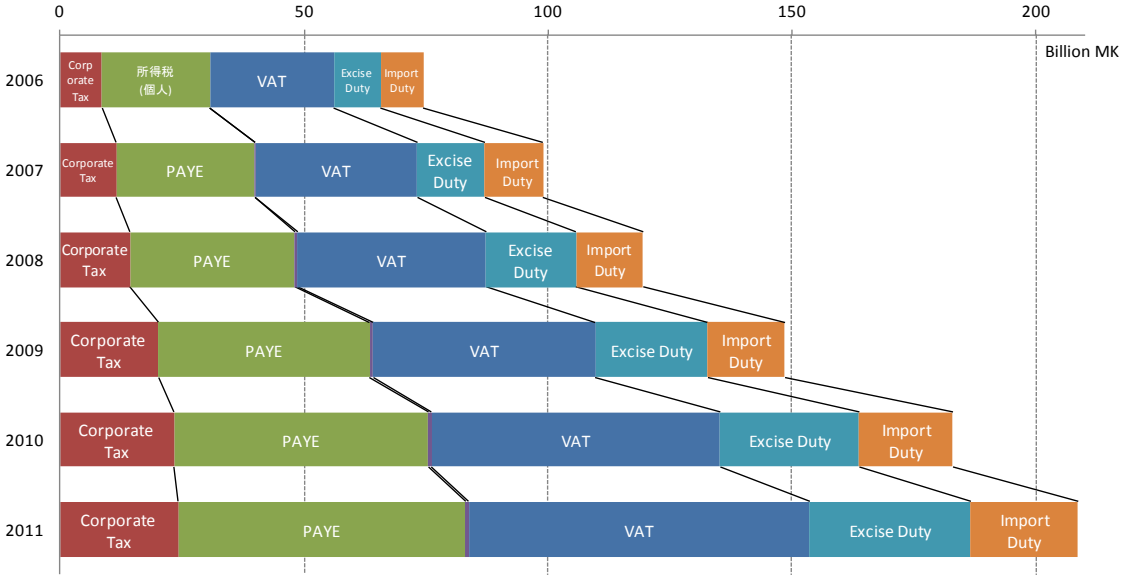
Figure 10: Nominal GDP and Tax Revenue as Percentage of GDP



*Data Source: Financial Statement for 2011-12 Financial Year, GoM

Then looking at the breakdown of tax revenue, the revenue of taxes imposed on goods (VAT, excite duty, and import duty) is increasing significantly; whereas income tax does not grow as expected since its share among total tax revenue is expected to go down by 4% in 2011 from 45% and 2% up for VAT. With the fact that 52.4 percent of population is poor and 22.3 % is ultra poor (IHS-2), middle income population in Malawi is exceedingly small. In this regard, the growth of income tax is not expected since most of their income is either informal or below the target amount. The biggest challenge is how to transform these poor into middle income class.

Figure 11: Breakdown of Tax Revenue



*Data Source: Financial Statement for 2011-12 Financial Year, GoM

Chapter 3

3. Estimating Shadow Wages and Income, and Separability Test

3.1. Introduction

The key distinction in household modeling between typical and agricultural households is if their income and wages are endogenous or not in their decision making process. While typical households make migration, education and fertility choices based on their exogenous salaries, agricultural based households also need to take into account the expected production outputs and its price. Since the farm household as a producer

attempts to maximize its profit from the agricultural outputs, its income shall be referred to as corporate income, which is revenue minus cost of sales, operating expenses, and taxes over a given period of time. The utility of the household assumed to be derived from the consumption and its leisure time under the budget constraint but its constraint is not constant for the farm household since it varies with respect to the labor and commodity market conditions. The farm household, therefore, has to make consumption and production decisions simultaneously, which requires a higher level of risk management skills.

Owing to the complex interaction between the labor supply and demand decisions, many researchers have assumed separability in their analysis in which a farm household behaves as a pure profit-maximizing producer based on the perfectly competitive markets for inputs (labor, variable inputs and capital) and outputs. If all markets exist and all goods are tradable, and prices are exogenous, the decision making process is regarded as recursive or separable. Therefore, under separability, the production analysis and consumption analysis are taken independently. The empirical evidence of farm household and microeconomic theories, on the other hand, indicates that farm household decisions on production and consumption are "non-separable", which means that the farm household maximizes profits as a producer and utilities as a consumer simultaneously not independently and its labor supply decision cannot be made without consideration of its labor needs on and off farm.

Since shadow wages[8] for on-farm work contribute a lot to determining the labor supply and demand choices of the farm households in non-separable modes, under separable model in which there is no market constraint, farmers' shadow wages are equivalent to market wages (because family and hired labor are perfect substitutes) and their labor supply decision can be made through following two stages (Strauss 1986, and Benjamin 1992); 1) a household determines necessary total labor supply on its farm

[8] Since farmers do not receive actual salary for their farming activities, this paper uses the term "shadow wage" to distinguish from market wages. The same is applied for shadow income.

to maximize profits from agricultural production without regarding consumption and leisure preferences; 2) considering expected profits above, market commodity prices and off-farm income, the household determines the amount of consumption and labor supply to the market. In this regard, the separation model test is inevitable to verify the correct model in the sample, unless otherwise yields different results in analysis. This paper will therefore test a separation model for Malawi agricultural households whether there are any market constraints observed in the sample using both conventional and modified Benjamin and Jacoby tests.

Le (2009) proposed a new estimation method to derive shadow wages and income for farm households, while most papers estimated an agricultural production function and used the marginal product of labor (MPL) for shadow wages. This method holds true as far as some issues are cleared such as intensive data requirement, assumptions on functional form, and justification for the instruments to address the endogenous problem (Le 2009). By contrast, the new methodology Le suggested allows shadow wages and income to be derived by estimating only labor supply functions instead of a production function. In this chapter, both strategies are applied to derive shadow wages for comparison but the following chapters use Le's shadow wages for further analysis.

3.2. Theoretical Framework

3.2.1. Model Specification

As previously explained, a farm household is defined as an economic actor who has mainly two activities – production and consumption. As a producer, the farm household has productive activities by choosing the allocation of labor and other inputs based on crop prices and input prices under technological constraints, whereas as a consumer, consumption decisions are made by choosing the allocation of income sourced from agricultural profits and off-farm labor activities. The basic assumption of preferences and shared income by all household members is put in place.

For the sake of easy understanding of the model, let all denotations be specified as follows;

Y	:	Quantity of own farm production,
P_y	:	Price of Y,
L	:	Allocation of hours (both family and hired labor input) for Y production,
W_F	:	Shadow wage for farm work,
M	:	Allocation of hours for off-farm work (M>0: labor supply, M<0: hired labor),
W_M	:	Off-farm work wage (market wage),
T	:	Leisure hours,
H	:	Total labor supply (H = L + M),
D	:	Total available hours (D = T + L + M),
V	:	Vector of variable inputs e.g. Fertilizer,
p_v	:	Price of V,
K	:	Vector of fixed inputs e.g. Land,
C	:	Consumption of market-purchased goods,
Z	:	Non-wage, non-crop net other income (Z=capital gain – saving),
X	:	Off-farm labor constraint or maximum available hours for off-farm work,
A	:	Vector of individual characteristics / preference shifters.

Using notations and assumptions above, the household model can be formulated as follows;

*** Agricultural Production Function**

$$Y = Y(L, V, K) \tag{3-1}$$

*** Utility Function**

$$U = U(C, T) \tag{3-2}$$

*** Budget Constraint**

$$C = \left(p_y Y - p_v V\right) + W_M M + Z \tag{3-3}$$

*** Time Constraint**

$$D = T + L + M \tag{3-4}$$

Given equation (3-1) through (3-4), utility optimization problem is defined by:

$$\begin{aligned} &\text{Max } U = U(C, T) \\ &\text{Subject to} \\ &C = \left(p_y Y - p_v V\right) + W_M M + Z \\ &D = T + L + M \\ &M \leq X \end{aligned} \tag{3-5}$$

The objective function is therefore given as:

$$\mathcal{L} = U(C, T) + \lambda\left[C - p_y Y(L, V, K) + p_v V - W_M(D - T - L) - Z\right] \tag{3-6}$$

The conditional optimization problem yields the following first-order equations:

$$\frac{\partial \mathcal{L}}{\partial L} = -\lambda p_y \frac{\partial Y}{\partial L} + \lambda W_M = 0 \qquad p_y \frac{\partial Y}{\partial L} = W_M \tag{3-7a}$$

$$\frac{\partial \mathcal{L}}{\partial T} = \frac{\partial U}{\partial T} + \lambda W_M = 0 \qquad \frac{\partial U}{\partial T} = -\lambda W_M \tag{3-7b}$$

$$\frac{\partial \mathcal{L}}{\partial C} = \frac{\partial U}{\partial C} + \lambda = 0 \qquad \frac{\partial U}{\partial C} = -\lambda \tag{3-7c}$$

$$\frac{\partial \mathcal{L}}{\partial V} = -\lambda p_y \frac{\partial Y}{\partial V} + \lambda P_V = 0 \qquad P_V = p_y \frac{\partial Y}{\partial V} \tag{3-7d}$$

From (3-7b) and (3-7c), the following can be derived:

$$\frac{\frac{\partial U}{\partial T}}{\frac{\partial U}{\partial C}} = W_M \tag{3-8}$$

Using equation (3-7a) and (3-8), the relationship between market wage and farm wage can be expressed as:

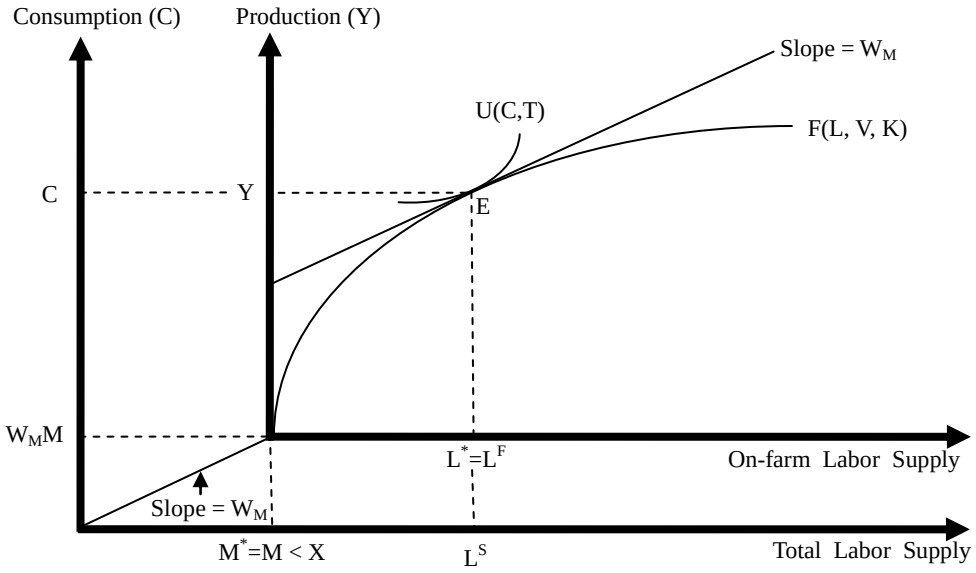
$$W_F = p_y \frac{\partial Y}{\partial L} = \frac{\frac{\partial U}{\partial T}}{\frac{\partial U}{\partial C}} = W_M \qquad \text{If} \quad M < X \qquad (3\text{-}9a)$$

$$W_F = p_y \frac{\partial Y}{\partial L} = \frac{\frac{\partial U}{\partial T}}{\frac{\partial U}{\partial C}} < W_M \qquad \text{If} \quad M = X \qquad (3\text{-}9b)$$

W_F is called a shadow wage, value of marginal product of labor in agriculture, or opportunity cost of time. Suppose the relationship in labor supply between on-farm and off-farm is perfect substitution in which labor market has adequate capacity to absorb labor demand (M<X), zero transaction costs lead to a free flow of labor to the labor market and then finally the farm wage is consistent to the market wage (3-9a). On the other hand, when there exists huge transaction costs or other market failure aspects (in this model called market constraint denoted by X), eventually the household has less opportunity to work at the market (the labor market is limited to meet the demand (M=X)) and farmers' shadow wage cannot be equivalent to or even less than the market labor wage (in this case the farm wage becomes exogenous). Figure 12 and 13 illustrate graphical representation of equation (3-9). The vertical axes represent household consumption (C) and agricultural production (Y), and horizontal axes are labor supply for farming above and total labor supply at the bottom. Assuming perfect market where there is no constraint on off-farm employment opportunity, the optimal choice of total labor supply (L^S) is where marginal product of labor (market wage rate (W_M)) is tangent to the production function (F(L,V,K)) and the utility function (U(C,T)), which is at the point (E) in Figure 12. The process of having that equilibrium is quite simple in that a given market wage rate, time availability, production function and utility function, the farm household can make labor supply decision on farming at (L^*) and off-farm work at

(M^*). Since there is sufficient employment opportunity, the household can work off-farm for as long as (M) hours. In this scenario, the actual farming hours (L^F) and optimal labor supply for farming (L^*) are equal, and the same is applicable for actual off-farm work (M) and optimal hours (M^*).

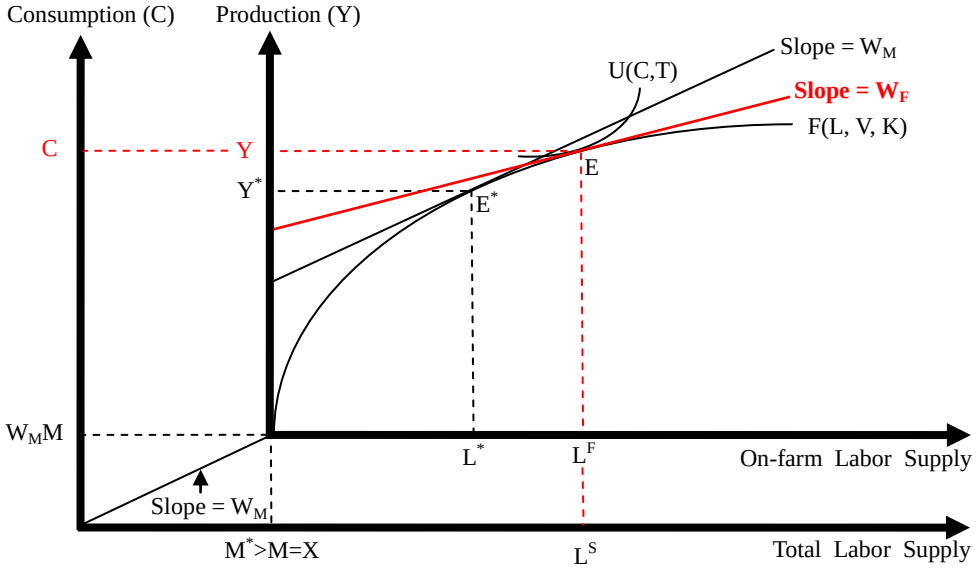
Figure 12: Optimal Labor Supply in Perfect Market



Under market imperfection, on the other hand, it has a completely different scenario as has been described in Figure 13 but determination process of labor supply in the initial stage that the household first determines to provide (L^*) and (M^*) hours for farming and off-farm work respectively is unchanged in both cases of perfect and imperfect markets. Regardless of the willingness to work for (M^*) hours, the household could only find M hours to work because of limited employment opportunities (X). As a result, the remaining hours (M^*-M) will be allocated to leisure and farming activities that yields lower marginal product of labor and lower farm wage rate (slope of W_F) with slightly higher agricultural output (Y). The economic disparity in total expenditure or income between the cases of perfect and imperfect markets can be expressed as $W^M(M^*-M) - (Y-Y^*)$. Thus this scenario is economically inefficient since utility and expected income (agricultural output + salaries) of the household are lower than those in

the case of perfect market.

Figure 13: Optimal Labor Supply Under Presence of Market Imperfections



Replacing non-linear budget constraint with linear budget constraint could derive the same optimal point. Imposing the linear budget constraint, the conditional optimization problem in equation (3.5) can be rewritten as:

$$\text{Max } U = U(C, T)$$

Subject to (3-10)

$$C - W_F H = I^*$$

I^* above is defined as shadow income and can be computed as follows;

$$I^* = (p_y Y - p_v V) + W_M M + Z - W_F H \quad (3\text{-}11)$$

Finally labor supply functions can be written as;

$$H^* = H(W_F, I^*) \quad (3\text{-}12)$$

The goal of this chapter is to estimate shadow wage (W_F) and shadow income (I^*) for evaluation of income and wage distribution and its data will be used in following chapters for further analysis. Conventional and alternative estimation strategies are

described in the subsequent sub chapters.

3.2.2. Conventional Estimation Strategy

The most empirical analyses on shadow wage estimation have used marginal product of labor as a measure of shadow wage. Conventional means of estimating shadow wages and income using an MPL approach is followed through two steps – 1) Estimation of an agricultural production function and 2) Computing shadow wages and income using estimated marginal product of labor and mean values of each variable.

Step 1: Estimating Production function

The production function can be specified in Cobb-Douglas form as:

$$Y = \alpha_0 L^{\alpha_1} V^{\alpha_2} K^{\alpha_3} \quad (3\text{-}13)$$

and regression function is therefore

$$\ln(Y) = \ln(\alpha_0) + \alpha_1 \ln(L) + \alpha_2 \ln(V) + \alpha_3 \ln(K) + \tau$$

where (3-14)

$$\tau = \upsilon + \varepsilon$$

τ, υ and ε represent an error term, technology variables, and weather shocks (independent from other variables since it is not controllable) respectively. As far as estimating parameters of the production function is concerned, simultaneity bias will be posed if it contains unobservable inputs such as managerial ability (Jacoby 1993, and Barnum and Squire 1979). It is demonstrated by Zellner, Kmenta and Dreze (1966) that in the recursive nature of the model (given the lag between input and output decisions) ordinary least squares will give unbiased estimates of the production function. Hence instruments must be found to get consistent estimates for cross-sectional data.

Step 2: Estimating the Shadow Wage and Shadow Income

Given parameters estimated in Step 1, equation (3-15) has been used to calculate

shadow wages

$$W_F = p_y \frac{\partial Y}{\partial L} = p_y \alpha_1 \frac{Y}{L} \tag{3-15}$$

Finally, by substituting the shadow wage into equation (3-11), the shadow income can be derived.

In general, fitted output ($\bar{Y}$) computed from equation (3-13) instead of real output Y is employed in the actual estimation of the shadow wage and income. The reason not to use observed output is that as far as unexpected weather shocks are concerned, the farmers act based on predicted outputs.

Derivation for equation (3-15) :

Partially differentiate equation (3-13) with respect to L:

$$\frac{\partial Y}{\partial L} = \alpha_1 \alpha_0 L^{\alpha_1 - 1} V^{\alpha_2} K^{\alpha_3}$$

Rearranging the above equation yields,

$$\alpha_1 \alpha_0 L^{\alpha_1 - 1} V^{\alpha_2} K^{\alpha_3} = \alpha_1 \frac{\alpha_0 L^{\alpha_1} V^{\alpha_2} K^{\alpha_3}}{L} = \alpha_1 \frac{Y}{L}$$

3.2.3. Alternative (Le) Estimation Strategy

As Le (2009) pointed out in his paper, the conventional means of estimation has several problems:

1 Existence of sample bias and inefficiency

   i. Misspecification of production function (Cobb-Douglas or even Translog may not be applicable)

   ii. Data intensive estimation of production function (more variables needed more measurement errors)

iii. Data limitation on farm outputs and inputs (only expenditure data for variable physical inputs such as fertilizer, insecticides and transportation are available.)

iv. The use of value (product quantity and price) in place of quantities to estimate a production function obtains biased estimates, if price variation among regions is substantial.

2 Estimation bias in the marginal product of labor

i. Misspecification of production function and omitted variables lead to incorrect estimation of fitted outputs.

■ Deriving Shadow Wage

Alternative approach to derive shadow wages proposed by Le is to avoid from estimating a production function, however estimating a labor supply function makes this happen. In order to solve the above problems, a more flexible production function has to be specified as shown below:

$$\overline{Y} = L^{\alpha_1} V_1^{\alpha_2} f(V_2, K) \quad (3\text{-}16)$$

The advantage of this function is that specification of fixed inputs and other variables is not necessary. And since this production function is not estimated by this method, any form of functional forms like translog can be put in $F(V_2, K)$. Furthermore, items of other variables and fixed variables can be anything and be different across households.

The real output (Y) is theoretically different from expected output ($\overline{Y}$) because farmers cannot flexibly adjust input variables in according to given weather shocks (ε) and some other external shocks. Assuming$E(e^{\varepsilon}) = 1$, the real output (Y) is generally expressed as:

$$Y = \overline{Y} e^{\varepsilon} \quad (3\text{-}17)$$

However tests in this chapter employ the alternative equation (3-18) because it is comparable to the production function used in this chapter:

$$Y = \overline{Y} + \varepsilon$$

where ε is assumed: (3-18)

$$E(\varepsilon) = 0$$

Within the alternative methodology, $\overline{Y}$ is used to compute a marginal product of labor because as already mentioned, weather shocks cannot be predicted and farmers' behavior can be determined based on predicted or expected outputs. Equation (3-15) can be rewritten as:

$$W_F = p_y \frac{\partial E(Y)}{\partial L} = p_y \alpha_1 \frac{\overline{Y}}{L} \quad (3\text{-}19)$$

As it is shown in equation (3-7d), utility maximizing problem makes a variable input price to be equivalent to marginal product of the variable input:

$$p_{V_1} = p_y \frac{\partial Y}{\partial V_1} = p_y \alpha_2 \frac{\overline{Y}}{V_1} \quad (3\text{-}20)$$

Using equation (3-19) and (3-20), shadow wages can be computed from:

$$W_F = MPL = p_{V_1} \frac{\alpha_1}{\alpha_2} \frac{V_1}{L} \quad (3\text{-}21)$$

The good thing about equation (3-21) is that only data of variable input and farm labor supply can derive shadow wages for each household. Therefore collecting data on these variables is much easier than putting value on agricultural outputs that are self consumed by the household but not sold at the market. Consequently this method yields more precise estimation results.

Derivation for equation (3-21) :

Rearranging equation (3-19) into the form of "$\overline{Y}$=" yields

$$\overline{Y} = \frac{p_{V_1} V_1}{\alpha_2 p_y}$$

Then substituting the above into equation (3-20),

$$MPL = p_y \alpha_1 \frac{\frac{p_{V_1} V_1}{\alpha_2 p_y}}{L} = p_v \frac{\alpha_1}{\alpha_2} \frac{V_1}{L}$$

■ Deriving Shadow Income

To calculate shadow income, real output in equation (3-11) needs to be replaced by expected output as:

$$I^* = \left(p_y \overline{Y} - p_v V\right) + W_M M + Z - W_F H \quad (3\text{-}22)$$

then $p_y \overline{Y}$ can be derived by rearranging equation (3-20):

$$p_y \overline{Y} = \frac{p_{V_1} V_1}{\alpha_2} \quad (3\text{-}23)$$

Finally, substituting equation (3-23) into (3-22) and shadow income deriving equation is

$$I^* = \left(\frac{p_{V_1} V_1}{\alpha_2} - p_v V\right) + W_M M + Z - W_F H \quad (3\text{-}24)$$

Equation (3-24) has the same advantage as well – unnecessary of agricultural output information. The only requirement is estimated parameters of α_1 and α_2 which come from following procedures.

■ **Identification**

Unlike the conventional method, calculation of shadow wages and income can be achieved by only estimating a labor supply function $\mathrm{H}(\mathrm{W_F}, \mathrm{I}^*; \mathrm{A})$ where A denotes a vector of individual characteristics or preference shifters. The regression form of the labor supply function is therefore:

$$\mathrm{H} = \beta_1 \mathrm{W_F} + \beta_2 \mathrm{I}^* + \beta_3 \mathrm{A} + e \tag{3-25}$$

where (e) is the regression residual.

By substituting equation (3-21) and (3-24) into (3-25), the following equation can be obtained:

$$\mathrm{H} = \beta_1 \left(\mathrm{p_{V_1}} \frac{\alpha_1}{\alpha_2} \frac{\mathrm{V_1}}{\mathrm{L}} \right) + \beta_2 \left(\frac{\mathrm{p_{V_1} V_1}}{\alpha_2} - \mathrm{p_v V} + \mathrm{W_M M} + \mathrm{Z} + \mathrm{p_{V_1}} \mathrm{H} \frac{\alpha_1}{\alpha_2} \frac{\mathrm{V_1}}{\mathrm{L}} \right) + \beta_3 \mathrm{A} + e \tag{3-26}$$

The above supply function can be rewritten as:

$$\mathrm{H} = \beta_1 \frac{\alpha_1}{\alpha_2} \left(\mathrm{p_{V_1}} \frac{\mathrm{V_1}}{\mathrm{L}} \right) + \frac{\beta_2}{\alpha_2} \left(\mathrm{p_{V_1} V_1} \right) + \beta_2 (-\mathrm{p_v V} + \mathrm{W_M M} + \mathrm{Z}) + \beta_2 \frac{\alpha_1}{\alpha_2} \left(\mathrm{p_{V_1}} \mathrm{H} \frac{\mathrm{V_1}}{\mathrm{L}} \right) + \beta_3 \mathrm{A} + e \tag{3-27}$$

Process of identifying alphas and betas is that 1) obtain the parameter β_2 by estimating equation (3-27); 2) then α_2 and α_1 from $\frac{\beta_2}{\alpha_2}$ and $\beta_2 \frac{\alpha_1}{\alpha_2}$ respectively. Having these alphas, equation (3-21) and (3-24), shadow wages and income can be derived.

3.3. Separability Test

Understanding equation (3-9), in the case of no market constraints (separation model), market wage equals shadow wage whereas shadow wage becomes an endogenous variable that would vary according to household preferences in non-separation model (where laborers are not perfect substitution). It is, therefore, necessary to test if the sample used in this paper is explained by separability or non-separability. The identification of a right model in agricultural households is emphasized in many papers and has shown that the results are different between separation and non-separation models. Taylor and Adelman (2003) discovered that Mexican trade and transfer policies, which envisaged to stimulate development of the agriculture sector and improve rural household income, have not had as much impact as expected because of market imperfection. Lofgren and Robinson (2002) indicated that existence of higher transaction costs in the market would sluggish households' response to the price change, but lower transaction cost stimulates market participation and gains more income.

The following items are major distinctive features or conditions of imperfect labor market in which workers do not receive full marginal product of labor:

1. Presence of transaction costs
2. Fragmented labor markets or poor access to markets due to geographical disadvantages
3. Lack of market clearing or absence of regulations that prevent wages from flexible adjustment
4. Limited employment opportunity that raises involuntary unemployment because of premature economy
5. Less pervasiveness of long-term contracts
6. Unequal treatment between long-term contracts and casual basis workers at

lower wages.

7. Absence of human capital concept (no investment on human capital to improve efficiency)
8. Distorted price floor (Minimum wage)
9. Provision of incentives such as efficiency wage
10. Health issue (negative relationship between malnutrition/sickness and productivity)

Of the above listed items, transaction cost is the most serious factor that causes market distorted. Some types of transaction costs associated to market imperfection are uncertain with respect to the laborer's ability, arranging a contract and negotiations, poor access due to poor infrastructure development, information asymmetry, organizing collective actions, and so forth. Since transaction costs can be divided into non-policy and policy related transaction costs, policy related transaction costs shall, at least, be reduced or removed though effective policy interventions.

The following sub-chapters express how to test the presence of imperfection in labor market using conventional and modified methodologies.

3.3.1. Conventional Test

There are two major testing strategies for separation model namely Benjamin and Jacoby Tests.

Benjamin (1992) derives labor demand function from Cobb-Douglas production function as:

$$\ln(L) = \beta_0 + \beta_1 \ln(p_v) + \beta_2 \ln(K) + \beta_3 \ln(W_F) \quad (3\text{-}28)$$

It is obvious that W_F is exogenous in separation model; however, it becomes an endogenous variable which varies depending on households' preference shifters in

non-separation model. Therefore, the relationship between W_F and W_M can be written as:

$$W_F = W_M e^{\alpha A} \tag{3-29}$$

Thus the following regression model is used for Benjamin test:

$$\ln(L) = \beta_0 + \beta_1 \ln(p_v) + \beta_2 \ln(K) + \beta_3 [\ln(W_M) + \alpha A] + \xi \tag{3-30}$$

The actual test of the separability is to check whether α is zero or not. Accepting H_0: $\alpha = 0$ implies $W_F = W_M$ and there is no market constraints (separable).

Even though the above regression requires price of variable inputs, fixed inputs and shadow wages, a simple model having only market wage variable is more than enough for separation model test. Jacoby (1993) therefore proposes following regression model:

$$\ln(W_F) = \beta_0 + \beta_1 \ln(W_M) + \xi \tag{3-31}$$

Suppose H_0: $(\beta_0, \beta_1) = (0, 1)$ is accepted, then market imperfection does not exist. The challenge here is that the regression above excludes households that do not provide labor to the market, which means that sampling may be non-random with respect to the taste for work (ξ). Even though sampling is not random, the mean of ξ is still zero and thus sample selection bias is not a concern (Jacoby 1993).

3.3.2. Modified Test

There are still several issues to be discussed in the conventional testing such as unobserved household characteristics, information asymmetry on wage information, measurement error and simultaneity bias (refer to Jacoby 1993 and Benjamin 1992 for more detailed discussions). In order to react to these issues, a counter-proposal defines, first of all, a production function as:

$$\overline{Y} = L^{\alpha_1} f(V, K) \tag{3-32}$$

The above equation looks the same as equation (3-16) but the difference is that the variable input also is included in the non functional form so as to be more flexible.

Using equation (3-19) and (3-17), shadow wage can be expressed as:

$$W_F = p_y \alpha_1 \frac{Y}{Le^{\varepsilon}} \tag{3-33}$$

Take a log of the above equation and rearrange into:

$$\ln\left(p_y \frac{Y}{L}\right) = \ln(W_F) - \ln(\alpha_1) + \varepsilon \tag{3-34}$$

Substituting equation (3-29) into (3-34), the equation gets

$$\ln\left(p_y \frac{Y}{L}\right) = \ln[\ln(W_M) + \alpha A] - \ln(\alpha_1) + \varepsilon \tag{3-35}$$

Finally the regression equation for modified Benjamin test can be simplified as:

$$\ln\left(p_y \frac{Y}{L}\right) = \beta + \alpha A + u \tag{3-36}$$

where the error term u has both ε and $\ln(\alpha_1)$ and null hypothesis H_0 is $\alpha = 0$. The advantage about this test is that variables used for estimating the shadow wage and income can be reused.

For the Jacoby test, applying the same technique used for equation (3-31) into (3-34) yields:

$$\ln\left(p_y \frac{Y}{L}\right) = \beta_0 + \beta_1 \ln(W_F) + u \tag{3-37}$$

where null hypothesis H_0 is $(\beta_0, \beta_1) = (0, 1)$. The advantage of this equation is that those households that do not supply labor to the market can be included in the sample.

3.4. Empirical Analysis

■ **Data**

The estimation requires data on household activities such as farm input, market wage, hours of on/off farm work, other income, individual characteristics and so forth. In this regard, cross-sectional household data for Malawi – Second Integrated Household Survey (IHS-2) – is used for empirical analysis and even the following chapters employ this survey data for similar analysis. IHS is supposed to be carried out by Malawi National Statistics Office (NSO) every five years with the support from World Bank. Thus the first IHS was implemented in 1997/98 and the second IHS was done in 2003. At the time this dissertation was written, IHS-3 was about to be released but unfortunately the desire to use of IHS-3 for these analyses did not come true.

Table 2: Description of Variables

Variable	Units	Average / Share
Output Value	Total amount of agricultural output in Malawi Kwacha harvested during rainy season	11,550.72
Labor	Total hours of labor input for rainy season	1,202.497
Land size	The area of the plot in square meters	44,824.9
Variable input	Total amount of variable inputs in Malawi Kwacha	3,197.66
Household head age	Age of household head	42.45
Household head gender	Gender of household head (male=1)	Male: 70.10%
Educational Qualification	Dummy Variables for PSLC, JCE, MSCE, Technical Education and University or higher education	PSLC: 10.10% JCE: 7.91% MSCE: 4.37% Tech: 0.66% Univ:0.74%

In the IHS-2, there were 11,280 households with 52,707 family members registered as sample (see Appendix 1 for more details). Of those, households living in urban areas and do not have any farming activities were dropped from the sample. In this paper, only crops produced in the rain season are considered for analysis because farming activities during the dry season are rare since irrigation systems in Malawi are not well

developed. Therefore all figures used in regressions and other analysis are targeted for the period of rainfed cultivation, which is between October and April. The descriptive statistics of the variables used in this chapter are expressed in Table 2.

■ Estimating Shadow Wage and Income

Using the IHS-2 data, both conventional and alternative methodologies were employed to estimate shadow wages and income. Reviewing the conventional method, the first thing to do is to estimate production functions. Table 3 presents the regression results of Cobb-Douglas production functions using OLS and GMM methods.

Table 3: Results of Estimated Cobb-Douglas Production Function

Equation	(1)	(2)
Dependent Variable	Log (Output Value) OLS	Log (Output Value) GMM
Log (labor)	0.1407***	0.4315***
	(0.011)	(0.057)
Log (land size)	0.2962***	0.2683***
	(0.015)	(0.016)
Log (variable input)	0.0832***	0.0803***
	(0.002)	(0.003)
Household head age	0.0201***	0.0086**
	(0.003)	(0.003)
Household head age square	-0.0002***	-0.0001*
	(0.000)	(0.000)
Household head gender	0.1652***	0.0661**
	(0.023)	(0.031)
Educational Qualification		
PSLC Holder	0.1751***	0.1772***
	(0.033)	(0.034)
JCE Holder	0.2490***	0.2792***
	(0.039)	(0.042)
MSCE Holder	0.4009***	0.5575***
	(0.067)	(0.079)
Technical Education	0.6433***	0.6666***
	(0.176)	(0.184)
University or Higher Degree	1.0918**	1.2739**
	(0.443)	(0.503)
Constant	4.2069***	2.8687***
	(0.143)	(0.282)
Observations	7,782	7,782
R-squared	0.320	0.261

NOTE: Values in parentheses are White's corrected standard errors
*** significant at 1%, ** significant at 5%, * significant at 10%
Instruments for GMM: the number of adults in the household (age 18 to 64) and elders (age more than 64)

Despite that both regressions yield moderate levels of significance in the results, coefficients of GMM results are used in estimating shadow wages and income. This is so because, as mentioned, non-recursive nature of the model (or cross-sectional data) has a simultaneous equations bias, which can be sorted out by use of instruments.

The parameters for education, which can be translated as a rate of return to education or opportunity cost from going to schooling, indicate interesting implication that higher education for household heads earns larger agricultural output. Typically the rate of return per year to different levels of schooling can be obtained from:

$$r_{\text{Level}} = \frac{\theta_{\text{Level}} - \theta_{\text{Level}-1}}{\text{School Years}} \tag{3-38}$$

where

r : rate of return per year
Level : Schooling Level
θ : Estimated coefficient

The rates of returns to school computed using the GMM parameters are reported in Table 4. One obtaining a university or higher degree is the best performer with the highest rate of return 0.71 followed by MSCE 0.27, PSLCE 0.17, technical education 0.109 and JCE 0.102. These results reveal that agriculture requires much more skills or knowledge to promote efficiency and that "knowledge gap" is the key to reduce inequality. Taking a cost-benefit aspect and context of Malawian culture into account, graduating primary school might be the best choice for farmers. Per year rates of return from each level of education can conclude that opportunity cost from schooling is increasing as proceeds to higher level of education. The possible reason for the higher rates of return from higher education is the extent of access to credit markets to acquire fertilizer and other inputs.

Chirwa and Matita (2008) estimated the returns to education for Malawi urban wage earners through extended Mincerian earning functions using IHS-2 data to discover

linkages between education, employment and earnings. Their empirical analysis found that primary education increases income by 4.9 percent, secondary education by 14.9 percent, technical education by 29.1 percent, and higher education by 67.2 percent[9]. Since all these rates are relative to no schooling or incomplete primary education, converted per level rates of return are computed as in the last column of Table 4. It is noted that in spite of different sample and targets, both result show that higher education leads to better income and earnings. Interestingly, except technical education, farmers can earn more from each level of education than those of paid jobs.

Table 4: Rates of Return to School

School Level / Qualification	Rate of Return		
	My Estimation for Rural Farmers		Estimation by Chirwa and Matita for urban wage earners
	Per Level	Per Year	Per Level
Primary School			
Grade 1 – 8 (PSLCE)	0.1772	0.0221	0.049
Secondary Education			
Grade 1 – 2 (JCE)	0.1020	0.0510	
Grade 3 – 4 (MSCE)	0.2783	0.1391	0.100
Tertiary Education			
Grade 1 – 2 (Technical education)	0.1091	0.0545	0.142
Grade 1 – 4 (University degree)	0.7164	0.1791	0.523

Moving on to the Le methodology, it is necessary to estimate the labor supply function of equation (3-27). And parameters of alphas and betas are derived using the identification methods as seen in Table 5.

Table 5: Parameters Estimated through Alternative Method

Parameter	Estimated Value
Alpha 1 (α_1)	0.380
Alpha 2 (α_2)	0.037
Beta 1 (β_1)	-0.989
Beta 2 (β_2)	0.001

[9] The study focuses on individuals aged 15 years and over engaged in wage employment for urban areas.

Having alphas, betas and equations explained in the previous sub-chapter, shadow wages and income can be calculated. The table below briefly expresses the comparison between results of conventional approach and alternative approach.

Table 6: Estimation Results of Shadow Wage and Income

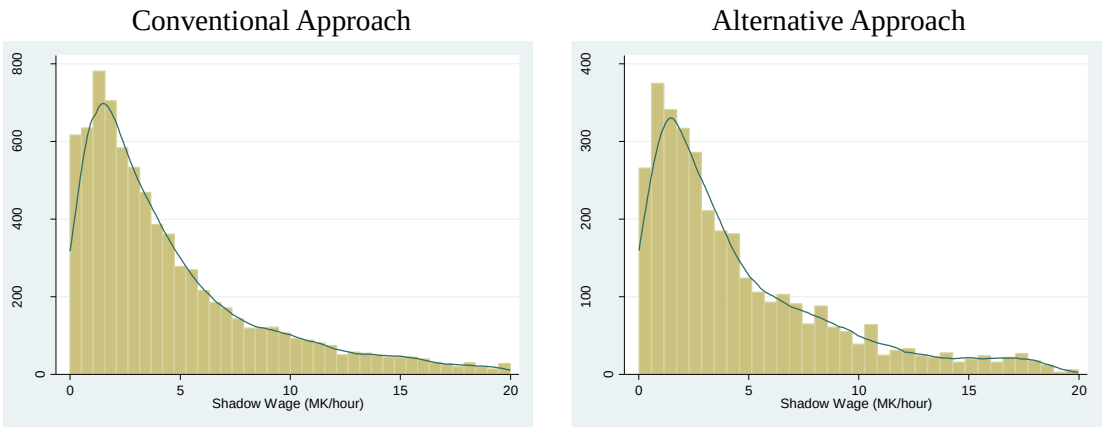
Variable	Conventional Approach	Alternative Approach
Permanent job wage / hour		
Mean	33.618	
Median	11.538	
Casual / *Ganyu* work wage / hour		
Mean	22.993	
Median	12.500	
Shadow Wage / hour		
Mean	8.821	10.258
Median	3.525	3.530
Shadow Income for the rain season		
Mean	32,521.237	30,792.565
Median	11,576.302	10,210.557

*Wage rates are hourly rates in Malawi Kwacha.

Fortunately comparing shadow wages derived from both methods does not indicate significant discrepancy, as well as for shadow income. The average wage rates of permanent jobs and casual work including part-time work (*ganyu*) just come from sample data. *Ganyu*, casual labor employment in Malawian term, is the most important source of livelihood for the poorest households. Some papers written on the same, however, dispute that low *ganyu* wages drive poor rural households into even further destitution. It has been further argued that poor farm households tend to supply more *ganyu* at lower wage and less to own farm activities because there are limited income diversification options and rural households may end up selecting low-risk, low-return portfolios that presumably lower the risk of hunger, which is so called “risk-averse” (Barret et al 2008 and Whiteside 2000). As Table 6 indicates permanent employees receive the highest wage rate with the average rate of about 34 Kwacha per hour, and the casual workers (*ganyu*) receive about 30% less wage than those of permanent

workers. The farmers' shadow wage, on the other hand, is far less than those of off-farm labor by about 70 % down from the permanent job wage. According to Malawi Government, monthly minimum wage was set at MK3,519 for urban areas and MK2,863 for rural workers. These rates can be translated into hourly rates to roughly MK22 for urban and MK18 for rural areas. The fact that wages for rural farmers are even less than government minimum wage supports the reason why most of Malawi poor are subsistent farmers. Suppose these results are true, there must be a market constraint or to say a non-separable model should be applied to the sample, which will be tested in the following sessions. The evidence with the lower shadow wage than *ganyu* wage could not support the reason of the tendency to supply more for *ganyu* work than on-farm activities as suggested by Barret. Rather the households are positively encouraged to supply *ganyu* labor because of the relatively higher wage than on-farm work. This finding supports the Schultz's (1964) hypothesis that farm households in developing countries are "poor but efficient." Graphical presentation of shadow wage and income distribution is given in Figure 14 and 15:

Figure 14: Distribution of Shadow Wage



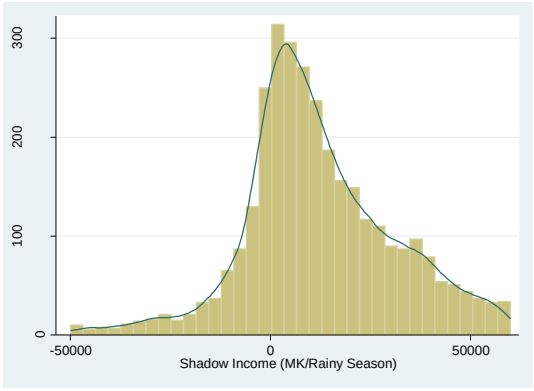
*Wage rates are hourly rates.

As the figures show, the distributions of shadow wage are skewed to the right while

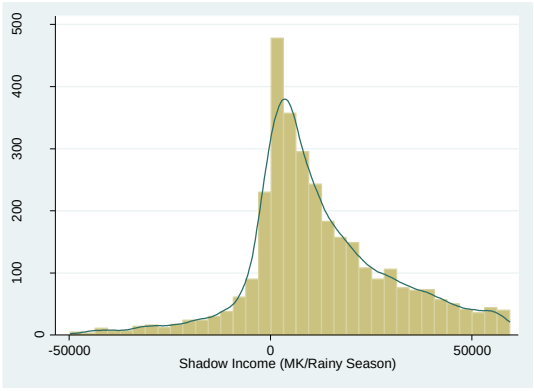
those of income are more likely to be normally distributed.

Figure 15: Distribution of Shadow Income

Conventional Approach



Alternative Approach

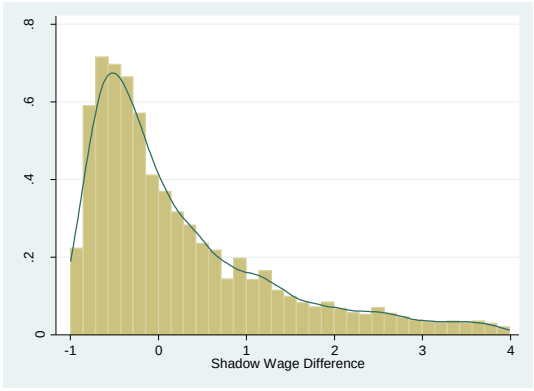


*Total shadow income for rain-fed cultivation season in Malawi Kwacha.

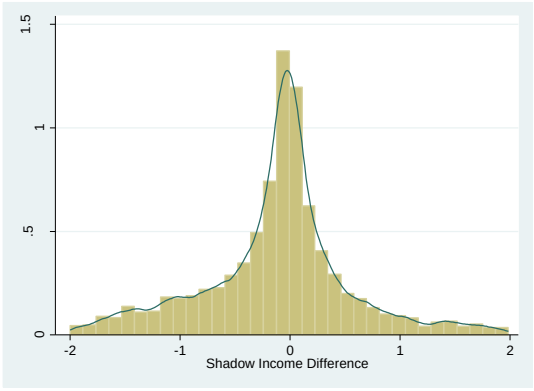
Figure 16 describes the distribution of the percent difference in results between the two methods. The distributions are pretty much similar to those of Le's results that the wage distribution is looking like a chi square distribution while income is normally distributed at the mean of zero. It is difficult to translate these results but as Le mentioned the alternative means would be better off.

Figure 16: Distribution of percent difference between the two methods

Shadow Wage



Shadow Income



*Differences are percent change

■ Separation Model Test

Test results of separability are presented in Tables 7 and 8. Table 7 shows the results of Benjamin test. Variables of the number of male adults, female adults, children and infants are selected as a preference shifter. Although some variables do not meet statistical significance, it is evident that all four tests reject null hypothesis (H_0: separation model) with high significance in favor of non-separation model.

Table 7: Separation Tests (Based on Benjamin Test)

Equation	(1)	(2)
Dependent Variable	Log (Labor) Conventional Test	Log $\left(p_y \frac{Y}{L}\right)$ Modified Test
Number of male adults	0.2749***	-0.0443
	(0.043)	(0.032)
Number of female adults	0.1901***	-0.0231
	(0.049)	(0.029)
Number of children	0.0833***	-0.0243***
	(0.014)	(0.009)
Number of infants	0.0218	0.0347**
	(0.025)	(0.016)
Log (Market Wage)	-0.1183***	
	(0.023)	
Log (Variable Input Price)	-0.0106	
	(0.017)	
Log (Land Area)	0.0696***	
	(0.021)	
Constant	5.5844***	2.2901***
	(0.193)	(0.047)
Observations	1,360	6,413
R-squared	0.133	0.003
P-value:		
F-test for joint significance of alphas ($\alpha = 0$)	0.0000	0.0017

NOTE: Values in parentheses are standard errors
*** significant at 1%, ** significant at 5%, * significant at 10%

Table 8 indicates the results of the Jacoby tests. As already mentioned, both tests support the non-separate model.

Table 8: Separation Tests (Based on Jacoby Test)

Equation	(1)	(2)
Dependent Variable	Log (Shadow Wage) Conventional Test	Log $\left(p_y \frac{\bar{Y}}{L}\right)$ Modified Test
Log (Market Wage)	0.2744***	0.5140***
	(0.027)	(0.013)
Constant	0.9047***	1.5889***
	(0.066)	(0.024)
Observations	1,770	3,685
R-squared	0.055	0.299
P-value:		
F-test ($\beta_1 = 1$)	0.0000	0.0000
F-test ($\beta_0 = 0$)	0.0000	0.0000
F-test ($\beta_0 , \beta_1) = (0,1)$	0.0000	0.0000

NOTE: Values in parentheses are standard errors
*** significant at 1%, ** significant at 5%, * significant at 10%

3.5. Concluding Remarks

In this chapter conventional and alternative approaches were used to come up with shadow wages and income for farming activities. The empirical analysis confirmed the theory of non-reparability in rural farm households in Malawi by having lower shadow wages than market wages and rejecting null hypotheses in Benjamin and Jacoby tests. Furthermore, the results could also identify a new theory that explains why rural households tend to supply more *ganyu* labor than on-farm work. The fact that *ganyu* wage rates are double as much as shadow wages can conclude that farmers can efficiently make decision on labor supply, which supports the Schultz's (1964) hypothesis that farm households in developing countries are "poor but efficient." Unfortunately the farm wage is found to be much lower than government minimum wage, which supports why most of the poor are subsistent farmers. The rate of returns to education in agriculture has also been obtained. The results show that proceeding to higher education yields higher rate of return but taking into account the cost-benefit aspect including current policy of free primary education, graduating primary school may be the best choice for efficient level of productivity. Therefore reducing the knowledge gap is an option to improve productivity and inequality.

For a policy implication, several actions need to be measured by the Malawi government to improve welfare of farm households since most of the poor are rural subsistence farmers. The first strategy is to improve the shadow wages for farming activities. As it is evident, farmers' wage is much lower than those of permanent and casual work, and even minimum wage set by the government of Malawi. The most effective means for this strategy may be to induce use of technologies for improving agricultural outputs. As equation (3-15) indicates, either increasing output, reducing on-farm labor supply or increase output price will raise the shadow wage. Technology will help the first two ways by increasing productivity and substituting labor supply. In

Malawi, farm gate prices for maize tend to be arbitrary lowered because grain traders form a cartel to buy maize from rural farmers at lower prices than actual market values. In order to control this, the government of Malawi bans grain traders from buying any maize but instead lets ADMARC be the only authority to buy maize straight from the garden so as to ration the farm gate prices. In this regard, longstanding input subsidy program and maize market intervention policies conducted by Malawi government can be supported as a poverty alleviation strategy. But looking at the long-term perspective, maize market intervention may not be the right solution since it entails market distortion. The counter proposal for the market correction therefore can be empowerment of farm households while it is widely known that knowledge gaps and information asymmetry would cause farm households to sell their crops at lower prices. In addition, creation of trade centers is another way of reducing information asymmetry and knowledge gap as far as farmers have more than one trader to negotiate.

Another policy may be anything that is spearheaded to grow labor markets. As the model illustrates, market constraint affects the farm households negatively to reduce opportunity to obtain cash income. In Malawi labor force is the most abundant resource for the poor. However most of the labor force is idle because of lack of absorptive capacity in the labor market (market imperfection), which in turn leads to wage gaps between the market wage and the shadow wage. Since the economic growth simply increases demand for labor force, government can take some measures such as providing foreign investors incentives to invest in Malawi, stimulating import substituting policy to shift from import based economy to “local production for local consumption” economy and so forth. Currently this area of policy in Malawi seems to be weaker and needs to be emphasized. As far as the labor market has capacity to absorb needs of labor supply, vulnerability of the poor will be an issue of the past.

The following chapters will have further analysis based on the facts and results discovered in this chapter including shadow wages and the non-separation model.

Chapter 4

4. Decision Making in Labor Market Entrants

4.1. Introduction

Farm households, have dual character of households as both families and enterprises, simultaneously make decisions about production, consumption and market participation. The household responses to a change in an exogenous variable, such as price change in consumption goods, by restructuring consumption patterns attributed to expenditure and

consumption substitution effects, and production. It is therefore necessary to consider both production and consumption activities into farm household analysis. Besides the importance of a complete household analysis, estimating impacts of changes in exogenous variables such as wage rates or market conditions obtains more precise results in the complete household model than independent estimations on consumption and production segments alone. The complete household model is constructed from the demand function on the consumption side, which derived from the utility function and the first order utility maximizing conditions, and the profit function on the production side, derived from the production function and first order profit maximizing conditions.

Agriculture is the most important source of income for Malawi rural households. Employment for rural people takes forms of casual day labor and long-term arrangements governed by contracts as an important source of cash to cope with negative shocks. Generally farm households make production decisions under high levels of uncertainty induced by natural hazards such as weather, pests, diseases and natural disasters, and social uncertainty associated with control over resources such as state interventions and war. Income diversification is therefore key to reducing the vulnerability of the poor. According to IHS-2, 81 percent of the active population aged over 15 years old are subsistence farmers and importantly the rural farm households rely 54 percent of their income in average on agriculture, 9 percent and 37 percent from permanent and casual work respectively. In this regard, understanding farm household behavior is inevitable for Malawi policy makers.

The price changes in any commodities affect not only agricultural production for the household but consumption decisions as well and in addition the price changes have external impacts on non-farm households. For instance, increase in food price will raise demand of hired labor because farm households are focusing on farming activities by reducing market labor supply to increase its agricultural production and possibly increase its profit. On the other hand it reduces real income for nonfood producers due

to higher input costs. Increased demand of hired labor will raise its wages and nominal income of the typical households, but may or may not compensate for increased food prices, which would end up with decreased real income. The off-farm wage rate change is a quite significant event for farmers as some studies, like Pfeiffer et al 2009, concluded using Mexico data that as rural households become increasingly involved in non-farm activities their on-farm production decreases but use of purchased input increases. Unfortunately there was no further discussion or evidence on the impact of off-farm wage rate change on total household income but borrowing evidence from the previous chapter one can deduce that active involvement of casual work may improve income status even though their production decreases (because it gets closer to the optimal point of agricultural production and labor supply), since off-farm wages are much higher than on-farm shadow wages.

The objective of this chapter is to estimate price and wage elasticities with respect to labor supply decisions through Linear Expenditure System, so as to understand how Malawi rural farm households react in terms of labor supply to changes in exogenous variables.

4.2. Theoretical Framework

4.2.1. Household Model Specification

The assumptions used in the previous chapter are applied to this model as well. The explanation is therefore skipped here. For simplification in empirical analysis, wages for women and men are assumed to be equal and housework and entrepreneurship activities are excluded from the model.

Consider the agricultural production function is:

$$Y = F(L, V, K, A) \quad (4\text{-}1)$$

where

Y	:	Quantity of own farm production,
L	:	Allocation of hours (both family and hired labor input) for Y production,
V	:	Variable inputs e.g. Fertilizer,
K	:	Fixed inputs e.g. Land,
A	:	Production technology index

The household utility is determined based on its leisure time and consumption in the form of:

$$U = U(T_1, T_2, T_3, T_4, C_y, C_g) \quad (4\text{-}2)$$

where

T_1	:	Leisure hours for on-farm workers,
T_2	:	Leisure hours for permanent wage workers,
T_3	:	Leisure hours for part-time wage workers,
T_4	:	Leisure hours for dependants,
C_y	:	Consumption of own farm production,
C_g	:	Consumption of market-purchased goods,

Having consideration of labor supply and leisure time, income constraint can be defined as:

$$\begin{aligned} &\left(p_y Y - w_1 L - p_V V\right) + \sum_{j=1}^{3} w_j \left(D_j - T_j\right) + Z \\ &= \left(p_y Y - w_1 L - p_V V\right) + \sum_{j=1}^{3} w_j S_j + Z \\ &= p_y C_y + p_g C_g \end{aligned} \tag{4-3}$$

where

P_y	:	Price of Y,
P_g	:	Price of C_g
P_v	:	Price of V
w_j (j=1,2,3)	:	Wage of on-farm, off-farm permanent, and off-farm part-time workers
D_j (j=1,2,3)	:	Total available time of on-farm, off-farm permanent, and off-farm part-time workers
S_j (j=1,2,3)	:	Total working time of on-farm, off-farm permanent, and off-farm part-time workers $L = S_1 + \Delta$ $\Delta > 0$: Hire work force from market $\Delta < 0$: Supply work force to market
Z	:	Non-wage, non-crop net other income (Z=capital gain – saving),

Thus, the budget constraint can be written as:

$$\begin{aligned} I &= \left(p_y Y - w_1 L - p_V V\right) + \sum_{j=1}^{3} w_j D_j + Z \\ &= \sum_{j=1}^{3} w_j T_j + p_y C_y + p_g C_g \end{aligned} \tag{4-4}$$

Having the budget constraint function and utility function, a utility optimization problem can be defined by:

$$\mathcal{L} = U(T_1, T_2, T_3, T_4, C_y, C_g) + \lambda\left[I - \left\{(p_y F(L, V, K, A) - w_1 L - p_V V) + \sum_{j=1}^{3} w_j D_j + Z\right\}\right] \quad (4\text{-}5)$$

where

λ : Lagrange Multiplier

The conditional optimization problem yields the following first-order equations:

$$\frac{\partial \mathcal{L}}{\partial \theta_i} = U_{\theta i} - \lambda p_{\mu i} = 0 \ (i = 1, \cdots, 6)$$

where (4-6)

θ_i = T_1, T_2, T_3, T_4, C_y, C_g
$p_{\mu i}$ = w_1, w_2, w_3, 0, p_y, p_g

$$\frac{\partial \mathcal{L}}{\partial L} = p_y F_L - w_1 = 0$$

$$\frac{\partial \mathcal{L}}{\partial V} = p_y F_V - p_v = 0 \quad (4\text{-}7)$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = I - \left\{\left[p_y F(L, V, K, A) - w_1 L - p_V V\right] + \sum_{j=1}^{3} w_j D_j + Z\right\} = 0 \quad (4\text{-}8)$$

Given P_y, W_1, P_v, K, A, equation (4-7) indicates the profit maximizing conditions or optimal points for production activities independent from equation (4-6) and (4-8). The equation (4-6) and (4-8) present the utility maximizing conditions for consumption activities. Since part of the equation (4-8) is the profit function from the farming activities, the first-order equations can be translated as the farm household optimizes its utility subject to the budget constraint that includes maximum agricultural profit as well.

■ **Internalizing farm household income**

Following the argument on recursive decision making process between production and consumption, internalizing income – more specifically a profit function – is

required for farm household analysis; because the household decision process follows that changes in exogenous variable underlying the profit function will influence total household expenditure, which will in turn initiate a further change in household consumption patterns (Barnum and Squire 1979).

Let the household leisure demand function be:

$$T_i = T_i(w_1, w_2, w_3, p_y, p_g, I) \quad (i = 1, 2, 3) \tag{4-9}$$

and the time constraint be:

$$T_i = D_i - S_i \quad (i = 1, 2, 3) \tag{4-10}$$

thus the labor supply function is:

$$S_i = S_i(w_1, w_2, w_3, p_y, p_g, I) \quad (i = 1, 2, 3) \tag{4-11}$$

Borrowing equation (4-4), the household income can be express as:

$$\begin{aligned} I &= (p_y Y - w_1 L - p_V V) + \sum_{j=1}^{3} w_j D_j + Z \\ &= \Pi(p_y, w_1, p_V, K, A) + \sum_{j=1}^{3} w_j D_j + Z \end{aligned} \tag{4-12}$$

where $\Pi(p_y, w_1, p_V, K, A)$ is a profit function corresponding to the production function, equation (4-1).

Deriving labor supply elasticity requires total differentiation of equation (4-11) and (4-12):

$$dS_i = \sum_{j=1}^{3} \frac{\partial S_i}{\partial w_j} dw_j + \frac{\partial S_i}{\partial p_y} dp_y + \frac{\partial S_i}{\partial p_g} dp_g + \frac{\partial S_i}{\partial I} dI \quad (i = 1,2,3; j = 1,2,3) \tag{4-13}$$

$$dI = \frac{\partial \Pi}{\partial p_y} dp_y + \frac{\partial \Pi}{\partial w_1} dw_1 + \frac{\partial \Pi}{\partial p_v} dp_v + \frac{\partial \Pi}{\partial A} dA + \sum_{j=1}^{3} D_j dw_j \quad (j = 1,2,3) \tag{4-14}$$

*K, D_j, Z are thought to be consistent against any exogenous variables.

Applying equation (4-13) and (4-14) to Slutsky's decomposition equation, total response elasticities can be broken down into component partial elasticities:

$$\eta_{s_i w_j} = \epsilon_{s_i w_j} + e_{s_i w_j} \quad (i = 1,2,3; j = 1,2,3) \tag{4-15}$$

Where

$$\eta_{s_i w_j} = \frac{dS_i}{dw_j}\frac{w_j}{S_i} \qquad \epsilon_{s_i w_j} = \frac{\partial S_i}{\partial w_j}\frac{w_j}{S_i}$$

$$e_{s_i w_j} = \epsilon_{s_i I}\left[\frac{w_j D_j}{I} + \varepsilon_{\pi w_j}\left(\frac{\Pi}{I}\right)\right]$$

$$\epsilon_{s_i I} = \frac{\partial S_i}{\partial I}\frac{I}{S_i} \qquad \varepsilon_{\pi w_j} = \frac{\partial \Pi}{\partial w_j}\frac{w_j}{\Pi}$$

$\epsilon_{s_i w_j}$ represents substitution effect or elasticity obtained under the assumption of farm profit constant, while $e_{s_i w_j}$ indicates income effect or elasticity obtained when the farm profit is treated as endogenous (allowed to change)[10].

Derivation for equation (4-15) :

Ex. Solving for W_1

The Slutsky decomposition which breaks total elasticity into both substitution and income effects can be written as:

$$\frac{dS_i}{dw_1} = \frac{dS_i}{dw_1}\Big|_{\overline{w}_2,\overline{w}_3,\overline{p}_y,\overline{p}_g,\overline{I}} + \frac{dS_i}{dI}\Big|_{\overline{w}_2,\overline{w}_3,\overline{p}_y,\overline{p}_v,\overline{A}}$$

To compute influence of farm wage change(dw_1) assuming other prices/wages are constant, substituting dl in equation (4-14) into (4-13) yields:

$$dS_i|_{\overline{w}_2,\overline{w}_3,\overline{p}_y,\overline{p}_g,\overline{p}_v,\overline{A}} = \frac{\partial S_i}{\partial w_1}dw_1 + \frac{\partial S_i}{\partial I}\left(\frac{\partial \Pi}{\partial w_1}dw_1 + D_1 dw_1\right)$$

[10] The complete equation is $\frac{dS_i}{dw_j}\frac{w_j}{S_i} = \frac{\partial S_i}{\partial w_j}\frac{w_j}{S_i} + \frac{\partial S_i}{\partial I}\frac{I}{S_i}\left[\frac{w_j D_j}{I} + \frac{\partial \Pi}{\partial w_j}\frac{w_j}{\Pi}\left(\frac{\Pi}{I}\right)\right]$

divide both sides by dw_1 :

$$\frac{dS_i}{dw_1} = \frac{\partial S_i}{\partial w_1} + \frac{\partial S_i}{\partial I}\left(\frac{\partial \Pi}{\partial w_1} + D_1\right)$$

Multiply both sides by $\frac{w_1}{S_i}$:

$$\frac{dS_i}{dw_1}\frac{w_1}{S_i} = \frac{\partial S_i}{\partial w_1}\frac{w_1}{S_i} + \frac{\partial S_i}{\partial I}\frac{w_1}{S_i}\left(\frac{\partial \Pi}{\partial w_1} + D_1\right)$$

Multiply the first term in the right side by $\frac{I}{I}$ and rearrange:

$$\frac{dS_i}{dw_1}\frac{w_1}{S_i} = \frac{\partial S_i}{\partial w_1}\frac{w_1}{S_i} + \frac{\partial S_i}{\partial I}\frac{I}{S_i}\left(\frac{\partial \Pi}{\partial w_1}\frac{w_1}{I} + \frac{w_1 D_1}{I}\right)$$

Multiply the second term in the bracket by $\frac{\Pi}{\Pi}$ and rearrange:

$$\frac{dS_i}{dw_1}\frac{w_1}{S_i} = \frac{\partial S_i}{\partial w_1}\frac{w_1}{S_i} + \frac{\partial S_i}{\partial I}\frac{I}{S_i}\left(\frac{\partial \Pi}{\partial w_1}\frac{w_1}{\Pi}\frac{\Pi}{I} + \frac{w_1 D_1}{I}\right)$$

4.2.2. Estimation Strategy

This paper assumes additive preference on household utility function as:

$$U = \sum_{i=1}^{3}(\beta_i \ln(T_i - \gamma_i)) + \beta_4 \ln(C_y - \gamma_4) + \beta_5 \ln(C_g - \gamma_5) + \beta_6 \ln(T_4 - \gamma_6) \qquad (4\text{-}16)$$

This form is also known as a Stone-Geary utility function, which emphasizes that a certain minimal level of goods has to be consumed, irrespective of its price or the consumer's income. γ can therefore be translated as minimum required, subsistence or committed quantities. More specifically $\gamma 1 - \gamma 3$ are base consumption of leisure time. This Stone-Geary utility function can give rise to the Linear Expenditure System.

As already shown in equation (4-4), the budget constraint is:

$$I = \sum_{j=1}^{3} w_j T_j + p_y C_y + p_g C_g \qquad (4\text{-}17)$$

The objective function is therefore given as:

$$\mathcal{L} = \sum_{i=1}^{3}(\beta_i \ln(T_i - \gamma_i)) + \beta_4 \ln(C_y - \gamma_4) + \beta_5 \ln(C_g - \gamma_5) + \beta_6 \ln(T_4 - \gamma_6) + \lambda\left[I - \left\{\sum_{j=1}^{3} w_j T_j + p_y C_y + p_g C_g\right\}\right] \quad (4\text{-}18)$$

Solving the above equation, first-order equations can obtain:

$$\frac{\partial \mathcal{L}}{\partial T_i} = \beta_i \frac{1}{T_i - \gamma_i} - \lambda w_i = 0 \qquad T_i = \frac{\beta_i}{\lambda w_i} + \gamma_i \quad (4\text{-}19a)$$

$$\frac{\partial \mathcal{L}}{\partial C_y} = \beta_4 \frac{1}{C_y - \gamma_4} - \lambda p_y = 0 \qquad C_y = \frac{\beta_4}{\lambda p_y} + \gamma_4 \quad (4\text{-}19b)$$

$$\frac{\partial \mathcal{L}}{\partial C_g} = \beta_5 \frac{1}{C_g - \gamma_5} - \lambda p_g = 0 \qquad C_g = \frac{\beta_5}{\lambda p_g} + \gamma_5 \quad (4\text{-}19c)$$

$$\frac{\partial \mathcal{L}}{\partial T_4} = \beta_6 \frac{1}{T_4 - \gamma_6} = 0 \qquad \beta_6 = 0 \quad (4\text{-}19d)$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = I - \sum_{j=1}^{3} w_j T_j - p_y C_y - p_g C_g = 0 \quad (4\text{-}19e)$$

The elasticity in equation (4-15) can be calculated using Linear Expenditure System (LES) Model. To derive LES, first substituting equation (4-19a), (4-19b) and (4-19c) into (4-19e) and rearranging it using the condition of ($\sum_{i=1}^{5} \beta_i = 1$)[11] yields:

$$\lambda = \frac{1}{I - \sum_{j=1}^{3} w_j \gamma_j - p_y \gamma_4 - p_g \gamma_5} = \frac{1}{I - B} \quad (4\text{-}20)$$

where

$$B = \sum_{j=1}^{3} w_j \gamma_j - p_y \gamma_4 - p_g \gamma_5$$

[11] $\sum_{i=1}^{N} p_i x_i = I$ holds when tet $P_i x_i$ be an expenditure of *i*th item, but in LES model, $\sum_{i=1}^{N} \frac{\partial p_i x_i}{\partial I} = \sum_{i=1}^{N} \beta_i = 1$ is still the same. $\sum_{i=1}^{5} \beta_i = 1$ since β6 = 0 in equation (4-19d)

Derivation for equation (4-20) :

$$I - \sum_{j=1}^{3} w_j \left(\frac{\beta_i}{\lambda w_i} + \gamma_i\right) - p_y \left(\frac{\beta_4}{\lambda p_y} + \gamma_4\right) - p_g \left(\frac{\beta_5}{\lambda p_g} + \gamma_5\right) = 0$$

$$I - \sum_{j=1}^{3} \frac{\beta_i}{\lambda} - \sum_{j=1}^{3} w_j \gamma_i - \frac{\beta_4}{\lambda} - p_y \gamma_4 - \frac{\beta_5}{\lambda} - p_g \gamma_5 = 0$$

$$\sum_{j=1}^{5} \frac{\beta_i}{\lambda} = I - \sum_{j=1}^{3} w_j \gamma_i - p_y \gamma_4 - p_g \gamma_5$$

Finally apply the condition of $(\sum_{i=1}^{5} \beta_i = 1)$

The next step is to substitute equation (4-20) into (4-19a), (4-19b) and (4-19c), following LES equations can be obtained:

$$\begin{aligned} w_i T_i &= w_i \gamma_i + \beta_i (I - B) \qquad (i = 1, 2, 3) \\ p_y C_y &= p_y \gamma_4 + \beta_4 (I - B) \\ p_g C_g &= p_g \gamma_5 + \beta_5 (I - B) \end{aligned} \tag{4-21}$$

What can be translated from the equation (4-21) is that the farm household first consumes the base amount (γ) and the remaining budget (I-B) be allocated among items at the rate of (β)s. Even though the set of LES equations in (4-21) can be used for empirical analysis, there exists a problem of data measurement because explicitly measuring leisure time consumed is obtained only by arbitrary assumption about the value of total available time D_i (Abbott and Ashenfetter 1976). To tackle this issue, the idea of Abbott and Ashenfetter, which is a conversion from leisure demand function to labor supply function, is applied. The actual procedure is that by specifying $D_i - \gamma_i \equiv \bar{\gamma}_i$ ($\bar{\gamma}_i$ can be translated as maximum feasible working hours), its condition being set as $\gamma_i = D_i - \bar{\gamma}_i$ (i = 1, 2, 3) is substituted into equation (4-21), then these equations can be rearranged and transformed into a matrix form as:

$$\begin{bmatrix} w_1 S_1 \\ w_2 S_2 \\ w_3 S_3 \\ p_y C_y \\ p_g C_g \end{bmatrix} = \left(I - \sum_{j=1}^{3} w_j D_j \right) \begin{bmatrix} -\beta_1 \\ -\beta_2 \\ -\beta_3 \\ \beta_4 \\ \beta_5 \end{bmatrix} + \begin{bmatrix} 1-\beta_1 & -\beta_1 & -\beta_1 & \beta_1 & \beta_1 \\ -\beta_2 & 1-\beta_2 & -\beta_2 & \beta_2 & \beta_2 \\ -\beta_3 & -\beta_3 & 1-\beta_3 & \beta_3 & \beta_3 \\ \beta_4 & \beta_4 & \beta_4 & 1-\beta_4 & \beta_4 \\ \beta_5 & \beta_5 & \beta_5 & \beta_5 & 1-\beta_5 \end{bmatrix} \begin{bmatrix} w_1 \bar{\gamma}_1 \\ w_2 \bar{\gamma}_2 \\ w_3 \bar{\gamma}_3 \\ p_y \gamma_4 \\ p_g \gamma_5 \end{bmatrix} \quad (4\text{-}22)$$

or into simple expression as:

$$Y = X\beta + PZ\gamma$$
$$Z=(w_1, w_2, w_3, P_y, P_g) \quad (4\text{-}23)$$

Derivation for equation (4-22) :

Ex. Solving for W_1S_1

$$w_1 T_1 = w_1(D_1 - \bar{\gamma}_1) + \beta_1 \left(I - \sum_{j=1}^{3} w_j (D_j - \bar{\gamma}_j) - p_y \gamma_4 - p_g \gamma_5 \right)$$

$$w_1 T_1 = w_1 D_1 - w_1 \bar{\gamma}_1 + \beta_1 I - \beta_1 \sum_{j=1}^{3} w_j D_j + \beta_1 \sum_{j=1}^{3} w_j \bar{\gamma}_1 - \beta_1 p_y \gamma_4 - \beta_1 p_g \gamma_5$$

$$w_1(T_1 - D_1) = \beta_1 \left(I - \sum_{j=1}^{3} w_j D_j \right) - w_1 \bar{\gamma}_1 + \beta_1 w_1 \bar{\gamma}_1 + \beta_1 w_2 \bar{\gamma}_2 + \beta_1 w_3 \bar{\gamma}_3 - \beta_1 p_y \gamma_4 - \beta_1 p_g \gamma_5$$

applying equation (4-10) yields

$$w_1(S_1) = -\beta_1 \left(I - \sum_{j=1}^{3} w_j (D_j) \right) + (1-\beta_1) w_1 \bar{\gamma}_1 - \beta_1 w_2 \bar{\gamma}_2 - \beta_1 w_3 \bar{\gamma}_3 + \beta_1 p_y \gamma_4 + \beta_1 p_g \gamma_5$$

Estimation of betas (β) and gammas (γ) in the equations (4-22) allows computing elasticity through the following strategy. Actual estimation of the equations (4-22) uses Iterative Seemingly Unrelated Regression (ISUR) method of Zellner (another name is so called Iterative Zellner's Efficient (IZEF) method). This method is equivalent to Full Information Maximum Likelihood (FIML) estimation and follows the procedure proposed by Stone (1954) as follows:

1. Assuming $\gamma P=\delta$ and $Y = X\beta + Z\delta$ for the equation (4-23), first estimate betas (β);
2. Construct a P matrix using estimated betas (β);
3. Re-estimate betas (β) and gammas (γ) using the P matrix and the equation (4-23);
4. Make a new P matrix using re-estimated betas (β);
5. Continue the procedure iteratively until convergence is obtained.

Based on estimation results and the arithmetic means of the sample, a complete array of elasticities in equation (4-15) is computed. Even though price elasticity can be calculated from the LES estimation results, deriving income elasticity requires the estimation of a profit function.

By deriving profit function, the agricultural production function for equation (4-1) can be specified in the Cobb-Douglas form as:

$$Y = AL^{\alpha_1}V^{\alpha_2}K^{\alpha_3}\exp(\alpha_4 A) \qquad (4\text{-}24)$$

The Cobb-Douglas profit function corresponding to equation (4-24) is

$$\Pi^* = \alpha_0' w_1^{*\alpha_1'} p_v^{*\alpha_2'} K^{\alpha_3'} \exp(\alpha_4' A) \tag{4-25}$$

where

$$\Pi^* = \frac{\Pi}{p_y}, \qquad \Pi = p_y Y - w_1 L - p_V V$$

$$w_1^* = \frac{w_1}{p_y}, \qquad p_v^* = \frac{p_v}{p_y}$$

thus the regression equation is

$$\ln(\Pi^*) = \ln(\alpha_0') + \alpha_1' \ln(w_1^*) + \alpha_2' \ln(p_v^*) + \alpha_3' \ln(K) + \alpha_4' A + u \tag{4-26}$$

The equation (4-25) corresponds to the first term of equation (4-12), and $\varepsilon_{\pi w_j}$ in the equation (4-15) corresponds to α_1' and α_2'. Production Technology Index (A) is produced by taking geometric mean of land productivity (production capacity per unit area) and labor productivity index (production capacity per unit labor force).

Suppose farm output price elasticity of profit is defined as $\varepsilon_{\pi p_y}$, the nature of the profit function that is homogeneous to degree of one yields:

$$\varepsilon_{\pi p_y} = 1 - \sum_{i=1}^{2} \alpha_i' \tag{4-27}$$

and $\varepsilon_{\pi t}$ can be computed by

$$\varepsilon_{\pi t} = \alpha_4' \bar{A} \tag{4-28}$$

4.3. Empirical Analysis

4.3.1 Estimation Results

In this analysis, cross-sectional household data for Malawi, the Second Integrated Household Survey (IHS-2), has been used and detailed description on IHS-2 refer to Chapter 3. Shadow wages estimated in Chapter 3 are employed in order to get farm wage information. Calculation of price indices for own farm production and market purchased goods used a method of Adulavidhaya et al (1984), where equation is expressed as $P = \prod_{i=1}^{n} p_i^{\%Share_i}$. Table 9 describes the variable used in the estimation analysis.

Table 9: Description of Variables

Variable	Units	Average
Labor earnings		
Farming (W_1S_1)	Total earnings of on-farm work	18,004.874
Permanent jobs (W_2S_2)	Total earnings of permanent jobs	33,888.849
Part-time /Casual jobs (W_3S_3)	Total earnings of part-time jobs	52,609.210
Wage Rate		
Farming (S_1)	Shadow Wage / hour	10.258
Permanent jobs (S_2)	On-farm (market) wage / hour	33.618
Part-time / casual jobs (S_3)	Part-time job (market) wage / hour	22.993
Consumption of own farm production (P_yC_y)	Total amount of agricultural output in Malawi Kwhacha consumed during rainy season	10,699.431
Price index of C_y	Price index of agricultural output consumed computed by $P = \prod_{i=1}^{n} p_i^{\%Share_i}$	649.911
Consumption of market purchased goods (P_gC_g)	Total amount of market good in Malawi Kwhacha purchased during rainy season	10,149.127
Price index of C_g	Price index of agricultural output consumed computed by $P = \prod_{i=1}^{n} p_i^{\%Share_i}$	561.873
Total Income	Total Income calculated from equation (4-4)	13,012.182
Agricultural Profit	The amount of profit accruing to a household	11,850.439

The estimated parameters of the Linear Expenditure System are presented in Table

10. All coefficients were found to be significant at one or five percent with correct signs.

Table 10: Estimated Parameters of Linear Expenditure System

Coefficient	Estimate	T-statistics
β_1	-0.13599***	-8.81
β_2	-0.13443***	-21.64
β_3	-0.53313***	-27.59
β_4	0.05907***	5.89
β_5	0.13735***	11.05
$\bar{\gamma}_1$	1,143.65300***	50.06
$\bar{\gamma}_2$	1,124.36500***	47.67
$\bar{\gamma}_3$	399.61940***	24.58
γ_4	22.26327**	2.29
γ_5	159.54190***	25.41

NOTE: N=1,394
*** significant at 1%, ** significant at 5%, * significant at 10%

The regression results of the profit function are reported in Table 11. All coefficients were found to be significant at one percent with correct signs.

Table 11: Result of Estimated Profit Function

α_0'	α_1'	α_2'	α_3'	α_4'	R^2
-6.435***	-0.3619 ***	-0.1842 ***	0.4345***	0.0906***	0.05
(1.2043)	(0.0716)	(0.0626)	(0.1248)	(0.0191)	

NOTE: Values in parentheses are standard errors
Regression Equation: $\ln(\Pi^*) = \ln(\alpha_0') + \alpha_1'\ln(w_1^*) + \alpha_2'\ln(p_v^*) + \alpha_3'\ln(K) + \alpha_4'A + u$
*** significant at 1%, ** significant at 5%, * significant at 10%

4.3.2 Labor Supply Elasticity

Estimated parameters and arithmetic means of the sample are used to derive an array of labor supply elasticities. The elasticity is decomposed into a substitution effect and an income effect by applying the Slutsky equation. Furthermore, standard errors of the elasticities are obtained through a method for computing an asymptotic variance for a function of random variables.

Table 12 indicates substitution effects of changes in a wage rate, commodity price and income subject to labor supply. All elasticities presented in Table 12 met expected signs. For instance, own-price elasticities have positive values while income elasticities have negative values. Overall implication of substitution effects from the table is that the household susceptibly responds to changes in permanent job wage, market purchased good prices and income level since changes in other conditions are less likely to motivate households to change their labor supply patterns. Looking at the individual effects, wage rate changes in on-farm and casual work provide less opportunity to change their behavior. This may be because the households already recognize the presence of the market constraint based on their past experience and thus the market fails to provide adequate working opportunities. Interestingly when there is a wage increase in casual work, the household find time from on-farm work hours for casual work rather than shrinking leisure time whereas labor supply to farming in the case of on-farm wage change is adjusted through casual work and leisure time. As the wage of the permanent job increases, the households are much more willing to increase working hours for the permanent job by giving up some hours to work for both on-farm and casual work, then some of the deduced hours may be allocated to leisure time. Own-production price change slightly motivates the households to work for part time but relatively greater effects are observed for on-farm and permanent work. Market commodity price increase has serious and immediate effects on the household, thus they

are more likely to compensate the loss from the price hike by either increasing casual work or producing more agricultural products for higher income. Finally increase in their income is more likely to discourage the households to work on the farm and part-time at the market but less likely for the permanent job, which may be because the hours to work is nearly fixed for the permanent employment based on the long term contract. This reason can also explain why the households are discouraged to change hours to work for permanent jobs (inelastic permanent labor supply elasticities).

Table 12: Labor Supply Elasticity (Substitution Effect)

Variable	$e_{s_i w_j}$ $(i = 1,2,3: j = 1, \cdots, 6)$		
	S_1	S_2	S_3
W_1	0.534618 [9.38hr] (0.010)	-0.008891 [-0.09hr] (0.000)	-0.205546 [-4.70hr] (0.004)
W_2	-0.161869 [-2.84hr] (0.003)	0.908361 [9.16hr] (0.019)	-0.662210 [-15.15hr] (0.013)
W_3	-0.039350 [-0.69hr] (0.001)	-0.006963 [-0.07hr] (0.000)	0.035307 [0.81hr] (0.001)
P_y	0.061962 [1.09hr] (0.027)	0.010965 [0.11hr] (0.004)	0.253490 [5.80hr] (0.110)
P_g	0.701670 [12.31hr] (0.027)	0.124167 [1.25hr] (0.004)	2.870548 [65.68hr] (0.112)
I	-0.535411 [-9.40hr] (0.060)	-0.263205 [-2.65hr] (0.012)	-0.899472 [-20.58hr] (0.032)

*Values in brackets[] represent labor supply responses in hour(s) subject to one percentage change in price/wage of each item.
*Values in parentheses() below elasticities are asymptotic standard errors

Table 13 presents income effects of exogenous change in variables. All elasticities show correct signs. The elasticities of wage rate change in farming and variable input price change are positive because an increase in its price/wage has a negative impact on their income as shown in equation (4-12). Though overall responses are quite inelastic, adjustment of permanent work is found to be relatively inelastic.

Table 13: Labor Supply Elasticity (Income Effect)

Variable	$e_{s_i w_j}$ (i = 1,2,3: j = 1, ⋯ ,6)		
	S_1	S_2	S_3
W_1	0.002842 [0.05hr] (0.002)	0.001397 [0.01hr] (0.001)	0.004774 [0.11hr] (0.004)
W_2	-0.040207 [-0.71hr] (0.004)	-0.019765 [-0.20hr] (0.000)	-0.067546 [-1.55hr] (0.002)
W_3	-0.023379 [-0.41hr] (0.002)	-0.011493 [-0.12hr] (0.005)	-0.039275 [-0.90hr] (0.001)
P_y	-0.057377 [-1.01hr] (0.007)	-0.028206 [-0.28hr] (0.001)	-0.096391 [-2.21hr] (0.006)
P_v	0.006837 [0.12hr] (0.002)	0.003361 [0.03hr] (0.001)	0.011486 [0.26hr] (0.003)
A	-0.002247 [-0.04hr] (0.000)	-0.002221 [-0.02hr] (0.000)	-0.008810 [-0.20hr] (0.001)

*Values in brackets[] represent labor supply responses in hour(s) subject to one percentage change in price/wage of each item.
*Values in parentheses() below elasticities are asymptotic standard errors

Table 14 indicates the overall effects of exogenous change in variables. Of those, own wage elasticity with respect to casual work wage and own farm production price elasticity with respect to permanent work have their signs changed due to greater income effects than substitution effects. It can be concluded same as for the substitution effect that price or wage rate change in permanent work and market commodity has greater influence on household labor supply decisions. It is further noted that household's response for permanent work subject to any price and wage changes is inelastic because of the long-term contract between employees and employers. Price change in own-production would lead to increased supply for farming and casual work but decease hours to work for the permanent job. Price hikes in variable inputs will be compensated by increasing labor hours for all types of work, and the technology index is found to be substitutable for the labor input even if the extent to which households

change their behavior is unsubstantial.

Table 14: Labor Supply Elasticity (Total Effect)

Variable	$\eta_{s_i w_j}$ (i = 1,2,3: j = 1, ⋯ ,7)		
	S_1	S_2	S_3
W_1	0.537459 [9.43hr] (0.011)	-0.007494 [-0.08hr] (0.001)	-0.200772 [-4.59hr] (0.006)
W_2	-0.202076 [-3.55hr] (0.005)	0.888596 [8.96hr] (0.019)	-0.729757 [-16.70hr] (0.014)
W_3	-0.062729 [-1.10hr] (0.003)	-0.018456 [-0.19hr] (0.000)	-0.003968 [-0.09hr] (0.002)
P_y	0.004586 [0.08hr] (0.027)	-0.017241 [-0.17hr] (0.004)	0.157099 [3.59hr] (0.111)
P_g	0.701670 [12.31hr] (0.027)	0.124167 [1.25hr] (0.004)	2.870548 [65.68hr] (0.112)
P_v	0.006837 [0.12hr] (0.002)	0.003361 [0.03hr] (0.001)	0.011486 [0.26hr] (0.003)
A	-0.002247 [-0.04hr] (0.000)	-0.002221 [-0.02hr] (0.000)	-0.008810 [-0.20hr] (0.001)

*Values in brackets[] represent labor supply responses in hour(s) subject to one percentage change in price/wage of each item.
*Values in parentheses() below elasticities are asymptotic standard errors

4.4. Concluding Remarks

The sample data indicates that the rural farm household income composes 59 percent from farming activities ($S_1W_1 + \Pi$), 8 percent and 33 percent from permanent and casual work respectively. Therefore this tells us that permanent job opportunities are limited due to the market constraints and casual job market plays an important role for the farm households as a secondary source of income for livelihood. The estimation results also support this theory by having lower substitution effects from casual work to permanent work.

There are two schools of thought that have arisen which need to be verified – one is whether the households identify markets separately for permanent jobs and casual work, and the other is whether the proportion of income share reflects its importance as a source or role of household income. Regarding the first question about labor market distinction between permanent and part-time jobs, own-price elasticities in Table 12 and 14 could be the answer since elasticity of the permanent job is relatively higher than that of casual work. Furthermore, discrepancy of own-price elasticities in total substitution effects between permanent and casual labor wages becomes wider through relatively higher income elasticity of the permanent work wage. Having this evidence, shifting labor supply pattern from casual work to permanent is less likely to occur but the reverse flow is more likely to occur. This theory can be supported by the fact that except own-price elasticities, all elasticities for casual work are relatively higher than those for permanent work. This discrepancy in elasticities could be explained by differences in entry costs arrived from different level of market constraints such as skills, qualifications, and other requirements. Higher entry costs for permanent employment makes its response slower or inelastic. It is therefore concluded that the farm households regard both markets identically.

The other question is about the relationship between income share and its

importance. In this case, the importance implies when casual labor elasticity of non-wage variables in a homothetic production function is relatively greater. Suppose this relationship is held, then casual work with higher income share takes an important role in sustainable household livelihood. Looking at the effects of technology change, which is one of variables that construct the homothetic production function, casual work receives more elastic responses than permanent work does. This can be translated that when the production function shifts downwards due to external shocks, the households depend on casual work to compensate for the loss. In this theory, an important role of casual work for the rural farm households is held consistent with the findings obtained in Chapter 3.

Goldberg (2010) has recently estimated the labor supply elasticity with a sample of adults who participate in the day labor market in rural Malawi. Within the sample of 530 individuals in 298 households, most of them supply *ganyu* (casual) work, in other words, the elasticities Goldberg calculated were only for *ganyu* work without any distinction between substitution and income effects and between types of households. Furthermore, her estimated elasticities for labor supply between 0.15 and 0.17 are found to be antagonistic to my estimations with negative own-wage elasticity, but at least both agreed as regards inelastic response by the household compared to studies on other countries. One of the reasons for inelastic *ganyu* labor response, as Goldberg mentioned, is that there is social pressure to work at the lower wage including a directive by a local leader to work. And thus social or cultural characteristics may also affect these elasticities.

With the observations above, the following suggestions can be made for the Malawi government to consider. First of all is any initiatives that reduce entry costs for labor markets. The higher entry costs come from some entry barriers, such as skills, qualifications and other requirements. Unfortunately, Malawi fails to take advantage of labor abundant since many are either less educated or uneducated work forces. The

issue of the inadequate educated labor supply is attributed to poor quality of school education due to lack of qualified teachers, learning materials, relevant infrastructures, teaching skills and motivation of the teachers. Since education for all was committed through free primary education initiative introduced in 1994, it is now time for Malawi to transform the education strategy from quantity education to quality education. Students get bored when they face difficulties in understanding subjects, and at the end they end up dropping out of school. Declining interest in schooling is, among other things, one of the major reasons for dropping out and is mostly caused by poor guidance or teacher quality in developing countries. The recent teacher quality literature indicates that teacher quality has a large effect on students performance and the graduation outcomes[12]. Malawi thereby needs to intervene aggressively in teachers educations and to introduce incentive measures for teachers such as salaries, secondary benefits, and intangible rewards. The increased number of educated work force through educational reforms will reduce entry costs to the labor market and reduce discrepancy between farm shadow wages and market wages as discussed in Chapter 3. These educated workers definitely help the industrialization of Malawi.

The second proposal is any attempts to improve agricultural productivity and production. Historically Malawi's land and labor productivities have not grown as much as population growth to meet the growing food demand. Inefficient agricultural production requires many labor forces that cause labor market illiquid. In this regard, any measures to improve agricultural productivity, such as construction of irrigation systems, subsidizing fertilizers, investing in R&D for seed selective breeding, and providing quality education, are necessary and need to be taken into consideration. Improved agricultural productivity can bring a lot of benefits to Malawi besides their per capita income and shadow wages to be raised. Increased food supply in the domestic market can reduce food prices that indirectly improve non-farm poor household finance.

[12] See, for instance, Aaronson et al (2007), Koedel (2007), Loeb and Page (2000).

Improved productivity and food prices decrease labor demand for agricultural activities that generate more available labor forces, thereby those surplus labor forces may move to urban areas to seek their jobs. Since these migrants are educated workers through quality education initiative proposed above, urban areas can pool many quality work forces at lower wages in the labor market that are able to attract foreign investors for FDI in Malawi.

In addition to the two suggested strategies (reduction of entry costs and improvement of agricultural productivity), which are minimum requirement for the further development, taking risk management measures to the agricultural production is proposed as well. Domestic and international food supply and price risks can be resolved through a risk management strategy based on hedging. For Malawi, this could be done through introduction of a forward contract, futures contract, or put option.

Chapter 5

5. Food Consumption Decisions

5.1. Introduction

For a wide range of development policy issues, it is inevitable to understand how rural households respond to changes in relative prices, real income and households' socio-economic characteristics. For instance, effective policy design for indirect taxation and subsidies requires knowledge of price elasticities for taxable commodities and services (Deaton 1988). Moreover, these elasticities are very helpful when

estimating impacts of inflation or discussions on inflation targeting policy because most of developing countries struggle with higher inflation which indirectly deteriorates livelihoods of rural households by relatively lowering their income.

The studies in agricultural household consumption decisions adopt two major approaches to estimate a demand function. One of them is to estimate a single-equation demand function, which does now rely on economic models, and the other is system approach that is based on an economic model. The system approach can allow simultaneous estimation and testing of the demand theory. The complete demand system can be broken down into three popular demand systems: the Linear Expenditure System (LES), the Rotterdam system (RS), and the Almost Ideal Demand System (AIDS). Since the introduction of the AIDS model by Deaton and Muellbauer (1980a), food expenditure structures for many countries have been empirically discovered because the AIDS model has theoretical flexibility that does not require the general restrictions of demand theory to hold, and additive preferences. There are several studies on the US (Kuo and Biing-Hwan 2000, Reed 2011, and Heien and Wessells 1990), China (Frederick and Kuo 2007, and Shenggen et al 1994), Spain (Molina 1994), Mexico (Dong et al 2004), and Bangladesh (Ahmed and Shams 1994).

The purpose of this chapter is to present empirical evidence about food consumption behavior by rural households in Malawi using the IHS-2 data, which collects detailed information on the quantity and expenditure of food consumed and on the economic and socio-demographic characteristics of households. AIDS model was applied to calculate Marshallian and Hecksian price elasticities for eight different commodity aggregates. None of the previous studies on Malawi estimated price elasticities of food demand and analyzed how consumers allocate their food expenditure. Thus using the food demand elasticities of Malawi rural households for food policy analysis is suggested when that group of households is of interest.

5.2. Theoretical Framework

5.2.1. Model Specification

For the *i*th commodity (in this case food group), using the AIDS specification the equilibrium expenditure share equation is defined as:

$$w_i = \alpha_i + \sum_{j=1}^{8} \gamma_{ij} \ln(p_j) + \beta_i \ln\left(\frac{M}{P}\right) + \sum_{h=1}^{3} \theta_{ih} H_h \qquad (5\text{-}1)$$

where

w_i	:	Budget share for the *i*th commodity group,
M	:	Per capita expenditure on all consumption items included in the model
P	:	Price index computed by the equation (5-3) or (5-4)
H_h	:	Number of household members of type h:
h	:	1, Children (aged ≤ 5 years) 2, Adolescents (aged 5-15 years) 3, Adults (aged over 15 years)
p_i	:	Price per unit or aggregate price of consumption items in a group
i, j	:	1, Maize 2, Rice 3, Wheat 4, Cassava 5, Beans 6, Meats (fish, beef, goat, pork and chicken) 7, Milk 8, Others (salt, sugar and cooking oil)

Suppose there are two or more commodities in a group, price index for the commodity can be aggregated using a method of Adulavidhaya et al (1984), which is expressed in the following equation:

$$p_g = \prod_{i=1}^{n} p_{gi}^{w_i} \qquad (5\text{-}2)$$

Where

$$w_i = \frac{p_{gi}Q_{gi}}{\sum_{j=1}^{n} p_{gj}Q_{gj}}$$

P_g : Aggregate price of consumption items in a group
P_{gi} : Price per unit of *i*th commodity in *g*th group
Q_{gi} : Consumption of *i*th commodity
n : Number of commodities in *g*th group

The price index (P) used in the expenditure share equations (5-1) is given by:

$$\ln(P) = \alpha_0 + \sum_{i=1}^{n} \ln(p_i) + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln(p_i)\ln(p_h) \quad (5\text{-}3)$$

Since the non-linear AIDS model is complicated, Deaton and Muellbauer (1980a) suggest the use of a linear approximation of the non-linear AIDS model by replacing the P term by the logarithm of the Stone price index:

$$\ln(P) = \sum_{i=1}^{n} w_i \ln(p_i) \quad (5\text{-}4)$$

The linear approximate AIDS (LA-AIDS) requires following restrictions on the parameters:

Adding-up restrictions $$\sum_{i=1}^{n} \alpha_i = 1, \quad \sum_{i=1}^{n} \gamma_{ij} = \sum_{i=1}^{n} \beta_i = 0 \quad (5\text{-}5a)$$

Homogeneity restrictions $$\sum_{j=1}^{n} \gamma_{ij} = 0 \quad (5\text{-}5b)$$

Symmetry restrictions $$\gamma_{ij} = \gamma_{ji} \quad (5\text{-}5c)$$

Finally price, income and other elasticities can be derived easily by following equations:

■ **Uncompensated (Marshallian) Price Elasticity**

Own-price elasticity can be computed by

$$\varepsilon_{ii} = -1 + \frac{(\gamma_{ii} - \beta_i w_i)}{w_i} \quad (5\text{-}6)$$

Cross-price elasticity by

$$\varepsilon_{ij} = \frac{(\gamma_{ij} - \beta_i w_j)}{w_i} \qquad \text{For } i \neq j \qquad (5\text{-}7)$$

and Income/Expenditure elasticity by

$$\eta_i = \frac{\beta_i}{w_i} + 1 \qquad (5\text{-}8)$$

■ **Compensated (Hicksian) Price Elasticity**

The Hicksian or compensated price elasticity can be derived easily by using above elasticities and the following relation:

$$e_{ij} = \varepsilon_{ij} + \eta_i w_j \qquad (5\text{-}9)$$

The difference between Marshallian and Hicksian elasticities is whether the income effect is combined or not. The Marshallian demand function, which is also known as "uncompensated" demand, is defined as $q=f(R, p_1, p_2)$ where p_1 and p_2 are prices of commodities and R is the revenue which is kept constant, while the Hicksian demand function, which is called "compensated" demand, is $q=f(U, p_1, p_2)$ where U is the utility which is constant. Marshallian demand curves can tell that holding income and other prices constant how the quantity of good X demanded changes subject to a price change of X. The Marshallian price elasticity is thereby denoted as the price effect which can be decomposed into a substitution effect and income effect. Hicksian demand curves, on the other hand, tell how the consumer is operating on the same indifference curve as the price of good X changes. Hicksian elasticity thereby indicates pure substitution effect of a change in the price of X.

The household age composition elasticity, which explains influence of household age composition on *i*th commodity demand, can be defined by:

$$\phi_{ih} = \frac{\theta_{ih} H_h - \beta_i \left(\frac{H_h}{N}\right)}{w_i}$$

where (5-10)

$$N = \sum_{h}^{3} H_h$$

This elasticity can tell how the demand for a commodity changes when there is a change in age group variable; for example, an addition of a child to the household. Theoretically a hungry mouth effect (incremental demand for a commodity generated by additional household member holding all other variables including income constant) and a real income effect (deductive demand for a commodity due to downward pressure on expenditure from additional household member) are combined in this elasticity. Therefore the negative figure implies that the hungry mouth effect outweighs the real income effect.

Finally, impact of a change in family composition on the budget share (the change in expenditure on *i*th good as a percent of household income) can be identified by :

$$\Omega_{ih} = \left[\theta_{ih} - \beta_i \ln\left(\frac{N+1}{N}\right)\right] * 100 \quad (5\text{-}11)$$

5.2.2. Estimation Strategy

Although it is pointed out by some studies that LA-AIDS has some estimating problem such as an assumption of normal distribution on error terms, this paper follows the estimation procedure below:

1. To avoid complicated non-linear estimation, linearize price index using the equation (5-4).

2. Test the restrictions of homogeneity (equation (5-5b)) and homogeneity with symmetry (equation (5-5b) and (5-5c)). Then estimate a demand system through unrestricted AIDS model when they are rejected, unless otherwise proceed to the next step.
3. Estimate the all expenditure share equations (5-1) subject to the restrictions (adding-up, homogeneity, and symmetry) in equation (5-5) using iterative Seemingly Unrelated Regression (ISUR) method of Zellner (another name is so called Iterative Zellner's Efficient (IZEF) method). This method is equivalent to Full Information Maximum Likelihood (FIML) estimation. Since there is a singularity problem on the error covariance matrix of system, one of the expenditure share equations is dropped from the system (in this paper, the commodity group of others is dropped). It is known that unrestricted SUR and OLS estimators give the same results when matrix of independent variables is identical in each equation[13], however, SUR is better used if a test of parameters between a set of equations is considered.

[13] This case also occurs when error terms are uncorrelated between equations.

5.3. Empirical Analysis

5.3.1 Estimation Results

Descriptive statistics about expenditure and budget share of various commodity groups, household size and age composition are presented in Table 15. The IHS-2 data is also employed in this analysis where eight major food categories are selected because shares of other food items are substantially in small portions. It is obvious from the budget share that Maize is a dominant staple food for Malawians. Rice, wheat and cassava are somewhat consumed in smaller amounts by rural households.

Table 15: Descriptive Statistics

Variable	Average	Standard Deviation	Minimum	Maximum
Expenditure (MK / week)				
Maize	292.4453	464.8974	2.7500	28,898.9600
Rice	124.4735	137.9435	0.9777	1,856.9070
Wheat	107.8454	220.0554	2.0000	10,450.0000
Cassava	45.3758	58.7544	0.5000	1,721.7780
Beans	90.2645	431.8361	2.5000	29,410.1000
Meats	256.9888	1,240.4150	5.0000	93,775.4600
Milk	265.6531	2,981.5160	3.0000	112,004.9000
Others	101.2452	1,004.9630	1.5090	105,120.0000
Total Per Capita Expenditure				
Budget Share (%)				
Maize	0.4947	0.2504	0.0012	0.9936
Rice	0.0329	0.1058	0.0010	0.8912
Wheat	0.0303	0.0764	0.0000	0.8881
Cassava	0.0349	0.0884	0.0004	0.9274
Beans	0.0685	0.1086	0.0005	0.9861
Meats	0.1973	0.1838	0.0006	0.9960
Milk	0.0153	0.1404	0.0007	0.9953
Others	0.1257	0.1097	0.0001	0.9953
Household Size	4.9439	2.2479	2.0000	27.000
Age Distribution (%)				
0-5	0.1844	0.1788	0.0000	0.8000
5-15	0.3285	0.2396	0.0000	1.0000
15-	0.4869	0.2425	0.0000	1.0000

The test results of the restrictions of homogeneity and homogeneity with symmetry are presented in Table 16. Both sets of the restrictions are unfortunately found to be rejected. Therefore, a system of share equations based on equation (5-1) is supposed to be estimated without homogeneity and symmetry restrictions. Such rejection of the restrictions for a demand system is not uncommon in empirical analysis, such as Umar et al (1999), Blanciforti and Green (1983), and Mergos and Donatos (1989). According to Umar et al (1999), rejection of the restrictions may be caused by some factors that: 1) the theory is inappropriate (the sample households do not maximize utility); 2) the model is miss-specified (for example, the commodity aggregation is inappropriate); or 3) there may be measurement errors in the data. The measurement errors in the sample may be the best explanation for the rejection since information given were based on memory recall of the sample farmers.

Table 16: Likelihood Ratio Test of the AIDS Restrictions

Item	Homogeneity	Homogeneity with Symmetry
Log-likelihood Value of Un-Restricted Model	74,776.85	74,776.85
Log-likelihood Value of Restricted Model	74,366.89	73,948.28
Likelihood Ratio Statistics	819.92	1,657.14
Critical Value at 5 Percent Significance Level	14.07	41.34
Number of Restrictions	7	28
Decision	Homogeneity is Rejected	Homogeneity with Symmetry is Rejected

The estimated parameters of the preferred model (unrestricted AIDS) are presented in Table 17 and 18. Majority of coefficients are statistically significant at one, five or ten

percent significance level.

Table 17: Parameter Estimates of Demand System (AIDS Model)

Variable	Maize	Rice	Wheat	Cassava	Beans	Meats	Milk	Others
Maize	0.0034 (0.13)	0.0570*** (13.01)	0.0524*** (16.32)	0.0357*** (9.99)	0.0016 (0.91)	-0.0227*** (-16.82)	0.0662*** (18.08)	-0.0410*** (-22.02)
Rice	-0.0005 (-0.39)	-0.0471*** (-26.53)	0.0001 (0.05)	0.0013 (0.92)	0.0019*** (2.67)	-0.0025*** (-4.58)	-0.0027* (-1.81)	0.0056*** (7.42)
Wheat	-0.0031*** (-3.60)	-0.0024** (-1.96)	-0.0241*** (-26.49)	-0.0027*** (-2.66)	0.0009* (1.81)	0.0002 (0.61)	0.0009 (0.89)	0.0061*** (11.53)
Cassava	0.0021* (1.82)	0.0042** (2.48)	0.0056*** (4.52)	-0.0322*** (-23.19)	-0.0008 (-1.15)	-0.0020*** (-3.73)	0.0010 (0.73)	-0.0005 (-0.71)
Beans	0.0006 (0.35)	0.0090*** (3.68)	-0.0006 (-0.35)	0.0047** (2.33)	-0.0089*** (-9.10)	-0.0024*** (-3.15)	0.0072*** (3.50)	-0.0040*** (-3.88)
Meats	-0.0161*** (-6.10)	-0.0086** (-2.25)	-0.0157*** (-5.61)	-0.0033 (-1.05)	0.0064*** (4.23)	0.0259*** (22.01)	0.0105*** (3.29)	0.0306*** (18.87)
Milk	0.0023*** (2.56)	0.0012 (0.91)	-0.0002 (-0.22)	0.0014 (1.27)	-0.0007 (-1.28)	-0.0008* (-1.87)	-0.0635*** (-58.10)	0.0033*** (5.94)
Others	0.0112*** (7.39)	-0.0134*** (-6.10)	-0.0175*** (-10.89)	-0.0049*** (-2.76)	-0.0005 (-0.53)	0.0042*** (6.17)	-0.0196*** (-10.70)	0.0000 (-0.03)

NOTE: Values in parentheses are T values
*** significant at 1%, ** significant at 5%, * significant at 10%

Table 18: Parameter Estimates of Other Variables

Variable	α_i	β_i	θ_1	θ_2	θ_3
Maize	0.0102 (0.30)	-0.0055** (-2.35)	0.0052* (1.93)	0.0080*** (5.05)	-0.0149*** (-5.56)
Rice	0.1637*** (12.02)	0.0117*** (12.42)	0.0014* (1.67)	0.0004 (0.86)	0.0001 (0.14)
Wheat	0.0486*** (5.10)	0.0072*** (10.87)	0.0010* (1.84)	-0.0004 (-1.30)	0.0017*** (2.70)
Cassava	0.0895*** (6.86)	-0.0076*** (-8.49)	-0.0015* (-1.88)	-0.0009** (-1.97)	0.0022** (2.43)
Beans	-0.0028 (-0.15)	0.0085*** (6.52)	0.0005 (0.44)	0.0030*** (4.46)	0.0044*** (3.44)
Meats	-0.1967*** (-6.71)	0.0525*** (25.91)	0.0077*** (3.88)	-0.0013 (-1.08)	0.0056*** (2.63)
Milk	0.2444*** (24.31)	0.0098*** (14.12)	0.0009 (1.46)	0.0016*** (4.50)	0.0024*** (3.47)
Others	0.6431*** (38.23)	-0.0764*** (-65.80)	-0.0153*** (-14.82)	-0.0104*** (-17.23)	-0.0015 (-1.34)

NOTE: Values in parentheses are T values
*** significant at 1%, ** significant at 5%, * significant at 10%

5.3.2 Elasticities

Having estimated parameters, sample means and formulas, Marshallian cross-price elasticities, Marshallian own-price and income elasticities, Hicksian price elasticiites, and impact of family composition on demand for food and on expenditure are computed as presented in Table 19, 20, 21 and 22 respectively. Standard errors of the elasticities are also obtained through a method for computing an asymptotic variance for a function of random variables. All own-price elasticities of both Marshal and Hicks indicate correct (negative) signs. 28 out of 56 Marshallian cross-price elasticities are found to be positive, while others are negative indicating complementary consumer goods.

Table 19: Marshallian Price Elasticities

Food Items	With Respect to the Price of							
	Maize	Rice	Wheat	Cassava	Beans	Meats	Milk	Others
Maize	-0.9876 (0.006)	0.1157 (0.008)	0.1063 (0.006)	0.0726 (0.007)	0.0040 (0.003)	-0.0437 (0.003)	0.1339 (0.007)	-0.0815 (0.003)
Rice	-0.1897 (0.041)	-2.4386 (0.053)	-0.0086 (0.039)	0.0280 (0.043)	0.0329 (0.021)	-0.1456 (0.018)	-0.0866 (0.044)	0.1249 (0.022)
Wheat	-0.2184 (0.031)	-0.0882 (0.040)	-1.8022 (0.029)	-0.0972 (0.033)	0.0133 (0.016)	-0.0389 (0.014)	0.0267 (0.034)	0.1709 (0.017)
Cassava	0.1692 (0.037)	0.1278 (0.048)	0.1678 (0.035)	-1.9131 (0.039)	-0.0073 (0.019)	-0.0127 (0.017)	0.0329 (0.040)	0.0128 (0.020)
Beans	-0.0526 (0.027)	0.1278 (0.035)	-0.0131 (0.026)	0.0639 (0.029)	-1.1382 (0.014)	-0.0591 (0.012)	0.1026 (0.029)	-0.0746 (0.015)
Meats	-0.2128 (0.014)	-0.0524 (0.019)	-0.0876 (0.014)	-0.0259 (0.015)	0.0144 (0.007)	-0.9213 (0.006)	0.0490 (0.016)	0.1217 (0.008)
Milk	-0.1656 (0.065)	0.0572 (0.085)	-0.0330 (0.062)	0.0660 (0.069)	-0.0874 (0.034)	-0.1756 (0.029)	-5.1585 (0.071)	0.1353 (0.036)
Others	0.3895 (0.013)	-0.0863 (0.017)	-0.1207 (0.012)	-0.0180 (0.014)	0.0380 (0.006)	0.1531 (0.006)	-0.1463 (0.014)	-0.9238 (0.007)

NOTE: Values in parentheses below elasticities are asymptotic standard errors

All estimated income elasticities shown in Table 20 are positive and statistically significant at one percent.

Table 20: Marshallian Own-price & Income Elasticities

Food Items	With Respect to the Price of	
	Own-Price	Income
Maize	-0.9876 (0.006)	0.9889 (0.004)
Rice	-2.4386 (0.053)	1.3538 (0.028)
Wheat	-1.8022 (0.029)	1.2359 (0.021)
Cassava	-1.9131 (0.039)	0.7812 (0.025)
Beans	-1.1382 (0.014)	1.1237 (0.018)
Meats	-0.9213 (0.006)	1.2657 (0.010)
Milk	-5.1585 (0.071)	1.6403 (0.045)
Others	-0.9238 (0.007)	0.3922 (0.009)

NOTE: Values in parentheses below elasticities are asymptotic standard errors

Marshallian Cross-price elasticities of all items with respect to Maize are relatively lower, which implies that maize is a significant food for their livelihood. Cassava may be a substitute for Maize with only positive elasticity of Maize price change. Only maize and cassava fall into necessity items (income elasticities are less than one) and everything else has the income elasticity larger than one. Amongst food crops (Maize, Rice, Wheat, Cassava), the own-price and income elasticities for maize indicate lower responses due to its recognition as an integral item of the household diet. The own-price elasticity of rice among food crops is registered highest followed by cassava, wheat and maize, which implies that the households are more responsive to a price change in rice compared to other crops. This may be because rice is not culturally taken by Malawi households as a stable food crop rather seen as a superior food crop, which is consumed occasionally when there is surplus in income to buy. This is why the income elasticity of the rice is also higher than those of other food crops. Regarding the consumption of protein goods (beans, meats and milk), milk seems to have the same characteristics as

the rice since its own-price and income elasticities are much higher than all other food groups. The own-price elasticity of meat is found to be lower but income effect shows relatively higher. In addition, the meat is in complementary type of relationship with all food items. Higher income elasticities of meats and milk tell that they are luxury goods for rural households.

Table 21: Hicksian Price Elasticities

Food Items	With Respect to the Price of							
	Maize	Rice	Wheat	Cassava	Beans	Meats	Milk	Others
Maize	-0.4984 (0.006)	0.1483 (0.008)	0.1363 (0.006)	0.1072 (0.007)	0.0717 (0.003)	0.1515 (0.002)	0.1490 (0.007)	0.0429 (0.003)
Rice	0.4801 (0.037)	-2.3939 (0.053)	0.0325 (0.039)	0.0753 (0.043)	0.1257 (0.021)	0.1216 (0.016)	-0.0659 (0.044)	0.2952 (0.022)
Wheat	0.3931 (0.028)	-0.0474 (0.040)	-1.7648 (0.030)	-0.0540 (0.033)	0.0980 (0.016)	0.2051 (0.012)	0.0456 (0.034)	0.3263 (0.017)
Cassava	0.5557 (0.033)	0.1536 (0.048)	0.1914 (0.035)	-1.8858 (0.039)	0.0462 (0.019)	0.1415 (0.014)	0.0449 (0.040)	0.1110 (0.020)
Beans	0.5033 (0.024)	0.1649 (0.035)	0.0210 (0.026)	0.1031 (0.029)	-1.0612 (0.014)	0.1627 (0.011)	0.1198 (0.029)	0.0667 (0.015)
Meats	0.4134 (0.013)	-0.0106 (0.019)	-0.0492 (0.014)	0.0184 (0.015)	0.1011 (0.007)	-0.6715 (0.005)	0.0684 (0.016)	0.2809 (0.008)
Milk	0.6459 (0.058)	0.1113 (0.085)	0.0167 (0.062)	0.1234 (0.069)	0.0251 (0.034)	0.1482 (0.026)	-5.1334 (0.071)	0.3416 (0.036)
Others	0.5836 (0.012)	-0.0733 (0.017)	-0.1088 (0.012)	-0.0043 (0.014)	0.0649 (0.006)	0.2305 (0.005)	-0.1403 (0.014)	-0.8745 (0.007)

NOTE: Values in parentheses below elasticities are asymptotic standard errors

As already mentioned, Hicksian elasticity indicates pure substitution effect. The results are much similar to Marshallian elastictities such that maize is price inelastic and milk is a luxury good. 47 out of 56 cross-price elasticities are found to be positive, while others are negative indicating complementary consumer goods, which implies that 19 Hicksian cross-price elasticities[14] become negative in Marshallian elasticities because of large income effects. This tells that income is an important factor for Malawi

[14] This figure comes from the difference between 47 positive cross elasticities (Hicks) and 28 positives (Marshall)

rural households to determine food consumption.

Table 22 shows the impact of change in age composition on both food demand and expenditure share. It is evident among food crops that an addition of a child and adolescent increases demand for maize and cassava, while adult increases its demand for wheat and cassava. Demand on over half of food items becomes negative, which implies that the real income effect surpasses the hungry mouths effect. Interestingly, as people grow, their preference or test of food changes to wider variety of food consumption patterns rather than to keep on having the staple food of Maize.

Table 22: Impact of Family Composition on Demand & Budget Share

Variable	Impact on Demand for Food			Impact on Budget Share		
	Children	Adolescents	Adults	Children	Adolescents	Adults
Maize	0.0122 (0.005)	0.0329 (0.005)	-0.0536 (0.012)	0.6265 (0.269)	0.9019 (0.160)	-1.3790 (0.310)
Rice	-0.0323 (0.023)	-0.1128 (0.026)	-0.1391 (0.055)	-0.0889 (0.081)	-0.1851 (0.048)	-0.2132 (0.094)
Wheat	-0.0150 (0.017)	-0.1157 (0.019)	0.0132 (0.041)	-0.0337 (0.056)	-0.1821 (0.033)	0.0350 (0.065)
Cassava	0.0041 (0.021)	0.0372 (0.023)	0.2103 (0.050)	-0.0004 (0.077)	0.0576 (0.046)	0.3636 (0.090)
Beans	-0.0179 (0.015)	0.0320 (0.017)	0.0743 (0.037)	-0.1126 (0.114)	0.1399 (0.068)	0.2797 (0.133)
Meats	-0.0168 (0.009)	-0.1129 (0.010)	-0.0557 (0.022)	-0.2438 (0.197)	-1.1440 (0.117)	-0.4612 (0.228)
Milk	-0.0755 (0.036)	-0.0592 (0.041)	0.0330 (0.087)	-0.1022 (0.059)	-0.0311 (0.035)	0.0457 (0.068)
Others	0.0082 (0.007)	0.0846 (0.008)	0.2287 (0.018)	-0.0448 (0.101)	0.4429 (0.060)	1.3294 (0.117)

NOTE: Values in parentheses below elasticities are asymptotic standard errors

5.4. Concluding Remarks

The empirical analysis on consumption patterns of rural households in Malawi reveals satisfactory results in terms of economic theory, statistical fitness and reflection of the Malawi contexts. The elasticities confirm that maize and cassava are necessary food items for Malawi households and are possibly substitutes; moreover maize is the integral item of the household diet. An increase in household income will induce substantial increase in demand for rice and wheat among food crops, as well as all protein food items (beans, meats and milk) but consumption of these food items will be down when household size grows, thereby these items are found to be luxury goods. Finally meats are found to be a complement to all type of food.

Rural households are more sensitive to the price variation since their market labor opportunities and income are quite limited. According to Morduch 1994, holding all other influences constant (*ceteris paribus*), a risk-averse household prefer a smooth consumption stream to a fluctuating one. They are also suffering from nutritional deficiencies due to lack of food variety. Globally malnutrition is the most important risk factor for illness and mortality; and a large number of pregnant women and young children are particularly affected. Therefore, massive efforts by the government to combat malnutrition and improve income are required as an integral part of the human development strategy. As is evident from the elasticites, prices of maize and meats need to be stable because they are important source of nutritional food for Malawi households. To lower those prices, there are three things to be considered, 1) to provide sustainable and sufficient amount of maize and meats to the market so that its prices are kept low by improving agricultural productivity to meet increasing demand for food, reducing transaction costs for trading at markets, increasing storage capacities and other things, 2) to exempt any taxes on these commodities to avoid unnecessary inflationary pressure on the essential food items, and 3) introduction of a forward contract, futures

contract, or put option for hedging food supply and price risks as proposed in Chapter 4. The school feeding program and any other strategies to increase relative and real household income are another option since it induces positive income effects of the households, and solves malnutrition and uneducated labor issues.

Food security is an important topic to discuss development. Food Security was defined by the World Food Summit of 1996 as existing "when all people at all times have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preference for an active and healthy life." Food security, therefore, requires both physical and economic access to food that meets people's dietary needs as well as their food preference. As mentioned above, in many developing countries, health problems and dietary problems are highly correlated and are an increasing threat to quality human capital (knowledge, competence and ability of people to perform labor) thereby to economic development. Food diversification has a direct bearing on the food security since it enhances food availability, accessibility and stability. Furthermore, food diversification may strengthen the terms of trade at local, national and international level and then contribute to greater opportunity to income generation. In this regard, as far as poverty alleviation with economic growth is concerned, agricultural diversification can be a good solution to achieve both aspects, which in result attains national food security. Some studies on Asian countries suggest that diversified food production can lead to consumption diversification, which has helped to improve rural households' nutrition status (Yu and Diao 2011). For Malawi, increasing production of rice and wheat would improve balanced food diversification and thereby rural households' nutrition, health and income status will be better off.

Chapter 6

6. Conclusion

6.1. Overview

Malawi has registered significant economic growth in the past decade, which is with no doubt, the achievement of President Bingu wa Mutharika. Regardless of successful macro-economic expansion, there has been less development achieved in social welfare, poverty reduction and resource reallocation since its poverty ratio is not lowering as planned in MDGs. The primal reasons of the sluggish progress in poverty alleviation

may be due to 1) lack of complementally policies or good governance to support resource reallocation from rich to poor, 2) inadequate economic structural reforms, 3) inefficient external donor coordination and possibly 4) inappropriate approaches of donor support and lack of long-term commitment by donors (these issues are interesting topics but will not be discussed in this paper). Importantly lack of information on rural household behavior, especially farm households that comprise 90 percent of Malawi's population, makes it difficult for policy makers to determine appropriate policies for them. The paper thereby challenges this issue by estimating shadow wages and income for rural farmers, testing market imperfection, estimating labor supply elasticities between on-farm, casual and permanent work, and estimating food price elasticites among eight primal food item groups.

This paper attempts several new challenges that have never been tackled before which are as follows: 1) the shadow wages and income for Malawi's self-employed peasants have never been estimated and thereby wage rates between permanent, casual, and on-farm work have never been compared. 2) The imperfect labor market has never been statistically confirmed. 3) Estimation of rates of return to education in agriculture has never been attempted although those for wage earners have already been done by some studies. 4) It may also be the first attempt to apply shadow wages into the farm household model analysis. 5) Cross-price elasticities of permanent, casual and on-farm work would never be estimated. 6) Cross-price elasticities of major food items would never be estimated. 7) Finally no paper has attempted to estimate a complete household model for Malawi rural farm households that considers both production and consumption activities simultaneously.

The empirical results in Chapter 3 concluded that wage rates of on-farm work (average hourly rate of MK10.3) are much lower than those of casual and permanent jobs (average hourly rate of MK33.6 and MK23 respectively), which could explain why poor farm households prefer to supply more labor to casual work. The common

understanding of this phenomenon is that since there are limited income diversification options, rural households may end up selecting low-risk, low-return portfolios that presumably lower the risk of hunger, which is known as “risk-averse”; however, the truth is that the farm households merely select casual work due to its higher wage than that of on-farm work. Unfortunately the wage rates for on-farm work are even lower than government set minimum wage (MK22 per hour for urban areas and MK18 for rural areas), which needs to be redressed as soon as possible. The rate of return to school reveals the importance of education for greater agricultural outputs through promoting efficiency on both human capital and technology. In addition, rates of return for farmers (benefit of education from agriculture) are found to be greater than those of wage earners. Education plays an important role in reducing the “knowledge gap,” increasing accessibility to credit market for acquisition of fertilizer and other inputs and reducing labor market entry costs for cash income. The theory of non-reparability in rural households in Malawi is also verified through having lower shadow wages than market wages and rejecting null hypotheses in Benjamin and Jacoby tests. This supports the market imperfection that restrains rural households from free entry into the labor market.

The price and wage elasticities with respect to on-farm, casual and permanent work elucidate the two important questions. The first question whether the households identify markets separately for permanent jobs and casual work, and the other asks whether the proportion of income share reflects its importance as a source or role of household income. Relatively higher own-price elasticities of permanent work as opposed to casual work, higher cross-price elasticities with respect to casual work, and wider gaps in total elasticities due to higher income effects of a change in the permanent work wage can conclude for the first question that there are definitely different entry costs – skills, qualifications and other requirements – incurred to both markets and the households basically recognize the market constraints. This is why shifting labor supply

pattern from casual work to permanent is less likely to happen. Regarding the later question, the casual work receives greater elastic responses of the non-wage variable for a homothetic production function can reveal that when the production function shifts downward due to external shocks, the households depend more on casual work to compensate the loss than on the permanent work. Since the rural farm household income composes 59 percent from farming activities ($S_1W_1 + \Pi$), 8 percent and 33 percent from permanent and casual work respectively, the casual work is obviously the important source of cash income for a risk-averse strategy.

The price elasticities of basic foods confirm that maize and cassava are necessary food items for Malawi households and possibly they are substitutes; moreover maize is the integral item of the household diet. An increase in household income will induce substantial increase in demand for rice and wheat among food crops, as well as all protein food items (beans, meats and milk) but consumption of these food items will be low when household size grows, thereby these items are found to be luxury goods. Finally meats are found to be a complement to all food items.

Within this paper, there are several policy suggestions to the Government of Malawi to fight against poverty based on experimental findings. Having the empirical results of lower farm shadow wages, policies to improve their wages are suggested. The formula for calculating shadow wages indicates that the three factors – price increase of agricultural products, expanding aggregate agricultural output, and decrease in farm labor supply – would increase the shadow wage, and thus any measures that affect the three factors are necessary to accomplish the purpose. In additions to this, any attempts to narrow imbalance in knowledge and information between farmers and mediators (traders) are inevitable to correct market distortion for appropriate farm gate prices. Specific proposals made in the paper are inducing use of technologies for improving agricultural outputs and substituting labor supply, gate price intervention, promoting market clearing, rectification of information asymmetry, empowerment of farmers,

establishment of trading centers at local levels, extending and making available of credit markets to the farmers and so forth.

The findings of inelastic household responses to the permanent job market suggest the importance of government intervention to reduce entry costs into the labor market, especially for long-term contract jobs. Higher entry costs come from some entry barriers, such as skills, qualifications and other requirements. Unfortunately, Malawi fails to take advantage of labor abundant since many are either less educated or uneducated work forces. The issue of the inadequate educated labor supply is attributed to poor quality of school education due to lack of qualified teachers, teaching materials, teaching skills and motivation of the teachers. Since education for all was committed through free primary education initiative introduced in 1994, it is now time for Malawi to transform the education strategy from quantity education to quality education. Declining students' interest in schooling is, among other things, one of the major reasons for drop out and is mostly caused by poor guidance or teacher quality in developing countries. The recent teacher quality literature indicates that teacher quality has a large effect on the student's performance and graduation outcomes. Malawi thereby needs to intervene aggressively in teachers educations and to introduce incentive measures for teachers such as salaries, secondary benefits, and intangible rewards. The increased number of educated work force through educational reforms will reduce entry costs to the labor market and reduce discrepancy between farm shadow wages and market wages as discussed in Chapter 3.

Efforts to improve agricultural productivity and production are suggested as well to reduce entry costs for labor markets. Inefficient agricultural production requires many labor forces that cause labor market illiquid. Thus, any measures to improve agricultural productivity, such as construction of irrigation systems, subsidizing fertilizers, investing in R&D for seed selective breeding, and providing quality education, are necessary to be taken. Improved agricultural productivity can bring a lot of benefits to Malawi besides their per capita income and shadow wages to be raised. Increased food supply in

the domestic market can reduce food prices that indirectly improve non-farm poor household finance. Improved productivity and food prices decrease labor demand for agricultural activities that generate more available labor forces, thereby those surplus labor forces may move to urban areas to seek their jobs. Since these migrants are educated workers through quality education initiative proposed above, urban areas can pool many quality work forces at lower wages in the labor market that are able to attract foreign investors for FDI in Malawi.

The households' labor supply patterns and food consumption patterns figured out in this paper insist on a government effort to lower or stabilize inflation on such commodities that the farm households consume, more importantly prices of subsistence foods, such as maize and meats, be kept low. The farmers are suffering a lot from high inflation resulting in poor human capital. According to Morduch 1994, holding all other influences constant (*ceteris paribus*), a risk-averse household prefer a smooth consumption stream to a fluctuating one. It is thus necessary to have inflation control measures to keep those prices low. There are three things to be considered, 1) to provide sustainable and sufficient amount of maize and meats to the market so that its prices are kept low by improving agricultural productivity to meet increasing demand for food, reducing transaction costs for trading at markets, increasing storage capacities and so forth, 2) to exempt any taxes on these commodities to avoid unnecessary inflation pressure on the essential food items, and 3) to introduce price stabilization mechanism such as a forward contract, futures contract, or put option for hedging food supply and price risks. The school feeding program and any other strategies to increase relative and real household income are another option since it induces positive income effects of the households, and solves malnutrition and uneducated labor issues.

Finally food security and food diversification are discussed. Food diversification promotion through increasing production of rice and wheat is suggested since it improves rural households' nutrition, health and income status.

6.2. Further Issues

In spite of the numerical findings in rural farm household behaviors, there still exist several challenges. The first challenge is the use of new data set to evaluate improvement in household conditions. Up to now, I have attempted to obtain IHS-3 data which is a survey that was conducted in 2010 but the results have not yet been released due to delays in data consolidation. In this regard, the elasticities estimated in this paper may or may not be appropriate to the present circumstances. The next issue is inclusion of entrepreneurship activities, housework, and gender distinctions into the household analysis. Because of data deficiencies and complexity of analysis, these activities are neglected in the analysis making it difficult to capture comprehensive household behavior. The household may prefer to venture into activities of searching for casual and market jobs. Thereby comprehensive analysis on rural farm households will be done hereafter. Finally, all consumption commodities, such as expenditures on electricity, education, clothes and transportation, shall be included for a comprehensive consumption pattern analysis. Unfortunately consumption patterns only among eight food groups were figured out in this paper, thereby important aspects, for instance roll of education could not be unveiled.

6.2. Discussions

Farm household theories in development economics have been evolving over time from profit-maximizing peasant theories, utility maximization theories to risk-averse theories. The modern development economics emphasize that market failures, institutional arrangements and *ex ante* abilities of households to manage risk are the determining factors to generate the gap between observed farm household production choices and efficient behaviors. It is widely known that farm household behavioral

responses with respect to market imperfections in low-income settings generate situations of efficiency losses and poverty traps. In other words, household preferences and market imperfections are not independent. The effect of uncertainty and risk involved in agricultural production, and the social context in which farming activities actually take place cannot be neglected to assess vulnerability of poor. This paper unfortunately or fortunately identified existence of market failure in Malawi. It was discussed in previous chapters that the market failure may be caused by higher transaction costs, which can be broken down into policy and non-policy related transaction costs. Since Malawi is landlocked, success reduction of transaction costs is highly dependent on logistic infrastructure (airports, inland-seaports, roads, bridges, etc). Hence the infrastructure development in Malawi is a pre-requisite for further growth and is to solve many areas of development concerns in Malawi.

Malawi's poor rural households are trying to escape from underprivileged life. But their efforts are not effective due to some fundamental constraints including poor education, inadequate labor opportunity and so forth. IHS-1 and IHS-2 data shows that approximately 30 percent of the poor moved out of poverty during the period, but 30 percent of the non-poor moved into poverty. This implies that about 20 percent of the Malawi population is chronic poor and over 30 percent (potentially 60 percent) is transitorily poor[15]. It is also said that there is continued economic vulnerability in Malawi. Therefore, as this paper suggested, implementing quality education, improving agricultural productivity, and any other means to remove market failure in addition to infrastructure development need to be considered for moving these transitorily poor to middle income class and the same time income redistribution shall be made for the chronic poor. Lastly to conclude this chapter, hopefully this paper helps the poor in Malawi escape poverty.

[15] Chronic poor is defined if a household is poor in every period; otherwise, it is transitorily poor.

References

Aaronson, Daniel; Barrow, Lisa; and Sander, William. 2007. Teachers and Student Achievement in the Chicago Public High Schools. *Journal of Labor Economics* 25, PP 95-135.

Abbott, Michael; and Ashenfelter, Orley. 1976. Labour Supply, Commodity Demand and the Allocation of Time. *Review of Economic Studies*, Wiley Blackwell, vol. 43(3), pages 389-411.

Adulavidhaya, Kamphol; Kuroda, Yoshimi; Lau, Lawrence J. and Yotopoulos, Pan A. 1984. The Comparative Statics of the Behaviour of Agricultural Household in Thailand. *The Singapore Economic Review* 29:1 67–96.

Ahmed, Akhter U.; and Shams, Yawar. 1994. Demand Elasticities in Rural Bangladesh: An Application of the AIDS Model. *The Bangladesh Development Studies*. Vol. 22, No. 1, pp. 1-25.

Barnum, Howard; and Squire. 1979. An Econometric Application of the Theory of the Farm Household. *Journal of Development Economics*. 6 , 79-102..

Barnum, Howard; Squire, Lyn; and World Bank. 1979. A model of an agricultural household : theory and evidence Published for the World Bank. Johns Hopkins University Press: Baltimore.

Barrett, Christopher B.; Carter, Michael R.; and Ikegami, Munenobu. 2008. *Poverty Traps and Social Protection*. Social Protection Discussion Paper 0804, World Bank.

Benjamin, Dwayne. 1992. Household Composition, Labor Markets, and Labor Demand: Testing for Separation in Agricultural Household Models. *Econometrica* 60:287-322.

Blanciforti, Laura and Green Richard. 1983. An Almost Ideal Demand System Incorporating Habits: An Analysis of Expenditures on Food and Aggregate Commodity Groups. *The Review of Economics and Statistics*, Vol. 65, No. 3. pp. 511-515.

Castel, Vincent; Phiri, Martha; and Stampini, Marco. 2010. *Education and Employment in Malawi*. African Development Bank (AfDB).

Chirwa, Ephrain W.; and Matita, Marriam M. 2008. *The Rate of Return on Education Investments in Malawi*. mimeo, study commissioned by the Department for International Development (DFID Malawi) as an input to DFID's Education Sector Support Programme in Malawi.

Chirwa, Themba G. 2010. Program evaluation of agricultural input subsidies in Malawi using treatment effects: Methods and practicability based on propensity scores. *MPRA Paper* No. 20878.

Deaton, Angus. 1988. Quality, Quantity, and Spatial Variation of Price. *The American Economic Review* Vol. 78, No. 3, pp. 418-430.

Deaton, Angus; and Muellbauer, John. 1980a. An Almost Ideal Demand System. *American Economic Review*, 70, 312-336.

Deaton, Angus; and Muellbauer, John. 1980b, *Economics and Consumer Behavior*. Cambridge, England: Cambridge University Press.

Denning, Genning; Kabambe, Patrick; Sanchez, Pedro; Malik, Alia; Flor, Rafael; Harawa, Rebbie; Nkhoma, Phelire; Zamba, Colleen; Banda, Clement; Magombo, Chrispin; Keating, Michael; Wangila, Justine; and Sachs, Jeffrey. 2009. Input Subsidies to Improve Smallholder Maize Productivity in Malawi: Toward an African Green Revolution. *PLoS Biol* 7(1): e1000023.

doi:10.1371/journal.pbio.1000023.

Dong, Diansheng; Gould, Brian W.; and Kaiser, Harry M. 2004. Food Demand in Mexico: An Application of the Amemiya-Tobin Approach to the Estimation of a Censored Food System. *American Journal of Agricultural Economics* Vol. 86, No. 4, pp. 1094-1107.

Frederick, Gale H.; and Kuo, Huang S. 2007. *Demand For Food Quantity And Quality In China*. Economic Research Report 7252, United States Department of Agriculture, Economic Research Service.

Goldberg, Jessica. 2010. *Kwacha Gonna Do? Experimental Evidence about Labor Supply in Rural Malawi*. Working paper.

Gough, Amy E.; Christina, Gladwin H.; and Hildebrand, Peter E. 2002. Vouchers Versus Grants of Inputs: Evidence From Malawi's Starter Pack Program. *African Studies* Quarterly 6, no.1

Heien, Dale and Wessells, Cathy R. 1990. Demand Systems Estimation with Microdata: A Censored Regression Approach. *Journal of Business & Economic Statistics* , Vol. 8, No. 3, pp. 365-371.

Jacoby, Hanan. 1992. Productivity of men and women and the sexual division of labour in peasant agriculture of the Peruvian Sierra. *Journal of Development Economics* 37: 265-287.

Jacoby, Hanan. 1993. Shadow Wages and Peasant Family Labour Supply: An Econometric Application to the Peruvian Sierra. *The Review of Economic Studies*, Wiley Blackwell, vol. 60(4), pages 903-21, October.

Koedel, Cory. 2007. *Teacher Quality and Joint Production in Secondary School*. University of Missouri Working Paper.

Kuo Huang S.; Biing-Hwan Lin. 2000. *Estimation of Food Demand and Nutrient Elasticities from Household Survey Data*. Economic Research Service, United States Department of Agriculture. Technical Bulletin Number 1887. Washington D.C. 28 pages.

Kusakari, Hitoshi. 1984. Evaluation of Off-Farming Employment Opportunities by Agricultural Household Model. *Hokkaido University Collection of Scholarly and Academic Papers* 40: 47-62.

Larson, Anne M. 2004. *Democratic Decentralization in the Forestry Sector: Lessons Learned from Africa, Asia and Latin America*. Center for International Forestry Research.

Le, Kien T. 2007, *Shadow wage and labor supply in agriculture: new estimation method*, University of Virginia, working paper: p.2.

Le, Kien T. 2009. Shadow Wages and Shadow Income in Farmers' Labor Supply Functions. *American Journal of Agricultural Economics*, Vol. 91, Issue 3, pp. 685-696.

Le, Kien, T. 2010. Separation Hypothesis Tests in the Agricultural Household Model. *American Journal of Agricultural Economics*, vol. 92, issue 5, pages 1420-1431.

Loeb, Susanna; and Page, Marianne. 2000. Examining the Link between Teacher Wages and Student Outcomes: The Importance of Alternative Labor Market Opportunities and Non-Pecuniary Variation. *The Review of Economics and Statistics* 82 PP 393-408.

Lofgren, Hans; and Robinson, Sherman. 2002. *To trade or not to trade: non-separable farm household models in partial and general equilibrium*. Washington DC: International Food Policy Research Institute (IFPRI).

Mergos, George J. and Donatos, George S. 1989. Demand for food in Greece: An Almost Ideal Demand System analysis. Journal of Agricultural Economics, 40, pp.178-l84.

Michael, Lipton; and Jacques van der Gaag. 1991. *Including the Poor*. Washington DC: World Bank.

Molina, José A. 1994. Food Demand In Spain: An Application Of The Almost Ideal System. Journal of Agricultural Economics, Volume 45, Issue 2, pages 252–258.

Morduch, Jonathan. 1994. Poverty and Vulnerability. *The American Economic Review*, Vol. 84, No. 2.

Pfeiffer, Lisa; López-Feldman, Alejandro; and Taylor, Edward, J. 2009. Is off-farm income reforming the farm? Evidence from Mexico. *Agricultural Economics*, 40: 125–138.

Ralitza, Dimova; Katharina, Michaelowa; and Anke, Weber. 2010. *Ganyu Labour in Malawi: Understanding Rural Households'Labour Supply Strategies*. Contributed paper at the Fifth IZA/World Bank Conference May 3-4 in Cape Town, South Africa.

Reed, Albert J. 2011. *AIDS Model Estimates of Food Demand and the Decline in Farm Value Shares. Annual Meeting*. Pittsburgh, Pennsylvania 103549, Agricultural and Applied Economics Association.

Ribot, Josse. 2002. *Democratic Decentralization of Natural Resources: Institutionalizing Popular Participation*. World Resources Institute, Washington, DC.

Sayer, Jeffrey A.; Elliott, Christopher; Barrow, Edmond; Gretzinger, Steve; Maginnis,

Stewart; McShane, Thomas; and Shepherd, Gill. 2005. Implications for Biodiversity Conservation of Decentralized Forest Resources Management management', in C. J. P. Colfer and D. Capistrano (eds) *The Politics of Decentralization: Forests, Power and People*, Earthscan, London.

Schultz, William T. 1964. *Transforming Traditional Agriculture*. New Haven: Yale University Press.

Shenggen; Fan; Cramer, Gail; and Wailes, Eric. 1994. Food demand in rural China: evidence from rural household survey. *Agricultural Economics*, Volume 11, Issue 1, September 1994, Pages 61-69.

Simwaka, Kisu. 2006. *The effectiveness of official intervention in foreign exchange market in Malawi*. Munich Personal RePEc Archive.

Stone, Richard. 1954. Linear expenditure systems and demand analysis: An application to pattern of British demand. *Economic Journal* 64. 511-527.

Strauss, John. 1986. The Theory and Comparative Statics of Agricultural Household Models: A General Approach. (Appendix) in Inderjit J. Singh, Lyn Squire and John Strauss (eds.), *Agricultural Household Models—Extensions, Applications and Policy*. Baltimore: The Johns Hopkins University Press.

Taylor, Edward J.; and Adelman, Irma. 2003. Agricultural Household Models: Genesis, Evolution, and Extensions. *Review of Economics of the Household* 1(1): 33-58.

Umar, Farooq; Trevor, Young; and Muhammad, Iqbal. 1999. An Investigation into the Farm Households Consumption Pattern in Punjab, Pakistan. *The Pakistan Development Review* 38:3, pp. 293-305.

Whiteside, Martin. 2000. Ganyu Labour In Malawi And Its Implications For Livelihood Security Interventions – An Analysis Of Recent Literature And Implications For

Poverty Alleviation. *Agricultural Research & Extension Network*, Network Paper No. 99.

World Bank. 1998. *Abstracts of Current Studies: Poverty, Rural Development, and Research on the Rural Non-farm Economy*. WB DECRG, Washington D.C.

Yu, Bingxin; and Diao, Xinshen. 2011. *Cambodia's Agricultural Strategy: Future Development Options for the Rice Sector*. A Policy Discussion Paper, International Food Policy Research Institute.

Zellner, Arnold J.; Kmenta, Jan; and Dreze Jacques. 1966. Specification and estimation of Cobb-Douglas production function models. *Econometrica* 34, 784-795.

Appendices

Appendix 1: Basic Facts about Malawi Household based on IHS-2

Description	Data
Number of Households	
Total	11,280
Major Urban	1,440 (13%)
Boma/Large center	200 (2%)
Small Urban	520 (5%)
Rural	9,100 (81%)
Gazetted	20 (0%)
Average Household Size	4.67
Number of Family Members	
Total	52,707
Male	25,931 (49%)
Female	26,776 (51%)
Children (~5)	10,699 (20%)
Adolescents (5~15)	14,744 (28%)
Adults (15~60)	24,559 (47%)
Elders (60~)	2,705 (5%)
Number of Family Members by Region	
Major Urban	6,515 (12%)
Boma/Large center	935 (2%)
Small Urban	2,483 (5%)
Rural	42,676 (81%)
Gazetted	98 (0%)
Average Age	
Total	21.3
Male	21.1
Female	21.5
Education	
None	46,290 (88%)
PSLC	3,045 (6%)
JCE	2,209 (4%)
MSCE	932 (2%)
Technical Education	117 (0%)
University Diploma	89 (0%)
Postgraduate Degree	25 (0%)
Average Schooling Years	
Total	3.2
Urban	5.4
Rural (Boma + Small Urban + Rural + Gazetted)	2.9
Male	3.6
Female	2.8

Appendix 2: List of Occupations and Average Wages

ID	Occupation	N	Mean Wage / day
1	Physical scientists and related technicians		
2	Architects	2	2,229.17
3	Engineers and related technicians	26	1,062.02
4	Aircraft and ships・officers	-	−
5	Life scientists and related technicians	2	521.40
6	Medical, dental, and related workers	63	267.51
7	Veterinary related workers	3	173.28
8	Statisticians, mathematicians, and related technicians	1	461.54
9	Economists	4	3,428.33
11	Accountants	31	1,296.83
12	Jurists, legal professionals	3	180.35
13	Teachers	257	373.35
14	Workers in religion	20	577.57
15	Authors, journalists and related writers	-	−
16	Sculptors, painters, photographers, and related creative artists	2	181.69
17	Composers and performing artists	2	458.33
18	Athletes, sportsmen, and related workers	-	−
19	Professional, technical, and related workers not elsewhere classified	79	478.23
20	Legislative officials and government administrators	13	947.68
21	Managers	32	3,865.25
30	Clerical supervisors	21	840.96
31	Government executive officials	3	985.67
32	Typists, secretaries	31	833.37
33	Bookkeepers, cashiers and related workers	34	370.23
34	Computer operators	3	1,738.37
35	Transport and communications supervisors	2	104.17
36	Transport conductors	7	93.73
37	Mail distribution clerks	8	137.51
38	Telephone and telegraph operators	15	222.35
39	Clerical related workers not elsewhere classified	122	339.97
40	Managers (wholesale and retail trade)	3	208.79
41	Working proprietors (wholesale and retail trade)	4	221.63
42	Sales supervisors and buyers	11	1,314.97
43	Technical sales agents and manufacturers・agents	-	−
44	Insurance, real estate, securities and business services sales agents	-	−
45	Sales agents, shop assistants, and related workers	96	119.32
49	Sales workers not elsewhere classified	66	234.20
50	Managers (food and lodging services)	1	50.00
51	Working proprietors (food and lodging services)	27	55.98
52	Housekeeping and related service supervisors	-	−
53	Cooks, waiters, bartenders, and related workers	79	139.07
54	Maids and related housekeeping service workers not elsewhere classified	192	82.90
55	Building caretakers, cleaners, and related workers	74	158.53
56	Launderers, drycleaners and pressers	4	111.07

57	Hairdressers, barbers, beauticians and related workers	4	90.83
58	Security, protective service workers	394	117.98
59	Service workers not elsewhere classified	78	119.22
60	Farm managers and supervisors	8	560.78
61	Farmers	201	51.79
62	Agriculture and animal husbandry workers	191	63.05
63	Forestry workers	44	103.98
64	Fishermen, hunters and related workers	16	225.11
70	Production supervisors and general supervisors	18	1,501.31
71	Miners, quarrymen, well drillers and related workers	7	122.52
72	Metal processors	1	125.00
73	Wood preparation workers	13	161.94
74	Chemical processors and related workers	3	132.05
75	Spinners, weavers, knitters, dyers, and related workers	11	76.00
76	Tanners, leather workers	-	–
77	Food and beverage processors	33	98.82
78	Tobacco preparers and tobacco product makers	17	150.31
79	Tailors, dressmakers, sewers, upholsterers, and related workers	25	170.33
80	Shoemakers and leather goods makers	-	–
81	Cabinetmakers and related woodworkers	3	405.00
82	Stone cutters and carvers	-	–
83	Blacksmiths, toolmakers and machine tool operators	6	283.80
84	Machinery workers, machine assemblers, and precision instrument makers (except electrical)	34	197.16
85	Electrical workers and related electrical and electronics workers	17	192.08
86	Broadcasting station and sound equipment operators and cinema projectionists	1	83.33
87	Plumbers, welders, sheet metal and structural metal preparers and erectors	30	195.13
88	Jewelers and precious metal workers	-	–
89	Glass formers, potters and related workers	-	–
90	Rubber and plastics product makers	20	131.86
91	Paper and paper board products makers	-	–
92	Printers and related workers	3	309.68
93	Painters	5	93.52
94	Production and related workers not elsewhere classified	15	154.01
95	Bricklayers, carpenters and other construction workers	273	119.16
96	Stationary engine and related equipment operators	15	107.95
97	Material handling and related equipment operators, dockers and freight handlers	7	170.31
98	Transport equipment operators	107	313.68
99	Labourers not elsewhere classified	977	92.96
	Total	3,920	228.73

Appendix 3: Elasticities Estimated through Linear Expenditure Systems

Substitution Effect

Variable	$\epsilon_{s_i w_j}$ $(i = 1,\cdots,5: j = 1,\cdots,6)$				
	S_1	S_2	S_3	C_y	C_g
W_1	0.534618 (0.010)	-0.008891 (0.000)	-0.205546 (0.004)	0.003046 (0.000)	0.050353 (0.001)
W_2	-0.161869 (0.003)	0.908361 (0.019)	-0.662210 (0.013)	0.009812 (0.000)	0.162222 (0.003)
W_3	-0.039350 (0.001)	-0.006963 (0.000)	0.035307 (0.001)	0.002385 (0.000)	0.039436 (0.001)
P_y	0.061962 (0.027)	0.010965 (0.004)	0.253490 (0.110)	-0.553706 (0.195)	0.062097 (0.027)
P_g	0.701670 (0.027)	0.124167 (0.004)	2.870548 (0.112)	0.042533 (0.001)	11.070340 (0.475)
I	-0.535411 (0.060)	-0.263205 (0.012)	-0.899472 (0.032)	0.145115 (0.024)	0.845719 (0.076)

NOTE: Values in parentheses below elasticities are asymptotic standard errors

Income Effect

Variable	$e_{s_i w_j}$ $(i = 1,\cdots,5: j = 1,\cdots,6)$				
	S_1	S_2	S_3	C_y	C_g
W_1	0.002842 (0.002)	0.001397 (0.001)	0.004774 (0.004)	-0.000770 (0.000)	-0.004489 (0.004)
W_2	-0.040207 (0.004)	-0.019765 (0.000)	-0.067546 (0.002)	0.010898 (0.001)	0.063510 (0.005)
W_3	-0.023379 (0.002)	-0.011493 (0.005)	-0.039275 (0.001)	0.006336 (0.001)	0.036928 (0.003)
P_y	-0.057377 (0.007)	-0.028206 (0.001)	-0.096391 (0.006)	0.015551 (0.002)	0.090631 (0.009)
P_v	0.006837 (0.002)	0.003361 (0.001)	0.011486 (0.003)	-0.001853 (0.000)	-0.010799 (0.003)
A	-0.002247 (0.000)	-0.002221 (0.000)	-0.008810 (0.001)	0.000976 (0.000)	0.002270 (0.000)

NOTE: Values in parentheses below elasticities are asymptotic standard errors

Total Effect

Variable	$\eta_{s_i w_j}$ $(i = 1, \cdots, 5: j = 1, \cdots, 7)$				
	S_1	S_2	S_3	C_y	C_g
W_1	0.537459 (0.011)	-0.007494 (0.001)	-0.200772 (0.006)	0.002275 (0.000)	0.045864 (0.004)
W_2	-0.202076 (0.005)	0.888596 (0.019)	-0.729757 (0.014)	0.020709 (0.001)	0.225731 (0.006)
W_3	-0.062729 (0.003)	-0.018456 (0.000)	-0.003968 (0.002)	0.008722 (0.001)	0.076364 (0.003)
P_y	0.004586 (0.027)	-0.017241 (0.004)	0.157099 (0.111)	-0.538155 (0.194)	0.152728 (0.027)
P_g	0.701670 (0.027)	0.124167 (0.004)	2.870548 (0.112)	0.042533 (0.001)	11.070340 (0.475)
P_v	0.006837 (0.002)	0.003361 (0.001)	0.011486 (0.003)	-0.001853 (0.000)	-0.010799 (0.003)
A	-0.002247 (0.000)	-0.002221 (0.000)	-0.008810 (0.001)	0.000976 (0.000)	0.002270 (0.000)

NOTE: Values in parentheses below elasticities are asymptotic standard errors

Appendix 4: Descriptive Statistics for Rainfed Crop Production

Crop Name	Total Crop Production		Average Crop Production Per HH (MK)	HH Number
	Amount (MK)	Share		
Local maize	27,100,000.00	20.85%	5,088.11	5,328
Composite maize	3,932,064.00	3.02%	7,664.84	513
Hybrid maize	38,500,000.00	29.62%	7,244.26	5,317
Cassava	6,091,445.00	4.69%	3,149.66	1,934
Sweet potato	2,677,202.00	2.06%	1,611.80	1,661
Irish potato	1,136,937.00	0.87%	4,017.45	283
Groundnut	10,300,000.00	7.92%	2,779.06	3,693
Ground bean (nzama)	280,277.10	0.22%	580.28	483
Rice	4,675,457.00	3.60%	6,343.90	737
Finger millet (mawere)	593,352.90	0.46%	1,533.21	387
Sorghum	839,247.70	0.65%	737.48	1,138
Pearl millet	195,345.80	0.15%	904.38	216
Bean	3,184,457.00	2.45%	1,650.83	1,929
Soyabean	1,917,332.00	1.47%	2,358.34	813
Pigeonpea	1,623,719.00	1.25%	714.35	2,273
Cotton	2,348,387.00	1.81%	8,070.06	291
Sugar cane	303,281.80	0.23%	1,872.11	162
Other 1	19,300,000.00	14.85%	8,696.13	2,219
Other 2	5,306,644.00	4.08%	8,628.69	615
Total	130,305,149.30	100.00%	13,348.23	9,761

*Data Source: Second Integrated Household Survey (IHS2)

Appendix 5: Descriptive Statistics for Food Consumption by Households

Food Item	Total Consumption (MK)	Average Consumption (MK)	Share	HH Number
Maize ufa mgaiwa (normal flour)	546,171	186	8.66%	2,942
Maize ufa refine (fine flour)	323,594	216	5.13%	1,495
Maize ufa madeya (bran flour)	9,680	54	0.15%	178
Maize grain (not as ufa)	3,487	25	0.06%	142
Green maize	23,424	47	0.37%	502
Rice	230,410	108	3.66%	2,130
Finger millet (mawere)	4,695	70	0.07%	67
Sorghum	2,311	62	0.04%	37
Pearl millet (mchewere)	1,021	93	0.02%	11
Wheat flour	9,135	158	0.14%	58
Bread	199,673	141	3.17%	1,412
Buns, scones	154,333	61	2.45%	2,510
Biscuits	30,748	33	0.49%	932
Spaghetti, macaroni, pasta	10,209	179	0.16%	57
Breakfast cereal	14,183	156	0.22%	91
Infant feeding cereals	8,422	241	0.13%	35
Other cereals	465	93	0.01%	5
Cassava tubers	83,892	33	1.33%	2,508
Cassava flour	12,513	78	0.20%	161
White sweet potato	55,878	40	0.89%	1,408
Orange sweet potato	26,062	39	0.41%	673
Irish potato	46,669	72	0.74%	648
Potato crisps	5,854	91	0.09%	64
Plantain, cooking banana	4,410	32	0.07%	137
Cocoyam (masimbi)	1,714	37	0.03%	46
Other roots	170	34	0.00%	5
Bean, white	49,965	57	0.79%	875
Bean, brown	160,384	58	2.54%	2,748
Pigeon pea (nandolo)	23,114	35	0.37%	653
Groundnut	48,363	38	0.77%	1,268
Groundnut flour	22,552	21	0.36%	1,080
Soyabean flour	5,320	53	0.08%	100
Ground bean	3,235	35	0.05%	92
Cowpea (khobwe)	14,109	37	0.22%	381
Other pulses	1,354	50	0.02%	27
Onion	59,124	18	0.94%	3,231
Cabbage	49,540	27	0.79%	1,866
Tanaposi rape	99,597	25	1.58%	3,979
Nkwani	32,987	21	0.52%	1,555
Chinese cabbage	11,464	19	0.18%	591
Other cultivated green leafy vegetables	9,874	22	0.16%	454
Gathered wild green leaves	1,470	18	0.02%	83
Tomato	294,517	42	4.67%	7,077
Cucumber	5,280	22	0.08%	240
Pumpkin	14,452	42	0.23%	343
Okra / Therere	12,305	18	0.20%	671
Tinned vegetable	1,385	277	0.02%	5
Other vegetable	520	40	0.01%	13
Eggs	122,831	83	1.95%	1,478
Dried fish	440,348	65	6.99%	6,810
Fresh fish	212,494	98	3.37%	2,169
Beef	206,809	262	3.28%	788
Goat	158,973	156	2.52%	1,019
Pork	65,238	118	1.03%	551
Chicken	181,139	310	2.87%	585
Other poultry-guinea fowl, doves, etc	2,990	136	0.05%	22
Small animal- rabbit, mice, etc	5,295	45	0.08%	117
Termites, other insects	6,223	45	0.10%	139
Tinned meat or fish	4,285	214	0.07%	20
Other meat fish	1,672	105	0.03%	16

Mango	18,136	29	0.29%	624
Banana	65,549	23	1.04%	2,896
Citrus, naartje, orange, etc	14,094	21	0.22%	678
Pineapple	2,604	36	0.04%	73
Papaya	5,284	25	0.08%	209
Guava	4,614	12	0.07%	371
Avocado	14,137	24	0.22%	596
Wild fruit (masau, mlambe, etc)	1,563	13	0.02%	120
Apple	8,391	120	0.13%	70
Other fruits	693	39	0.01%	18
Fresh milk	86,064	102	1.37%	843
Powdered milk	67,759	161	1.07%	421
Margarine	40,513	144	0.64%	281
Butter	3,848	143	0.06%	27
Chambiko - soure milk	8,013	68	0.13%	117
Yoghurt	11,400	90	0.18%	126
Cheese	2,402	267	0.04%	9
Infant feeding formula (for bottle)	9,094	395	0.14%	23
Other milk and milk products	1,530	765	0.02%	2
Sugar	431,788	70	6.85%	6,181
Sugar cane	48,761	20	0.77%	2,409
Cooking oil	366,505	67	5.81%	5,433
Other fats and oil	108	18	0.00%	6
Salt	143,609	14	2.28%	10,635
Spices	10,396	67	0.16%	155
Yeast, baking powder, bicarbonate of soda	11,166	6	0.18%	1,888
Tomato sauce (bottle)	6,049	132	0.10%	46
Hot sauce (nali, etc)	3,534	52	0.06%	68
Jam, jelly, honey	4,189	113	0.07%	37
Sweets, candy, chocolates	13,653	17	0.22%	809
Other spices/ miscellaneous	177	44	0.00%	4
Maize - boiled or roasted (vendor)	7,142	21	0.11%	337
Chips (vendor)	38,928	39	0.62%	990
Cassava - boiled (vendor)	5,571	15	0.09%	374
Eggs - boiled (vendor)	3,750	41	0.06%	92
Chicken (vendor)	7,977	63	0.13%	126
Meat (vendor)	11,852	44	0.19%	267
Fish (vendor)	12,813	24	0.20%	539
Mandazi, doughnut (vendor)	58,243	23	0.92%	2,523
Samosa (vendor)	5,371	24	0.09%	223
Meat eaten at restaurant	51,116	101	0.81%	504
Other cooked foods from vendors	952	21	0.02%	46
Tea	56,558	18	0.90%	3,131
Coffee	11,837	106	0.19%	112
Squash (sobo drink concentrate)	58,190	155	0.92%	376
Fruit juice	23,029	133	0.37%	173
Freezes (flavoured ice)	8,292	16	0.13%	503
Soft drinks (Coca-cola, Fanta, Sprite, etc)	118,956	90	1.89%	1,328
Chibuku/ Napolo	66,465	213	1.05%	312
Bottled/ canned beeter (Carlsberg, etc))	62,212	532	0.99%	117
Local sweet beer (thobwa)	6,485	62	0.10%	104
Traditional beer (masase)	76,399	79	1.21%	962
Wine or commercial liquor	6,419	338	0.10%	19
Locally brewed liquor (kachasu)	61,070	112	0.97%	547
Other beverages	288	36	0.00%	8

*The consumption data represents the amount of each food item consumed by households over one week.
*Data Source: Second Integrated Household Survey (IHS2)