Access to Credit and the Impact of Credit constraints on Agricultural Productivity in Ethiopia: Evidence from Selected Zones of Rural Amhara

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This is to certify that the thesis prepared by Tilahun Dessie Zewdie, entitled: *Access to credit and the impact of credit constraints on Agricultural productivity in Ethiopia: Evidence from selected Zones of Rural Amhara* and submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Economics (Economic Policy Analysis) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

The economy of Ethiopia is characterized by its reliance on subsistence agriculture and the existence of underdeveloped financial institutions, especially in rural areas. In the literature, the role of credit as an instrument to boost productivity and welfare has long been justified. The main goal of this paper is to show the agricultural credit access landscape and investigate the impact of credit constraints on agricultural productivity in Ethiopia by using a household survey data from rural Amhara collected in 2013. After adjustments throughout the data cleaning process, the study relied on a survey of 1082 households which are found with valid information for all the variables considered in study.

The study revealed that 66.17 percent of households are credit constrained which shows how the rural credit market landscape in Ethiopia is highly imperfect. By using an endogenous switching regression model, the study tried to show the effect of demographic and other socioeconomic variables on credit constraint status of households and simultaneously the impact of credit constraints on agricultural productivity. Finally, the paper uncovered the existence of a huge productivity loss due to various types of credit constraints. The cumulative impact is estimated to be 17.94 percent, i.e. an additional per hectare income of 1410.17 Ethiopian birr productivity gain if all types of credit constraints happen to be eliminated. This calls for a well-coordinated policy intervention compatible with the dynamics of rural institutions and other location bottlenecks.

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Acronyms

AEMFI	-	Association of Ethiopian Microfinance Institutions
CSA	-	Central Statistical Authority
EEA	-	Ethiopian Economics Association
EPIICA	-	Ethiopian Project on Interlinking Insurance with Credit in Agriculture
EUJRC	-	European Union Joint Research Center
FAO	-	Food and Agricultural Organization
GDP	-	Gross Domestic Product
FIML	-	Full Information Maximum Likelihood
GTP	-	Growth and Transformation Plan
IFAD	-	International Fund for Agricultural Development
IFC	-	International Finance Corporation
IMF	-	International Monetary Fund
LCH	-	Life cycle Hypothesis
MDGs	-	Millennium Development Goals
MFIs	-	Micro Finance Institutions
MFW4A	-	Making Finance Work for Africa
NBE	-	National Bank of Ethiopia
NGO	-	Non Governmental Organization
NISCO	-	Nyala Insurance share Company
PASDEP	-	Plan for Accelerated and Sustained Development to End Poverty
PhD	-	Doctor of Philosophy
PIH	-	Permanent Income Hypothesis
RUFIP	-	Rural Finance Intermediation Program
UNU	-	United Nations University
USA	-	Unites States of America
USAID	-	United States Aid for International Development
WIDER	-	World Institute for Development Economics Research
WII	-	Weather Index Insurance

1. Introduction

1.1. Background of the study

An overwhelming majority of the rural population in developing countries depends on agriculture for survival. Thus, agriculture is critical for both human welfare and economic growth in the developing world including Africa. Agriculture currently contributes 30%–50% of national incomes in sub-Saharan Africa and can generate considerably greater income and stimulate economic growth (MFW4A, 2012). In this region, roughly two-thirds of the population live in rural areas and are dependent on agriculture for their livelihoods; nearly half live in extreme poverty, earning less than $1/day; and one-third are undernourished. Therefore, the low performance of agriculture in Africa is critically at the heart of its food insecurity and slow economic growth. The policy brief produced by Making Finance Work for Africa (MFW4A) Task Force on Agricultural Finance (2011) reports that agriculture is, and will continue to be, a major building block in the economic success and the achievement of the Millennium Development Goals (MDGs) in most of Africa. Furthermore, agricultural production needs to increase by 70 percent by 2050 to feed the world, while climate change and urbanization will heavily reduce the area of cultivable land (MFW4A, 2012).

Like its fellow African economies, agriculture is the main stay of the Ethiopian economy. It remains the largest employer having a share of around 80 percent of the total labor force, accounts half of GDP and 88 per cent of exports (CSA, 2009). The sector holds the key to creation of demand in other sectors of the economy and remains by far an important indirect contributor to the country's GDP. The capability of the economy to address poverty, food insecurity and other socio economic problems is highly dependent on the performance of this sector (EEA; 2013). In fact, food security is emerging as an important policy concern, and the role of agriculture in ensuring equitable access to food has added a new perspective for policy makers.

The agricultural sector value added is registered to be 4.9% for 2011/12. But this figure is not consistent with the targeted 8.6% growth by GTP (EEA, 2013). Even though it's is slightly declining, the agricultural sector greatly influences the rate of economic growth in Ethiopia. The percentage share of the agricultural sector from the entire growth rate of the economy was 47.76

within 2000/01-2004/05, 37.13 between 2005/06-08/09, 35.16 in 2010/11 and 24.41 in 2011/12(EEA, 2013). Partly, the declining growth share is explained by the astonishing development of the service sector which accounts the highest share of GDP and growth of GDP.

Ethiopia's 12.7 million smallholder[1] farmers account for approximately 95 per cent of agricultural GDP. With a total area of about 1.13 million km^2 and about 51.3 million hectares of arable land, the country has tremendous potential for agricultural development (IFAD, 2011). But the Productivity of vastly smallholder dominated Ethiopian agriculture is very low. Low yield per unit area across major crops is considered as a regular feature of Ethiopian Farmers. Lack of irrigation facilities; Small and fragmented land holding; Lack of timely availability of quality seeds, fertilizers and insecticides in many parts of the country are considered reason for the existing low productivity agriculture (IFAD, 2011). A study by Toenniessen et.al (2008) documented that to increase productivity, profitability, and sustainability of small holders' farms, they need greater access to affordable yield-enhancing inputs, including well-adapted seeds and new methods for integrated soil fertility management, as well as to output markets where they can convert surplus production into cash. Therefore, with better access to credit in agriculture, a number of allied activities and related services such as technology, soil conservation, irrigation, storage and marketing etc, can be easily provided which would also help in reducing costs of production.

It has been argued that agricultural productivity is one of the key determinants of high and sustained agricultural growth, and in fact a key determinant of its growth over the longer term. Faster agricultural growth has put countries on the path of a much broader transformation process: rising farm incomes and demand for industrial goods; lowering food prices, curbing inflation and inducing non-farm growth, and creating an additional demand for workers. Rising on-farm productivity also encourages broad entrepreneurial activities through diversification into new products, the growth of rural service sectors, the birth of agro-processing industries, and the exploration of new export markets (World Bank, 2008).

[1]Smallholder farmers represent the backbone of Ethiopian agriculture and food security. Their importance derives from their numbers, their role in agricultural and economic development and the concentration of poverty in rural areas. The term ‘smallholder’ refers to their limited resource endowments relative to other larger scale and more commercial farmers

Following the aforementioned rationales, increasing productivity in smallholder agriculture is the Ethiopian Government's top priority, recognizing the importance of the smallholder sub-sector to mitigate the high prevalence of rural poverty and the large productivity gap (Chanyalew et.al, 2010). Ethiopia's current highly ambitious[2] plan, i.e GTP, promises to ensure smallholder agriculture as the main source of agricultural growth in its main strategic directions. Yet, the use of improved inputs, such as fertilizer and improved seeds is very low in the country. The overwhelming reason for low use of modern inputs is that they are considered too expensive or that there is lack of cash on hand and failure to acquire it through the capital market. The prevalent of high costs of credit adds to the cost of fertilizer resulting low productivity (McIntosha et.al, 2013).

Complementary developments in rural financial institutions often provide services for activities related to agriculture, such as input supply, production, or distribution and marketing of agricultural products. More importantly, loans for investments and working capital are crucial elements that enable rural entrepreneurs to make investments, create economic opportunities, and purchase agricultural inputs and working capital (Pollard and Heffernana, 1983). Signifying the role of credit in agriculture, the global food price crisis has moved agricultural finance on top of the African and international development agendas. Access to financial services for all types of agricultural producers and agribusinesses is key for unleashing Africa's agricultural potential and funding the growth of the sector (MFW4A, 2012). However, agriculture in Africa continues to receive only a small share of total credit, leaving farmers, particularly smallholder farmers, to rely on insufficient savings and informal sources of credit with only about 10 per cent of the total portfolio of commercial banks goes to agriculture, including agro-industries, and loans are rarely extended to smallholders (World Bank, 2009; cited in MFW4A, 2012). As explained by Besley (1994), the above problems arise due to the very nature of rural credit markets which are characterized by scarce collateral, existence of underdeveloped complementary institutions, prevalence of covariance risks and segmented markets in the small holder community and the

[2]as called by many international organizations including the World Bank and the IMF

enforcement problems as well. These imperfections constrained the rural credit markets from reaching the smallholder efficiently.

In Ethiopia, rural financial markets are still largely under-developed, despite the fact that the economy experienced significant growth in financial service provision. Ethiopia has one of the lowest financial inclusion ratios compared with its peer countries in Africa (Amha and Peck, 2010; Amha, 2011**).** Though recent figure is not available, during the 2005/06 season, only 26% of farmers accessed credit from formal sources (PASDEP, 2006).

Ethiopia ranked 127th out of 183 countries for ease of Getting Credit, behind Rwanda, 61st, and Kenya, 4th (USAID, 2012). Inadequate access to financial services is one of the major bottlenecks impeding economic growth and household incomes in rural areas where there is still a huge demand-supply gap (IFAD, 2011). The rural financial market landscape in Ethiopia is characterized by the coexistence of formal, semi-formal, and informal lenders. These finance providers or lenders vary in the cost of screening, monitoring and contract enforcement. The formal financial providers in Ethiopia include banks, MFIs and cooperatives. Iqqub or Rotating Savings and Credit Associations, iddir, mahiber, etc. are semi-formal financiers. The informal finance providers are the moneylenders, relatives, traders and suppliers, friends, church, etc. Although illegal, as per the regulatory framework in Ethiopia, NGOs, government and donor projects are providing loans to beneficiaries (Amha, 2011).

Generally, the status quo of the Ethiopian financial system is highly questionable. The problem becomes even worth in the rural parts of the country. It is obvious that the financial system is a primal lubricant for a meaningful expansion to happen in different sectors of the economy. Due to lack of complementary institutions complemented with expected high probability of default of smallholders, formal financial institutions usually abstain themselves to deliver financial services. However, the ongoing recent microfinance revolution creates opportunity for smallholder farmers in rural areas; one can easily notice that lack of liquidity is yet on top of problems in rural areas. Finally the theoretical and empirical implication of underdeveloped financial services on agriculture is elaborated in the following section.

1.2. Statement of the Problem

Agricultural production is strongly conditioned by the fact that inputs are transformed into outputs with considerable time lags, causing the rural household to balance its budget during the season when there are high expenditures for input purchases and consumption and few revenues. With limited access to credit, the budget balance within the year can become a constraint to agricultural production (Dong et.al, 2010; Ali and Deininger, 2012). Thus, if people are unable to finance their agricultural project themselves, they have to borrow from outside either formal lending institutions or informal money lenders. Their choices of borrowing depends on how they can access credit providers and how can they obtain the loan, given the cost of the loan itself.

Finance, in development theory, is the main lubricant and a pioneering engine of economic growth and development. Winter-Nelson and Temu (2005) stated that Small-scale farmers in developing countries may become trapped in poverty by lack of the liquidity needed to make profitable investments. Increased access to credit could generate pro-poor economic growth if poor households are otherwise liquidity-constrained and if liquidity-constrained households benefit from the new financial services. They further asserted that expanded access to credit has been enthusiastically championed in the development community for its potential to generate sustainable economic growth that favors the poor.

Access to finance is considered as one of the key elements in addressing development issues in Ethiopia. Improving financial access helps smallholder farmers to improve production and productivity through investment in irrigation, production equipment and inputs and in postharvest handling, processing and marketing (Amha and Peck, 2010; Amha, 2011). Similarly, a recent paper in Uganda by Khandker and Koolwal (2014) discussed that credit plays a crucial role in supporting agriculture by helping households in handling risk and purchase inputs/technology to improve their agricultural productivity. But they also demonstrated that access to credit in sub-Saharan Africa is among the lowest in the world. A study in Ethiopia by Ali and Deininger (2012) also documented that in settings where high exposure to risk and meager surpluses from subsistence agriculture limit opportunities for self-insurance and savings, provision of credit is often seen as a key element to increase productivity through more intensive use of fertilizer and seed and to facilitate consumption smoothing. Moreover, access to credit is found to be one of the

main determinants of competitiveness in agriculture among economies (Saldias and Cramon-Taubadel, 2012).

Even though the importance of financial services for rural development has been recognized for several decades and the microfinance boom in recent years has once more underlined the importance of financial services, large parts of the world's rural population remain excluded from formal financial services. Institutions offering financial services – such as banks, credit unions, microfinance institutions (MFI) or insurance companies are typically reluctant to serve rural areas. As a result, the majority of the developing world's rural population does not have access to the formal financial system. Confronted with this lack of access, households, farmers and small entrepreneurs rely on informal ways of accessing financial services (inforesources, 2008). But even these informal financial service providers are not capable of fulfilling the credit demand of small holder farmers in rural areas of developing nations (Besley, 1994).

The mismatch of demand and supply in rural credit markets can be explained, first of all, by the challenges the rural financial institutions has been faced– namely a difficult legal and economic environment, high transaction costs, higher sector-specific risks in agricultural lending and other characteristics of agricultural activities, such as seasonality and long maturation processes. Secondly, financial products that have been offered were not always demand-oriented, and institutions do not invest enough in careful product design (Pollard and Heffernan, 1983). In addition, as argued by Besley (1994), rural credit markets in developing countries are often described as repressed, imperfect and fragmented (or absented) in the sense that different segments of borrowers are observed to have different level of access to certain types of loans and certain types of credit institutions, which leads to the widespread prevalent of credit rationing.

In Ethiopia, the financial service offerings to the agricultural sector faces gaps in terms of access, product quality, and quantity. In terms of access, only few financial institutions serve rural areas in Ethiopia, leading to low levels of financial inclusion. The role of the now growing microfinance institutions and other financial cooperatives in providing financial services to the mostly unbanked community is undeniable. However, still there is a huge unmet demand supply gap. The overall Ethiopian economy is significantly credit constrained. And agriculture is strongly affected by this

credit crunch compared with other sectors of the economy due to its sectoral specificities (Amha and Peck, 2010).

The prevalence of credit constraints[3] in rural Ethiopia has been evident in number of previous studies. In his doctoral dissertation, Komicha (2007) uncovers that farm households in southern Ethiopia are credit constrained. In recent paper by Ali and Feininger (2012), almost half of small holder farmers in Amhara region are credit constrained. They also identified risk aversion behavior of farmers is the main determinant that hinder small holders from accessing agricultural credit. The Ethiopian agricultural finance diagnostic report for Ministry of Agriculture which was prepared by Amha and Peck (2010) explained that farm households in rural Ethiopia are highly credit constrained. In theory, it has been argued that a farm household facing binding credit constraint is more likely to misallocate its resources and under-invest than its unconstrained peers. Thus, it can be inferred that availability of finance and its accessibility crucially affect production start-up and subsequent performance of farmers (Hussien and Ohlmer, 2006; cited in Amha, 2011).

The productivity impact of these credit constraints in Ethiopia has been researched in a very limited extent. The study in two districts of Ethiopia by Komicha (2007) reported that credit constraint has a negative impact on the efficiency of small holder farmers in southern Ethiopia. But given the Ethiopia's diverse regional and agro ecological zones, it is not granted that the outcome of this paper can persist in other areas and there is no way that recommendations of this paper can be devised for other areas in the country. Another study by Ali and Deininger (2012) estimated the productivity implication of being credit rationed in two zones in Amhara region (East Gojjam and South Wollo) in the semiformal credit market alone[4]. They found that there is an approximate 11 percent productivity gap between credit-constrained and unconstrained households in productive areas (East Gojjam), while they found no significant relationship in potentially unproductive agro

[3] But when such market failures exist hardworking entrepreneurs cannot obtain all of the capital needed to run their businesses. As a result, they may turn to wage labor, stay in traditional farming, or take other paths that are less desirable and less profitable(for more detail see Aghion and Morduch ,2005; and Kumar and Francisco,2005)

[4]But according to Karlan and Morduch (2010), failure either in the semiformal or formal sector alone does not cause any effect on smallholders if the informal financial sector works efficiently. It is known that the informal financial sector is the main actor in the market for credit in rural Ethiopia. Therefore, ignoring this sector and ultimately rely on the semiformal sector does not reflect the prevailing clear picture of the problem and its impact on productivity of smallholders (for more detailed explanation see Karlan and Morduch, 2010)).

economic zones (South Wollo). The implication of their finding is that the link between credit constraint status of households and their corresponding effect on productivity is in part determined by the agro ecological zone under consideration. But given their paper was limited to two zones and they employed a data set in 2006/7 (a period in which much has been changed in the economy since then), it is rational for this paper to validate the impact of credit constraints on agricultural productivity using recent data set with a relatively diverse sample coverage. In addition, this study examined smallholders' access to agricultural credit and the various factors that distinguish credit constrained smallholders from those who are not.

1.3. Objectives of the study

The main objective of the study is to present a clear overview of household's access to credit and examine the cumulative impact of agricultural credit constraints on agricultural productivity[5]. In attaining this general objective, the paper tried to examine the following specific objectives.

- ✓ To assess smallholders access to agricultural credit from different sources in rural Amhara
- ✓ To examine factors that distinguish farm households who are credit constrained from those who are not
- ✓ To witness the link between credit constraint and agricultural productivity

1.4. Scope of the study

This study covered four zones in Amhara regional state (namely West Gojjam, South Wollo, North Wollo and North Shewa). By using a survey of 1082 smallholder households from these target zones, we tried to examine the agricultural credit access landscape, the detrimental factors that distinguish credit constrained and unconstrained smallholder farmers and finally the estimate the productivity impact of credit constraints has been the main issues that this paper intended to cover.

[5] This paper uses farm productivity, crop productivity, crop yield and agricultural productivity interchangeably which are equivalent to the value of agricultural yield per hectare (in birr) for selected cereals (includes Sorghum, Teff, Barley, Wheat, Maize and Millet).

1.5. Significance of the study

It looks obvious that a well-functioning financial sector is a necessary, if not a sufficient condition, to build a prosperous economy. Studies that deal with rural finance and its link with the agricultural sector will have a much greater role. Therefore, studies like this one can provide information that will enable financial institutions to understand how credit is related with agricultural production and thereby formulate appropriate lending policies accordingly. And also better understanding of constraints towards agricultural credit may assist policy makers in designing sustainable financial systems that can serve resource poor farmers escape from poverty and its complements.

More importantly, as stated earlier in the problem statement, the empirical literature in Ethiopia doesn't have a clear and an in-depth insight on the influence of credit constraints on smallholders' agricultural productivity. Therefore, this paper is believed to contribute to the body of literature by showing the cumulative effect of credit constraints on crop productivity of farm households in the country.

1.6. Limitation of the Study

Dealing with credit constraint issues, especially in countries with highly fragile and imperfect rural credit markets just like Ethiopia is not an easy task. But giving up for these difficulties and neglecting the issue at all will undoubtedly undermine future development prospects of the sector and the economy at large. Therefore, besides the below mentioned limitations, the paper will play an important role.

In surveys like EPIICA[6], respondents are expected to remember the whole things in which the questionnaire is intended to grasp. But farmers in rural areas are not familiar with record keeping about their day to day lives (including their production and consumption decisions). So using the data which ultimately depend on their recall may have some arguable problems. The other limitation is, the Ethiopian rural economy cannot be explained in the sense of country wide homogeneity. Therefore, the conclusions and its resultant policy recommendations should be

[6] Ethiopian Project on Interlinking Insurance with Credit in Agriculture(See the methodology part for more detail on this project)

considered cautiously when we are think of nationally and in other settings with different institutional and agro-ecological setup. But it is still relatively diversified than previous studies.

1.7. Organization of the Study

The remaining part of the report is organized as follows. In the next chapter, a detailed review of both theoretical and empirical literatures that are related with the main tenets of the paper is presented. It also included a review on the financial system of Ethiopia. Chapter three presented the methodological aspects of the paper. Findings from both the descriptive and econometric analysis are discussed in chapter four. Finally, chapter five outlines main conclusions, policy implications and further research insights based on the results of the study.

2. Literature Review

2.1. Theoretical Reviews

2.1.1. Definitions and concepts of credit markets

Credit is defined as a legal contract between the lender and the borrower, where the borrower receives resources or wealth with a promise to repay in the future. Credit refers to terms and conditions associated with deferred payment arrangements. Credit is a means to enable investment by solving a liquidity problem. The liquidity problem arises from the fact that outlays triggered by the investment precede (expected) future returns. Investment in turn is guided by certain higher-level goals such as profit or income generation (Petrick, 2004). In Agriculture, access to credit is primarily seen as a tool to increase agricultural output and productivity, adoption of new technologies, stabilizing household's income, and improving farm's inputs such as fertilizer, increasing rural employment and reducing poverty (Foltz, 2004).

2.1.2. Financial Markets in Rural Areas of Developing Nations

The term rural finance refers to the financial transactions related to both agricultural and non-agricultural activities that take place among households and institutions in rural areas. In some cases, rural finance has been wrongly equated with agricultural credit, based on the assumption that credit is the binding constraint to achieving project objectives related to agriculture. A more effective and comprehensive view of rural finance encompasses the full range of financial services that farmers and rural households require, not just credit (IFAD, 2009).

Access to credit remains a major challenge for smallholder farmers in most developing countries. The problem often is seen in terms of limited access to production credit to buy and use farm inputs as well as pay for non-family farm labor and other farm maintenance costs. Because smallholder farmers cannot afford yield-enhancing inputs, farm productivity often remains low on smallholder farms despite available technology for achieving higher yields (Onumahand Meijerink, 2011).

2.1.2.1. Features of rural credit markets in developing countries

Rural credit institutions can be broadly characterized into formal institution and informal institutions. Formal institutions are licensed and regulated by central banks. This sector comprises commercial banks, microfinance institutions[7], credit cooperatives, development banks and insurance companies. Informal credit markets refer to those markets which are not licensed and regulated by central authority. They include transactions between moneylenders, landlords, traders, friends and relatives. Besely (1994) identifies five forms of informal providers of credits as follows: credit from friends, relatives and community members, rotating savings and credit associations (ROSCAs), money lenders and informal banks, tied credit and pawning. In between these two ends of the range are financial nongovernment organizations, self-help groups, small financial cooperatives, and credit unions.

The informal sector is not regulated by any formal institution and the lending conditions are often flexible. This sector comprises local moneylenders, landlords, traders, RUSACCOs, friends and relatives. Other types of rural credit include semi-formal institutions, consisting of non-governmental and international organizations. The formal sector depends on deposits while, the informal sector relies more on its own funds (for more detail see Karlan and Morduch, 2010).

Given the co-existence of both formal and informal financial intermediaries, in studying rural credit markets, the interaction between informal and formal credit markets needs a due attention. Because observing a formal market failure need not lead to inefficiency if the informal market is complete. Examining the mechanics of the informal market is crucial for two reasons. First, the strength of the informal market is important for measuring and predicting how effective specific formal sector interventions will be. Second, lessons learned in the informal markets can help shape policy in the formal markets. For instance, they argued that group lending is based largely on lessons learned from observing risk-sharing and credit and savings associations in informal markets (Karlan and Mordush, 2010).

[7]The hand book of microfinance by Ledgerwood (1998) defines **Microfinance** as the provision of financial services to low-income clients, including the self-employed. They asserted that microfinance is not simply a type of banking; it is a development tool for those who live in vicious circles of poverty.

General Credit Market conditions

As far as they fail to operate like classical competitive markets, there exists no likelihood for rural credit markets to be efficient. The specific features of transactions in credit markets are not similar to other market transactions, where a transaction is terminated once payment is received. The commodity seller does not care who the buyer is or what happens to the commodity after sale, as long as he/she is paid. In contrast however, in the credit markets, information is required both on personal characteristics of the borrowers and on the project for which an application for financing is lodged. It is important for the bank or lender to know the viability of the project, the purpose of the loan, the borrower's credit-worthiness and his/her strategic behavior. Credit markets are different from an ideal market because they are largely dependent on information. According to Hoff and Stiglitz (1990), rural credit markets have to contend with the problems of screening, incentives, contract enforcement, information asymmetry and monitoring.

Unlike the financial system in developed countries and the relatively monetized urban areas of developing nations, financial markets in rural areas of less developed countries cannot be explained by conventional theories. Formal financial institutions involve in these areas very rarely. The following are some of the characteristics of rural financial markets in developing nations which can arguably applicable to Ethiopia as stated by Besley (1994).

I. **Segmented/Fragmented Market**

Rural credit markets in developing countries are often segmented or fragmented. Supply and demand conditions fail to determine credit market equilibrium conditions; this is because interest rates have the dual function of setting prices on one hand, and serving as an instrument for regulating the risk composition of the lender's portfolio on the other hand. However, by allowing the interest rate to reflect the market prices these imperfections may be eliminated. The cost of segmentation is that it hinders the flow of funds across regions or groups of individuals even though there are potential gains from doing so, as when needs for credit differ across locations (Besley, 1994).

II. **Collateral Security**

According to Udry (1990), collateral pledge in exchange for a loan directly reduces the cost to the lender in case of default on the loan; it can reduce the moral hazard associated with lending by providing an added incentive for the borrower to repay; it can alleviate the problem of adverse selection by screening out those borrowers most likely to default. Furthermore, according to Besley (1994), poorly developed property rights in the rural areas of many developing countries could render appropriation of collateral in the event of default difficult.

III. **Weak/Underdeveloped Complementary Institutions**

If rural financial markets are to function properly then the functioning of certain other complementary institutions and markets are essential. In most rural areas of developing countries, these institutions are not in place and are weak wherever they do exist. For example, there are limited and weak equity markets that provide a mechanism for sharing risks in most rural areas of developing countries. Also evident in most rural credit markets is the absence of insurance markets to mitigate the problems of income uncertainty. The absence of or weakness in infrastructure has been identified as a hindrance to the operations of financial institutions in the rural areas (Besley, 1994).

In addition to the main features of the aforementioned characteristics of rural credit markets which constrain engagement of formal financial intermediaries, the following list of characteristics explains the special features of the agricultural sector which ends lending to agriculture a risky business.

2.1.3. Problems of Lending to Agriculture

In Africa in general and Ethiopia in particular, agriculture is yet the main sector of the economy in which the formal financial sector is not conspicuously successful in delivering financial services to farmers in need. In the continent, finance for agriculture and the rural economy in general is unable to meet the rising demand. Inherent difficulties, risks, and costs impede the effectiveness of finance in each of these areas (Honohan and Beck, 2007). The following are some of the reasons from the literature why the financial system fails to meet the demand of the agricultural sector.

I. Seasonality with longer gestation period

Agriculture is very seasonal, from planting to harvest which takes longer gestation periods. The result is that cash flows are highly seasonal and sometimes irregular, with earnings concentrated in certain times of the year. As such, there is a slow rotation of the invested capital as investments are spread over longer time horizons than for non-seasonal businesses. For the banker, this means that short-term agricultural credit may need to be repaid in "lumpy installments," sometimes over multiple seasons. It also means that farmers require flexible and targeted savings and term finance products to meet their specific needs. From the banker's point of view, irregular repayment schedules make liquidity management more challenging and require costly investments in developing customized loan products in an unfamiliar sector (Honohan and Beck, 2007).

II. **Exposure to systematic risks**

Most agricultural households are not truly risk diversified. Even emerging farm businesses and SMEs tend to be either very concentrated in one activity or to have a portfolio of activities that are all exposed to similar key risks like droughts. Production and price risks have a large impact on the profitability and repayment capacity of the borrower. Moreover, risk mitigation mechanisms such as crop insurance or hedging are rarely available (Honohan and Beck, 2007).

Some of these risks, in particular weather and price risks are systemic, which means that ultimately whole agricultural finance portfolios are affected in addition to individual farm-level income losses. While the activities may be diversified (crops and livestock combinations, for example), the risks are still often concentrated (a drought would affect all activities and their market prices). Unless the banker manages to protect the loan portfolio against the most systemic risks, the lack of true risk diversification exposes the bank to the risk of default (Honohan and Beck, 2007).

III. **Limited collateral**

The lack of collateral is often viewed as a bottleneck to improve access to credit. Inadequate collateral or lack of it implies that the borrower is likely to become credit constrained. Collateral can signal the quality of borrower and the availability of collateral may decrease moral hazard problem (Hoff and Stiglitz, 1990; Boucher and Guirkinger, 2008). Consequently, most of the time banks are more likely to provide a loan if the borrower can pay back the loan by pledging collateral.

Agricultural financial service providers have few instruments at their disposal to manage various risks associated with agriculture; they therefore tend to protect themselves through excessive credit-rationing and by relying heavily on traditional land collateral. However, agricultural borrowers' assets are less suitable to be used as collateral. Due to legal and administrative impediments as well as cultural factors, rural assets are often not registered and consequently may be more difficult to foreclose and sell. Even where these constraints are less binding, collateral is a poor protection against massive defaults due to covariant risks(Honohan and Beck, 2007).

IV. **Higher transaction costs**

Agricultural financing involves higher transaction costs than in urban areas given the distances, lower population densities, and lower quality infrastructure. Together, these factors make it hard to aggregate agricultural loans into portfolios that make branches viable. In addition, it can be costly to have branches and staff in remote areas, handling small transactions. One of the most prominent gaps in developing financial services particularly for rural Africa is poor infrastructure, i.e. bad roads, erratic electricity provision, and lack of communications systems. Ethiopia is no exception from being prone to coordination failures in the rural community which creates unfavorable environment for finance providers (Honohan and Beck, 2007).

Financial institutions also face high creditworthiness assessment costs that might exceed the profits they can make with these relatively small loans. If farmers evolve from smallholders to more specialized farmers, the lender must analyze the borrower in all its details (e.g., ability and character, the prospects for the product, cash flow forecasts, etc.) in order to understand the risks involved. To cover such costs, loans must be significantly larger, reaching a size that substantially exceeds the absorption capacity for capital of the smallholder- hence the financing gap.

Farming is also very heterogeneous, and deep sector information is often not readily available. Farming households in particular often have a wide range of crops and activities that can make the assessment of creditworthiness more complex and costly (Honohan and Beck, 2007).

V. Banks competing priorities

Many banks in emerging markets face a number of priorities such as expanding their product offering mostly to urban customers or leveraging their branch networks and presence in urban

locations. They also need to improve their systems (e.g., IT, MIS, investment in risk management, etc.). In this context, expanding to the agricultural sector with all its particularities, without presence in rural areas, and with a lack of technical expertise, seems a significant challenge and appears to be a lower priority. The key issue here is for banks to understand the sector but, more importantly, to identify bankable opportunities in the agricultural space (IFC, 2012).

Scale: A World Bank report by Beck et.al (2011) asserted that dispersed populations and deteriorated road infrastructure make financial service provision through normal delivery channels prohibitively expensive. Deficient energy supply and, thus, the need for generators, as well as the lack of a reliable landline phone system, increase the costs of providing banking services through traditional delivery channels. In some countries, the difficult security situation drives costs up additionally.

Informality: Informality is typically more prominent in rural areas, where there are few formal residential addresses or land titles and little formal employment except government jobs. Competing systems governing land rights, that is, the overlap between modern land law and traditional land assignment systems make the use of land as collateral difficult for traditional lenders. This explains the Ethiopian land

Governance: The provision of subsidized credit through government-owned financial institutions has undermined the culture of credit, and commercial lenders are often reluctant to enter the market. Repeated debt forgiveness by government-owned institutions causes borrowers to confuse loans with grants. In addition, the agricultural sector in most countries is subject to substantial government intervention. Unlike in most developed countries, however, such intervention does not always favor agriculture. This makes agricultural finance more challenging.

2.1.4. Asymmetric information and credit constraints

In many theoretical literatures, it is argued that the presence of asymmetric information between banks and borrowers results in problems of adverse and moral hazard which in turn may hinder the performance of credit markets (Stiglitz and Weiss, 1981; Jappelli, 1990; Petrick, 2004). These

authors demonstrate that credit constrained individuals are those whose participation in the credit market is restricted as a result of asymmetric information. The result is known as credit rationing.[8]

I. Adverse selection

As mentioned earlier, the presence of asymmetric information between borrowers and lenders leads to the problems of adverse selection and moral hazard which may significantly hinder the performance of credit markets (Stiglitz and Weiss, 1981; Jappelli., 1990 and Boucher et. al, 2006).

As shown by Stigltz and Weiss (1981) equilibrium quantity rationing arises from lender unwillingness to increase the interest rate to clear excess demand because doing so would result in adverse selection of the borrower groups .This paper shows that the interest rate charged by banks may itself affect the riskiness of loan and may lead to two major problems. First, the direct effect of raising the interest rate leads to the increase of the bank's return, but there is an indirect effect, adverse selection acting in the opposite direction and it may outweigh the direct effect. To observe this, we simply assume that there are two groups of individuals, the safe group who borrow only if the interest rate is low, and the risky group who borrows when interest rate is increased. Secondly, under an asymmetric information regime, the risky borrower gets a loan at a lower level of interest rate than under perfect information. The opposite happens for a good or a safe borrower. This is because an increase in the interest rate punishes good borrowers and subsidizes bad ones. In credit markets, simply increasing the rate of interest would change the behavior of borrowers and induce them to undertake risky investments (Stigltz and Weiss, 1981). A higher interest rate will negatively affect the behavior of borrowers because risky projects become more attractive at a higher interest rate.

[8]According to Stiglitz and Weis (1981) the term credit rationing can be defined as a situation in which among loan applicants who seems to be identical some receive loans and others do not. The rejected applicants would not get the loan although they accepted to pay a high interest rate. There is also another group of individuals in the community who cannot obtain a loan even if the supply of loan in credit market has increased significantly. But their work deals directly with formal financial institutions.

II. Moral hazard

Moral hazard arises when individuals do not take full responsibility for their actions. However, it is very difficult and costly for the banks to directly control all the actions of borrowers. It needs to frame the terms of the loan contract such that it induces the borrowers to take actions which are in the interest of the lender and attracts low-risk borrowers (Hoff and Stiglitz, 1990).

Stiglitz and Weiss (1981) show that banks rationing behavior arises from lender unwillingness to increase the interest rate to clear excess demand. If the bank raises the interest rate, this would result in changing the borrower's behavior as well, because an increase of the interest rate raises the relative attractiveness of the riskier projects, for which the return to the bank becomes low. Thus increasing the interest rate may lead the borrowers to undertake actions that are contrary to the benefit of the lender, leading to another incentive for the bank to ration credit rather than increasing the interest rate in case of excess demand of credit. Therefore, the interest rate cannot equate demand and supply in credit markets.

Collateral can also be used by the lender as a screening mechanism inducing the borrower to undertake full responsibility of his action, and thereby solve the moral hazard problem (Conning and Udry, 2007). Thus, to solve this moral hazard problem the lender asks borrower to bear a minimum of risk by pledging his collateral.

Moreover, it is argued that both adverse selection and moral hazard arise directly from asymmetric information that characterizes credit markets of developing countries. This in turn may lead to the absence of formal lending institutions. This problem may be even larger since the poor cannot offer collateral and enforcement mechanisms are weak or even absent.

2.1.5. Measuring Access to Credit and Credit Constraints: A Review of Existing Approaches

There are two methodologies for measuring household access to credit and credit constraints. The first and indirect method detects the presence of credit constraints from violations of the assumptions of the life cycle or permanent income hypothesis, while the second involves the

collection of information directly from household surveys on whether households perceive themselves to be credit constrained or not.

I. Detection of Credit Constraints through Violation of Life-Cycle Hypothesis

In the literature, the starting point of the theory of household demand for debt and credit constraint is the life-cycle model and the permanent income hypothesis (Chen and Chiivakul, 2008) which is called the indirect method. Its assumption is that, under perfect capital market, households' demand for credit arises for consumption smoothing. Households maximize their utility over their life cycle by borrowing during low transitory income and saving when they have high transitory income. According to this model, current consumption should be independent of current income. However, because of asymmetry information and enforcement problem, households in developing countries, like Ethiopia, can be credit constrained and might not smooth their consumption (Diagne et al., 2000). The main weaknesses which undermined the validity of the indirect method analyzing households credit demand and access is better explained by Doan et.al (2010). They reasonably argued that households can smooth their consumption using saving, remittances or other accumulated assets; or credit demand can arise from none income smoothing objectives like health care expenses. And also households can engage in investments expecting better future returns by taking loans assuming they didn't have enough saving to finance their investment by themselves. Generally, credit is not usually required for consumption smoothing as it can also be demanded for other economic benefits as stated above. Therefore, the LC/PIH is not a good measure of the prevalence of credit rationing among households.

II. The Direct Elicitation Approach

The second method mostly used in empirical studies for detecting the presence of credit constraint uses information obtained directly from household members on their participation and experiences in the credit market to determine whether they are credit constrained or not. In practice, several qualitative questions regarding household loans applications (or lack of) and rejections during a given recall period are asked and households based on their responses are classified as credit constrained or not. This classification is then used to analyze the determinants of the likelihood of a household being credit constrained and the effects of this likelihood on various household outcomes in reduced form regression equations. Examples of this approach known as the direct

elicitation methodology (DEM) include a study by Petrick (2004) who researched the impact of credit constraints on farm output in Poland and Foltz (2004) who studied the impact of credit constraints on farm profit in Tunisia.

This method was first used by Jappelli (1990) with data from the United States 1983 Survey of Consumer Finances. Feder *et al.* (1990) using data from a household survey in China also employed this method. The theoretical justification for the direct elicitation method, (*i.e.* by directly asking the households if they are credit constrained or not), can be found in the extended version of the life-cycle/permanent income model that explicitly allows for the possibility of a credit constraint (see recent studies Guirkinger and Boucher, 2008, Dong et.al, 2010; Ali and Deininger, 2012; and Ali et.al, 2014 and many others).

Generally, by using the direct elicitation approach, researchers tried to differentiate households by their credit condition. For instance, Boucher et al. (2008) borrowers can be grouped in to the following five sub categories:

An individual is considered as a price-rationed borrower (Unconstrained) if he/she is unaffected by the credit limit from any of the lending institutions and obtains the amount requested. An individual is considered as a price rationed non-borrower (Unconstrained) if he or she is not affected by credit limit, but rather chooses not to borrow in the formal credit market because the price of available credit or interest rate associated with the available credit is too high. Therefore, the individual does not undertake profitable projects that would require credit. An individual is considered as quantity rationed if his participation in a given credit market is involuntarily restricted. He experiences excess demand for credit that is not met by banks and other financial institutions in two ways: (1) his application is either rejected or (2) accepted but he receives less than requested. A household is considered as transaction cost rationed if he or she chooses not to participate in the credit market because of the high transaction costs associated with the loan contract. Finally, a household is considered as risk rationed if he or she chooses not to participate in the credit market because the risk associated with available credit is too high.

2.1.6. Types of Credit Rationing

According to a paper by Chiu et.al (2014), there are four types of credit rationings that households tied with. These are price rationing, transaction cost rationing, quantity rationing and risk rationing. Each of them is described as follows.

Price rationed or unconstrained farmers are those who may either borrow or not, and are satisfied with the loan amount at the current market price. It may be internal or external. External price rationing can occur if the lender raises interest rates and/or transaction costs, so that free choice along the credit demand curve results in a utility maximizing position. Internal price rationing occurs when a borrower chooses not to borrow at fair market prices and transactions costs. Price rationing in this context is determined by cost-quantity tradeoffs along the demand curve and the degree by which these tradeoffs take place is determined by individual credit demand elasticities which differ among borrowers.

Quantity rationed, or supply-side-constrained, farmers may have either had a loan application rejected, or a non-applicant who knew that he would be rejected. A quantity rationed farmer faces a binding credit limit; therefore, the limiting constraint comes from the supply side. A quantity rationed farmer is expected to have excess credit demand.

Risk rationed farmers do not face a binding limit and therefore does not have excess demand for credit. The limiting constraint comes from the demand side. Their demand is lower because of the risk-sharing rules associated with the loan contract. Asset wealth, financial wealth, risk aversion, prudence and property rights are all aspects of the risk rationing problem that the farmer faces.

2.1.7. The Impact of credit rationing on Agricultural Productivity

Though many studies in the credit market literature documented the theoretical explanation how credit market imperfections hurt agricultural productivity, a study by Foltz (2004) outlined a much more compelling arguments. The study asserted that constraints in credit markets can influence level of farm profits and farmer's resource allocation decisions. Acknowledging the literature, the study further hypothesizes the following conclusions on how credit to farm households linked with their production outcomes;

Profit - Liquidity Effect: Access to credit allows farmers to optimize input usage for a given set of fixed assets in the short term. Credit constrained farmers will use inputs only up to their capital availability. In particular the amount of liquidity a constrained household has will influence the overall profit level.

Investment Demand Effect: Farmers facing credit constraints will invest less in capital assets and their land. Credit constrained farmers will not be able to smooth their expenses over time implying that they will not make long-term investments, especially those which entail sunk costs.

Technology Adoption Effect: Farmers without adequate capital cannot invest in a new technology irrespective of that technology's potential benefits. The technology adoption effect represents a specific type of investment demand effect. Often the uncertainty, information costs, and lumpiness of new technologies will have different effects from standard investments.

2.2. Empirical Review of Literatures

Under this section a thorough review of empirical literatures is presented. It includes link between credit constraint status of households and agricultural productivity, determinants of credit constraint conditions of households, i.e. what and how distinguished credit constrained farmers from their unconstrained counter parts. It covers both evidences form studies outside and within Ethiopia.

2.2.1. Credit Constraints and Agricultural Productivity

The literature on credit constraints (see for example Carter, 1989; Feder et al. 1990; Boucher et.al, 2006; Dong et al. 2010, Ali and Deininger, 2012; Ali et.al, 2014 etc) indicated that they can cause a misallocation of resources in farm production. This misallocation of inputs can then cause credit rationed farmers to have lower productivity levels than their unconstrained counterparts. The lower productivity levels may come from a number of sources including lower investment levels and a misallocation of variable inputs.

A study by Dong et.al (2010) in China tried to show the impact of credit rationing on agricultural productivity and income by using a survey data from 511 households from Xinglonggang County of China. Similarly with our study, they used a survey based elicitation approach to identify credit

constrained households from unconstrained ones. The actual econometric procedure was carried out by using an endogenous switching regression model believing it accounted for both heterogeneity and sample selection biases. Their study found considerably different marginal effects of explanatory variables on agricultural productivity. The study further reported that credit constraints resulted a huge agricultural productivity loss, i.e. 31.6 percent. It implies that if all types of credit constraints would eliminated there will be a 31.6 percent productivity gain for credit constrained households.

Another study in Peru by Guirkinger and Boucher (2006) studied the link between credit constrain status of households with agricultural productivity by using a panel survey of 914 smallholders in 1997 and 2003. They found that 52.2 percent of households under the study were credit constrained. They estimated the relationship between household endowments and agricultural productivity for both constrained and unconstrained households. And they found that the marginal effects of these endowments are not similar for the two groups of households and they believed that these differences are aroused due to credit constraint status of households. In this study the agricultural productivity loss due to credit rationing was found to be 26 percent. Thus, eliminating any of the existing constraints in the rural financial system of Peru would gain credit constrained households a 26 percent productivity boost. However, in this study credit constraint conditions are considered only for the formal financial sector. They believed that since rules and regulations of different financial institutions are not similar, a typical household which might constrained in one sector may fulfill the requirements and end credit unconstrained. Therefore, they believed that credit constraint conditions must be defined narrowly within each sector and their impact needs to be considered accordingly. But the main problem is that formal, semi-formal and informal financial institutions are more of complementary and credit constraint from whatever source it is needs to be considered for all sources otherwise it may overestimate the impact of credit rationing. The argument is that from whatever source the household is credit constrained, the household is constrained. From whom to apply is up to the household and credit constrained should be defined broadly as our study did.

Another study in Peru by Woutersen and Khandker (2013) tried to show the effect of credit rationing on Peruvian agriculture by using an endogenous switching regression with fixed effects. Like the previous study by Guirkinger and Boucher (2006), one of the main strengths of the paper

its exploitation of panel dataset. The two studies used a similar survey which was collected in 1997 and 2003. Though their main objective is similar, their difference lied on the estimation procedure. The study by Woutersen and Khandker (2013) used a selection equation to account for endogeniety. They estimated the impact of credit rationing on agricultural productivity and found a 10.6 percent productivity loss, a significantly lower magnitude compared to the 26 percent productivity gap estimated by Guirkinger and Boucher (2006). This shows how sensitive the impact of credit rationing on productivity due to methodological differences alone though they used a similar data set. The conclusions of the latest paper are much more compelling than the previous one mainly for using a relatively healthy econometric model that takes in to account endogeneity problems.

A recent study in neighborhood Rwanda by Ali, Deininger and Duponchel (2014) studied the relationship between credit constraints, agricultural productivity and rural nonfarm participation of households. They used a nationally representative data of 3600 households in rural Rwanda. Their study considered credit rationing in the semi-formal sector alone and 71 percent of households were credit constrained. They used an endogenous switching regression and estimated by using the Full information maximum likelihood procedure. Unlike the previous studies in the literature, this study came up with the idea that households' credit constraint status did not just affect their agricultural productivity but their probability of participating in rural nonfarm activities too. The loss of agricultural productivity due to credit constraint under this study in Rwanda is estimated for 17 percent. They argued that a prudent policy intervention which fully eliminated credit constraints will result a 17 percent productivity gain and will have a significant impact on the livelihood of households. The study also concluded that lifting credit constraints can play a crucial role in creating options to participate in rural nonfarm activities. However, its relatively large sample size and their idea about the impact of credit constraints on activity choice, dealing with credit constraints in the semi-formal sector alone may develop some sorts of skepticism. Because credit constrained households in the semi-formal sector may obtain the amount of credit they want from other sources which possibly relaxed the problem. Therefore, it might be better if credit constraint status is defined for all of the sources and execute the actual impact of credit rationing from wherever the household is constrained.

2.2.1.1. Ethiopian Context

The literature on the impact of credit rationing on agricultural productivity or efficiency in Ethiopia is relatively scarce. The only literatures that have been found are studies by Aliand Deininger (2012) in two zones of Amhara region and a dissertation by Komicha (2007) who studied farm Households' economic behavior in imperfect financial markets in two districts from Southern region of Ethiopia. But there are too many studies which tried to show the impact of credit on agricultural productivity by leveling credit as an explanatory variable treating it either dummy or continuous variable. We do have less interest in these studies as they cannot show the real impact of credit market conditions on agricultural productivity by believing credit is much more than an input in agriculture and needs to be considered differently like we did in this study.

For instance, a study by Matsumoto and Yamano (2010) evaluated the impact of fertilizer credit on crop choice, crop yield, and income using two-year panel data of 420 households in rural Ethiopia. Fertilizer credit is found to increase input application for crop production. They found that credit access increases inorganic fertilizer consumption by 35 kilograms per household. They also tried to show the crop specific impact of access to fertilizer credit, arguing access would increase the yield of teff by 37 and do nothing on maize and wheat crops. They tried to explain this variation by the presence of low adoption rates of high-yielding varieties of maize and wheat, even among those households who receive the fertilizer credit. They finally argued that fertilizer credit programs are effective only with better responsiveness of households to high yielding crop varieties. They also partly argued that adoption of fertilizer depends on the profitability of the crop under consideration. The more the crop is highly demanding in the market the more will be the willingness of households to adopt high yielding varieties simultaneously with high propensity to fertilizer credit. However, the paper did say nothing about the existence of credit rationing and constraints. In fact, the household had access to fertilizer credit doesn't mean he got the amount he was demanding and didn't obtained fertilizer credit doesn't mean that the typical household doesn't have the demand. And also fertilizer credit program participation of households is not usually random.

The study by Komicha (2007) used a survey of 240 households from Merti and Adamitullu Jido Kombolcha districts in Oromia regional state of Ethiopia. He estimated credit sectoral choice

probabilities of farm households. Under this study credit constraint status of households is defined broadly across all types of credit suppliers. The study further tries to show the impact of credit constraints on technical efficiency of farmers and uncovered a 12 percent efficiency gap between constrained and unconstrained households. It also showed a positive correlation between loan size and level of agricultural production efficiency. Given the study was carried out in Southern parts of Ethiopia which has a significant difference in agro-ecological and other socioeconomics settings from Amhara region, it is difficult to generalize the results of this paper. Therefore, it is reasonable to see the problem in Amhara region with a relatively updated and geographically diverse data set by using more efficient methodological tools.

World Bank economists, Aliand Deininger (2012), studied the causes and implications of credit rationing in two zones of Amhara region. Under their study a survey of 1587 households were exploited. The studies dealt with credit rationing of rural households in the semi-formal sector alone. They used the survey based elicitation approach in identifying credit constrained households from their unconstrained counterparts. The study found an 11.4 percent productivity gap between constrained and unconstrained households. The implication is that if exogenous policy shocks which can eliminate all types of credit constraints happen, there would be a productivity gain of 11.4 percent by credit constrained households. But we suspect here that considering credit rationing in the semi-formal sector alone doesn't reflect the real impact of credit rationing. In fact, the productivity impact from their study is significantly lower than what we evaluated under this paper. The relatively diverse and updated dataset and broader definition of credit rationing makes this study of ours much demanding to fill the existing literature gap, and more importantly, to light a clear insight on the status quo of credit rationing and its impact on smallholder farmers in Ethiopia.

2.2.2. Determinants of Credit Constraint status of households

Empirical evidence supports that household level demographic, socio-economic and institutional variables happen to affect the probability of being credit constrained. Among demographic variables age, sex and educational attainment of the household head, family size and dependency ratio are usually considered as determinants of credit rationing.

Many studies found that age of the household's head has a nonlinear impact on the probability of being credit constrained. For instance, a study by Zeller (1994) in Madagascar showed that households headed by younger aged individuals are significantly vulnerable to be credit constrained in the informal credit market. On the other hand older aged individual headed households are significantly less vulnerable for informal credit constraints. Under the same study, the effect of household age is found to be insignificant to determine vulnerability for credit constraints in the formal credit market. Another study in China by Dong, LU and Featherstone (2012)reported similar findings concluding nonlinear effect of household head's age on probability of being credit constrained were younger age is associated with more vulnerable to credit rationing and vice versa.

Education status of the head of the household is found to be one of the main determinants of the probability of being credit constraint in the literature. A study in Madagascar by Zeller (1994) documented that years of schooling of the household head was associated with significant and positive coefficient, i.e. the more educated the household head is the more vulnerable would be the household for credit rationing. He reasoned out as this might be explained by that relatively educated individuals demanded more loans to make productive investments in which the financial institutions are improbable to approve fully or partially. And lenders didn't value their education and rate them with a high probability of default leading them to rejection. Similarly, a study in Ethiopia by Ali and Deininger (2012) stressed that household heads with formal education are significantly more vulnerable to credit rationing in the semi-formal sector. On the contrary, a study in Rwanda by Ali, Deininger and Duponchel (2014) and in Peru by Zegarra, Escobal and Aldana (2008) concluded that number of years of schooling of the household head is significantly and negatively associated with probability of being credit constrained. These studies strongly defended that education of farmers must be one of the tools of reducing the extent of credit rationing. From this we can conclude that the impact of education of credit constraints is ambiguous in the literature.

Gender of the household head has been believed to be one of the leading determinants of credit rationing in the literature. Studies by Baiyegunhi (2008) in South Africa and by Chiu, Khantachavana and Turvey (2014) in China uncovered that gender of the household matters

in determining the probability of being credit constraint. They found that male headed households are less vulnerable than female headed households for credit rationing.

Saving status of households also leveled in the literature as one of the determining factors for households probability of credit constrained. A study in China by Dong, LU and Featherstone (2012) concluded that household savings are significantly and negatively associated with the probability of being credit constrained. They argued that more savings can finance full of part of the financial demands of households which left the typical net saver household less vulnerable to credit rationing. Surprisingly, under this study the impact of collateral is significantly and positively affected the probability of credit constrained. They didn't reasoned out why, but we think that such things appear because households having relatively better endowment of collateral may have higher propensity to ask for larger loans which may end them credit constrained as financial institutions working in rural areas disperse smaller size of loan per head.

The Rwandan study by Ali, Deininger and Duponchel (2014) reported that better access to information via news and variables for household members or relatives holding political office have a significant negative impact on credit rationing. They asserted that better access to information and political office affiliation minimizes the probability of ending credit constrained. The study further documented that households having greater value of assets and livestock ownerships are significantly less vulnerable for credit constraints (See also Chiu, Khantachavana and Turvey, 2014).

In Ethiopia, the study by Ali and Deininger (2012) found that value of nonfarm income, number of oxen and male adults in the household, value of livestock ownership (less oxen), political affiliation, membership in service cooperatives and MFIs significantly minimizes households' probability of being credit constrained. The study believed that income from off farm activities can relax credit constraints and membership in cooperatives and/or MFIs gives the household a relatively better access to credit and thus negatively affects vulnerability for credit constraints. They also asserted that households with a member holding political position are significantly less constrained.

Generally, there have been different determinants of credit constraints presented differently by different authors in the literature. The variation in the determinants of credit constraints across different studies mainly arise from the equivalent variations in their objectives or the contents of the dataset they exploited. Every author decides what variable to include and what not primarily depending up on the dataset they are working with. In this study, we are lucky enough from using a relatively rich dataset compared to previous studies that have been carried out within or outside Ethiopia. This allowed us to include additional variables rationalizing them with their intuitive theoretical relationships with the probability of credit rationing. For instance, this paper is the first in its kind to see how smallholder farmers' trust about financial institutions explains their status of credit rationing.

2.3. Ethiopian Financial Sector Review with respect to Agriculture

Unlike its East African neighbors (Kenya, Tanzania and Uganda) and other developing countries, Ethiopia is not yet opened its banking sector to foreign investors, though it liberalized the sector for domestic participation in 1992. There is no capital market and it has only a very limited informal investing in shares of private companies. This ends the financial development status quo of the country questionable.

As reported in the diagnostic of Agricultural finance potential in Ethiopia by Amha and Peck (2010) and a study by Amha (2011), the Ethiopian financial sector is characterized by the presence of formal, semi-formal and informal financial service providers. Formal providers include commercial banks, MFIs, and insurance companies while semiformal providers are financial cooperatives (SACCOs). Informal providers consist of social groups that provide savings and lending functions (e.g., Iddir that focus on savings and lending for social ceremonies such as burials, or Iqqub that provide savings and lending services within homogenous social groups), private money lenders, friends and relatives, as well as trade partners.

The commercial banking sector consists of one state-owned development bank (Development Bank of Ethiopia (DBE)), two state-owned commercial banks (Commercial Bank of Ethiopia (CBE), Construction and Business Bank (CBB)), and 16 private commercial banks (NBE, 2013). Despite the continuous increase in the capital base, the banking industry in Ethiopia is still very small compared to some big banks in Africa.

In response to the limited accessibility of the commercial banking system and NGO supported credit programs and the growing skepticism about the effectiveness of subsidized input supply loan programs, the Ethiopian government established Microfinance institutions and rural saving and credit cooperative societies (RUSACCOs) in 1996 by formulating the required legal and enforcement procedures (IFAD, 2011). Growth in Outreach and sustainability of microfinance institutions that reach a large number of rural and urban poor who are not served by the conventional financial institutions, such as the commercial banks, has been a prime component of the new development strategy of the Ethiopian government (Amha, 2011). Both the government and foreign as well as local NGOs established (or supported the establishment of) such institutions.

In Ethiopia, there are 30 microfinance institutions officially recognized by the National Bank of Ethiopia (NBE, 2013). These institutions deal directly with individual farmers who fulfill the loan provision criteria set by their management. Though an absolute figure is not available, it has been believed that these institutions play an important role in narrowing the gap between the demand and supply of credit in rural areas. The advantage of these financial institutions is that farmers can get loan in cash and use it to purchase the most limiting production resources.

In Ethiopia, cooperatives are playing a crucial role in the country's past and current development strategy. As of 2012, there were 43,256 primary cooperatives, both agricultural and non-agricultural, in Ethiopia with 6.5 million members (of which 21.5 percent are female) and 2.7 billion birr capital. Agricultural cooperatives, however, only account for 26.5 percent of cooperatives in the country. We noticed variations in the proportion of agricultural cooperatives across the four main regions – more than 37 percent of cooperatives in Tigray, Amhara and Oromia regions are agricultural cooperatives, compared to only 17.5 percent in SNNP region (Bernard et.al, 2012).

The informal financial sector in Ethiopia, as indicated earlier, comprises mainly Iqubs (rotating savings schemes), iddirs (traditional insurance schemes), money lenders etc. This sector is neither regulated nor counted for in the country's financial intermediation process. The sector, however, provides by far the greatest financial services to the bulk of the population on flexible terms. Though, the informal financial sector is important to most informal sector operators and the farming population, government support to the sector has been until recently very little.

Generally, the financial sector is challenged to deliver efficient and effective financial services in rural areas where a huge demand supply gap exists. A report by Amha and Peck (2010) listed the following constraints that are prevalent in the agricultural finance sector:

- Limited access to financial services in rural areas of the country
- High transaction costs due to small loan size, lumpy cash flows, and high covariant risks across borrowers and clients live dispersed and suffer from a lack of adequate infrastructure.
- Skills gap in the banking sector; especially a lack of knowledge of the agribusiness sector and poor risk management skills.
- Low product quality in savings, loans, insurance and payment services. This covers limited credit for input financing, for inventory and export financing, for long term loans, for cash flow based lending and deposit products.
- High collateral requirements and the inability to use land as collateral lead to the use of illiquid and perishable collateral.
- Lack of a dedicated regulatory framework for cooperatives.

3. Methodology of the Study

3.1. Data

As stated earlier, the principal objectives of the paper are examining the smallholders' access to credit and the impact of credit constraints on Agricultural productivity. In order to attain these objectives household level micro data is exploited.

The data used for this study obtained from the household survey managed for an ongoing research project titled " The Ethiopian Project on Interlinking Insurance with Credit in Agriculture (EPIICA)" jointly owned by the University of California San Diego, University of Athens, EUJRC ,FAO , Ethiopian Economics Association, Dashen Bank and Nyala Insurance company . The project aims at fostering the use of fertilizer by smallholder farmers to boost productivity (Ahmed et.al, 2011). The idea of the project is to foster agricultural production credit delivery by institutionalizing insurance back up schemes. Regional average price data[9] for Amhara region during the month of February, 2013, has been obtained from central statistics agency for the selected cereals used in the study.

EPIICA works with Dashen bank and Nyala Insurance share Company (NISCO) targeting Amhara regional state. Arguing the region is a high potential region, the project presumed that various aspects of risk and lack of sufficient credit are the main restraints in expanding agricultural production by the farm household. In early 2011, EPIICA conducted its baseline survey (McIntosh et.al, 2013). Using well organized questionnaire, detailed information was collected about different household level characteristics, farm output, production costs, off-farm income, asset endowments , household's participation in and perceptions of credit markets separately for agricultural and non-agricultural credit and attitudes towards Weather Index Insurance(WII). This fully-fledged data is sufficient to meet the paper's leading objective and more importantly it is compatible with the methodology employed underneath.

When we come to sampling issues, the survey followed NISCO's informed opinion based on best potential to purchase WII, Zones and then kebeles within selected zones were purposively selected. West Gojjam, North Wollo, South Wollo and North Shewa became target zones of the survey.

[9] Since we fail to obtain price data for selected cereals in each district, we decided to use regional average price data during the month the household level data was collected by EPIICA. The price dataset help us in evaluating the value of agricultural yield instead of making our analysis based on physical productivity which is a weak measure of land productivity compared to value of yield per hectare. It surely makes the analysis much more compelling.

The survey covers 60 kebeles from four zones of Amhara region, namely, West Gojjam, North Shewa, South Wollo and North Wollo. Households within the selected kebeles were randomly selected to participate in the study; in each kebele 18 cooperative member households and 2 households that are not a member of the primary cooperative were selected (McIntosh et.al, 2013). After a thorough data cleaning process up to the extent that households used in the final estimation procedures fulfill each variables of interest, a total of 1082 households has been used in the study. The sample households were distributed across the four target zones, i.e. 350 households from West Gojjam, 354 from North Shewa, 136 from North Wollo and the remaining 242 households from South Wollo.

3.2. Method of data Analysis

To meet the ultimate ends of the paper, we utilized both descriptive and econometric analytical tools. Firstly, for methodological simplicity we used descriptive methods of analysis to examine access to agricultural credit by the smallholder and discussion related to credit constraints and their linkages with selected variables in chapter four. Mean and percentage descriptive analytical tools have been used under a clearly understandable frequency distribution sketch. Finally, we empirically investigated the impact of credit constraints on Agricultural productivity and those factors that determine farmers to be credit constrained using the econometric estimation procedure. Under this procedure we estimated the productivity loss of being credit constrained.

3.3. Measuring Credit constraint

There are two frequently used methodologies for measuring household access to credit and credit constraints. These are the indirect and direct methods of identifying credit constrained households. The former method infers the presence of credit constraints from violations of the assumptions of the life-cycle or permanent income hypothesis (LCH/PIH)[10], while the latter collects information directly from household surveys on whether households perceive themselves to be credit constrained using a step by step sequential procedure (Diagne et.al, 2000; Boucher et.al, 2006).

[10] Detailed view of each of the procedure is presented at the literature review part. The two approaches are also reviewed in

On the relative importance of these procedures, this study argues that the direct approach ,which is also called the 'direct elicitation approach', enjoys substantial improvements compared to the procedures followed by the LCH/PIH to detect credit constraint issues(see also similar papers by Guirkinger and Boucher , 2008; Dong et.al, 2010; Ali and Deininger, 2012; Ali et.al , 2014 etc.). They stress that this approach is fundamentally qualitative and doesn't show how households are severely credit constrained. But as stated above similar studies by Guirkinger and Boucher (2008), Dong et.al (2010), Ali and Deininger (2012) and Ali et.al (2014) argued that this methodology is advantageous in disentangling the impact of credit constraints on the one hand and the determinants of credit constraints on the other hand, though the model still lacks to show the degree of the problem among constrained households.

Therefore, in light of the direct approach, we began our task by directly eliciting credit constrained households from those who are not. And finally, if a typical household is constrained, we further did investigation on which of the three forms of non-price rationing[11] that the smallholder experienced for our analysis. In our analysis, a typical household which is subject to one or more forms of non-price rationing was treated as rationed and coded accordingly in the below mentioned selection equation. More importantly, the EPIICA survey, on which this paper depend ultimately, allowed us to elicit credit constrained households through the step by step sequential procedures stated on the questionnaire.

3.4. The Model

3.4.1. Credit constraints and conventional Agricultural Household models

The literature on credit constraints (see Guirkinger and Boucher, 2008; Dong et.al, 2010; Ali and Deininger, 2012; Ali et.al, 2014 etc.) suggests that they can cause a misallocation of resources in agricultural production. This misallocation of agricultural inputs causes credit rationed farmers to

[11]Credit rationing can be either price (interest rate) or non-price rationing (See Stiglitz and Wies, 1981). In this paper we will deal with non-price rationing which may appear in three forms: quantity rationing, transaction cost rationing or risk rationing. It has been believed that each form of non interest rate rationing affects households' production resource allocations.

maintain lower levels of productivity than their unconstrained counterparts. This lower productivity comes in line with the conventional argument in production theory. If a typical household is tied with binding liquidity constraint, it will have lower investment levels in production and also suffer misallocation of variable inputs which will result lower level of productivity (Foltz, 2004).

In agriculture, at the beginning of the production period, farm households need to allocate their available resources between current period consumption, purchase of variable inputs for production, and investment. The household unconstrained in the capital market can separate consumption decision from farm production decisions. Households can then choose production inputs optimally for production process they face. In this scenario the levels of inputs in production and investment will not be affected by the level of credit they receive. However, in the case of credit constrained farm households, the choices they made in acquiring inputs for investment and production depends on the amount of credit they receive. They will have a productivity impact on constrained households (see Diagne and Zeller, 2001; Foltz, 2004; Guirkinger and Boucher, 2008; Ali and Deininger, 2012 and Ali et.al, 2014). All tried to derive testable relationships between credit constraints and potential outcome variables using the framework of the standard agricultural household model that combines both consumption and production decisions of farm households developed by Singh et al. (1986) under imperfect market situations.

In an ideal world of perfect and complete markets, the recursive property of the model implies that farm households' production and consumption decisions will be separable. Decisions about input use will thus be independent from households' initial resource endowments and output per area unit will be unaffected by the level of liquidity and initial endowments of resources such as land and family labor. But these arguments no more hold in scenarios with market imperfections, in which credit market failure is the one. Production and consumption decisions of households are simultaneous, implying agricultural input use will no more independent with the availability of capital and initial endowments. Those households who face binding credit constraints may fail to afford the maximum desired levels of input use which will in fact translate into levels of productivity below than if the other case happens, i.e levels of productivity if the household is free of liquidity constraint. Therefore, before we directly go through our econometric model

specification, it is better to build an extension of the conventional agricultural household model which is compatible with credit market imperfections as stated below.

3.4.2. Behavioral Foundation of the Model

As usual, let's start from a simple peasant economy where smallholder farm households are both producers and consumers. They make both production and consumption decisions simultaneously using the below mentioned formal utility maximization theory, which is widely covered in the neoclassical empirical literature. The following inter temporal model (which show the households' choice for period 0 and 1) is developed from a study by Briggeman et.al (2009) which based its analysis on neoclassical literature too.

$$\max_{c_0>0, c_1>0, x>0, B\geq 0} U(c_0, c_1; z^h) \quad \textbf{(1)}$$

Subject to the following list of constraint equations

$$a + B - c_0 - PX = 0 \quad \textbf{(2)}$$

$$f(x; z^q) + O - c_1 - (1+r)B = 0 \quad \textbf{(3)}$$

And

$$\bar{B}(z^h; z^q) \geq B \quad \textbf{(4)}$$

Where

"c_0 "=consumption in period 0

"c_1 "=consumption in period 1

"a "=liquid funds on hand

"B" = borrowed funds which will be paid in period 1 including interest

$f(x; z^q)$=Q=production function

$\bar{B}(z^h; z^q)$=borrowing constraint in period 0

"P" is price of variable input

$U(c_0, c_1; z^h)$ is a twice differentiable quasi-concave utility function, noting utility is additive between the two periods 0 and 1

"x" represents variable inputs used in the production process

"z^q" represents the total of fixed and exogenous inputs used in production

"O" represents the aggregate of all income generating activities by the household

"z^h" is exogenous household characteristics

"r" is price of borrowed funds which ultimately depend on the demand and supply of funds

Equation 1 outline the consumption and production choices the household make for the ultimate objective of utility maximization. But in the normal course of welfare maximization, the house hold is constrained by the budget constraint (expressed in equations 2 and 3) and the credit constraint indicated by equation 4. The last constraint states the credit market conditions the household will involve in, in case of limited liquidity in hand. Therefore, before constructing the farm households' productivity equations it is procedural first to find the optimal conditions in line with the arguments equations 1-5 hold when the household is credit unconstrained using the following Lagragian equation.

$$\boldsymbol{L = U(c_0, c_1; z^h) + \lambda(a + B - c_0 - PX) + \mu(f(x; z^q) + o - c_1 - (1 + r)B) + \pi(\bar{B}(z^h; z^q) - B)}\text{--.....} \quad \textbf{(5)}$$

After executing the model by following the conventional maximization procedures first assuming the household is unconstrained in the credit market, we will get the following optimal condition for production.

$$\frac{\partial(f(.)}{\partial x} = p(1 + r)\text{.....} \quad \textbf{(6)}$$

Since variable inputs are purchased initially and farm revenue is obtained latter, p needs to be inflated by r in our ideal model. Then we can evaluate the amount of the optimal input from equation 6, and let we denote it by x^{uncons} .

Finally, when we evaluate equations 1-4 when the household is tied with credit constraint, the optimal production condition will be different, i.e

$$\frac{\partial f(.)}{\partial x} = p((1 + r) + \frac{\pi}{\mu})\text{[12]}\text{.....} \quad \textbf{(7)}$$

[12]Respectively, π and μ represents the Lagragian multipliers for the borrowing constraint in period 0 and the budget constraint in period 1. And the model assumes that the two multipliers are strictly positive.

By following similar procedure, we can evaluate optimal production inputs from equation 7, and let we call it x^{cons}.

Theoretically, when a household is credit constrained it will purchase less productive inputs, i.e. $x^{cons} < x^{uncons}$. Therefore, the credit constrained household will produce lesser output than the unconstrained one, other things remain constant. Finally, we can develop an estimable model as follows with all due respect to our conceptual and behavioral sketches so far.

3.4. 3.The Empirical Model

First, unlike the previous studies those have been conducted in Ethiopia, this paper pursued to examine the farmers' agricultural credit access landscape using detailed descriptive analytical tools. Second, determinants of the probability of being credit constrained and the impact of credit constraints on agricultural productivity is estimated simultaneously by using an endogenous switching regression[13].

In estimating the impact of credit constraints on productivity, a study by Feder et al (1990), outlined two issues that may arise in estimation. The first is heterogeneity between the two groups of sample smallholders (constrained and unconstrained). These two groups of households are not homogenous with respect to their credit demand. Some non-borrowers perhaps do not borrow because they have enough liquidity so they do not need any sort of credit, while others do not borrow because they cannot borrow due to credit constraints that tied them from accessing the credit they need for. Thus, the effect of endowment variables on agricultural productivity may not be independent of credit status. Under credit constraints, factors of production may have differential effects on agricultural productivity than is the case of unconstrained scenarios. Therefore, the main significance of switching regression is that it allowed us to control both selection and unobserved heterogeneity issues that may arise onwards doing the basic estimation procedure. Because the main weakness of the other straight forward methods that treat credit

[13] This is a kind of model in which a criterion equation sorts individuals (in our case farm households) over two different regimes. See Maddala (1983) and Zurab and Sajaia (2004) for clear understanding of the endogenous switching model and its fundamentals.

constraint dummy as an explanatory variable is due to their failure to take in to account the evil outcomes of both selection and heterogeneity problems.

In this paper, a household is credit constrained if the household requested more loans than were supplied, or if it required loans but was unable to borrow due to various stated reasons in the questionnaire. So after separating credit constrained households from others, we then empirically explored the relationships between productivity and endowments of land and liquidity, various demographic and socio-economic factors for constrained and unconstrained households exclusively by using the data in hand (see similar studies by Guirkinger, and Boucher, 2008; Dong et.al, 2010; Alie and Deininger, 2012 and Alie et.al, 2014).

Consider the following model as presented by Maddala (1983), which describes the behavior of an agent (in our case the household) with two regression equations defining two regimes, and a certain function I_i that determines which regime the agent faces (selection equation):

Let the latent variable I_i^* (representing excess demand for credit) be expressed as

$$I_i^* = \gamma Z_i + U_i \quad \textbf{(8)}$$

The value of the latent variable is unobservable. It has been identified based on the succeeding two separate equations defining a dichotomous outcome for the latent variable.

$$I_i = 0 \; if \gamma Z_i + U_i \leq 0 \quad (\textbf{9})$$

Equation***ix*** is defined for those groups of households that are credit unconstrained. Because their excess demand equation valued either zero or negative (implying excess supply which means the household doesn't experience a binding credit constraint)

$$I_i = 1 \; if \gamma Z_i + U_i > 0 \quad (\textbf{10})$$

The above equation x applies for those groups of individuals whose excess demand function for credit assumed a positive value. This implies smallholders under this group face a binding credit constraint.

Following the above arguments from $equation$ 9 and, a continues productivity equation for both constrained and unconstrained regimes can be explicitly represented as

Regime 1: $Y_{1i} = \beta_1 X_{1i} + \in_{1i} \; if I_i = 0$ ……. (**11**)

Regime 2:$Y_{2i} = \beta_2 X_{2i} + \in_{2i} \; if I_i = 1$ ……. (**12**)

In the above model Y_{ji} represents the dependent variable, i.e. agricultural productivity proxied by cereal productivity (value of selected cereal yield per hectare of land). Equations 11.and 12 presents the production equation for credit unconstrained and constrained households respectively. These equations are formed based on the screening procedure under the selection equation. While$X_{1i} and X_{2i}$ are vectors of weakly exogenous variables. β_1 ,β_2 and γ are vectors of population parameters that are estimated in the model using the survey data. Our model relies on the assumption that the error terms, i.e.,$U_i, \in_i and \in_i$, have a trivariate normal distribution, with mean vector zero and covariance represented by the following matrix sketch.

$$\begin{bmatrix} \delta_u^2 & \delta_{u1} & \delta_{u2} \\ \delta_{1u} & \delta_1^2 & - \\ \delta_{2u} & - & \delta_2^2 \end{bmatrix}$$

On the above covariance matrix, δ_u^2 represents the variance of the error term in the selection equation 3.1. On the other hand, δ_1^2 and δ_2^2 are variances of error terms in the continuous equations 3.2 and 3.3, respectively. $u_i and \epsilon_{1i}$ has a covariance of δ_{1u}; and $u_i and \epsilon_{2i}$has a covariance of δ_{2u}. The model assumes that $Y_{1i}$and Y_{2i} cannot observe simultaneously, implying their corresponding error terms don't have a defined covariance. The model further assumes that δ_u^2=1, i.e. γ is estimable only up to a scalar factor.

Based on our argument on the distribution of disturbance terms, the logarithmic likelihood function can be formulated following the procedure by Zurab and Sajaia (2004) who depend their derivation on Madalla (1983).

$$lnL = \sum_{i=1} \left\{ I_i w_i \left[\ln(F(\eta_{1i}) + \ln(\mathrm{f}(\frac{\epsilon_{1\mathrm{j}}}{\delta_1})/\delta_1) \right] + (1 - \mathrm{I_i}) \mathrm{w_i} \left[\ln\left(1 - \mathrm{F}(\eta_{2\mathrm{i}})\right) + \ln(\mathrm{f}(\frac{\epsilon_{2\mathrm{i}}}{\delta_2})/\delta_2 \right] \right\} \ldots\ldots\ldots\ldots \; (\mathbf{13})$$

Where

F (..) represents a cumulative normal distribution function

f(..) denotes a normal density distribution function

wi is an optional weight for observation i

η_{ij} is defined as , $\eta_{ij} = \frac{\gamma Z_i + \frac{\rho_j \epsilon_{ji}}{\delta_i}}{\sqrt{1-\rho_j^2}}$ where j=1,2

ρ_1 is the correlation coefficient between $\epsilon_{1i} and u_i, which\ is\ defined\ as$ $\rho_1 = (\frac{\delta_{1u}^2}{\delta_u \delta_1})$

$\rho_2 isthecorrelationbetween \epsilon_{2i} and u_i , whichisdefinedas \rho_2 = (\delta_{2u}^2/\delta_u \delta_2)$

<u>Note that</u>; In line with the standard statistical arguments,

ρ_2 and ρ_1 must lie between -1 and 1, and

δ_1 and δ_2 must be always positive

The estimates of parameters in the endogenous switching regression can be obtained by using the Full information maximum likelihood estimation by using the movestay command in stata. The robust and meaningful standard errors and correlation coefficients are obtained simultaneously in the FIML estimation procedure (Madalla, 1983, Lokshin and Sajaia, 2004).

After estimating the models' parameters by using the above mentioned standard procedure, the following conditional expectations are consideredin our due procedure.

$$E(Y_{1i} / I_i = 0, X_{1i}) = X_{1i}\beta_1 + \delta_1\rho_1 f(\gamma Z_i)/F(\gamma Z_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (\mathbf{14})$$

$$E(Y_{1i} / I_i = 1, X_{1i}) = X_{1i}\beta_2 - \delta_1\rho_1 f(\gamma Z_i)/(1 - F(\gamma Z_i)) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (\mathbf{15})$$

$$E(Y_{2i} / I_i = 0, X_{1i}) = X_{2i}\beta_1 + \delta_2\rho_2 f(\gamma Z_i)/F(\gamma Z_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (16)$$

$$E(Y_{2i} / I_i = 1, X_{2i}) = X_{2i}\beta_2 - \delta_2\rho_2 f(\gamma Z_i)/(1 - F(\gamma Z_i)) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (\mathbf{17})$$

Given the aforementioned conditional expectations, the average impact of credit constraints on agricultural productivity can be computed as the difference between the expected value of crop productivity by the unconstrained smallholders and that of constrained households.

$\Delta Y_i = E(Y_{1i} / I_i = 0, X_{1i}) - E(Y_{2i} / I_i = 1, X_{2i})$..... …… (**18)**

Previous studies on the impact of credit rationing on agricultural productivity used a similar approach by using an equivalent mathematical expression equation 4.1 in chapter four.

3.5. Description of Variables used in the study

In the following table the explanatory variables that are used in explaining the dependent variables in both the selection (Probability of being credit constrained) and production (crop productivity) equations are listed with their expected sign in each of the equations. These listed explanatory variables are recruited based on their theoretical relationship with each of the dependent variables and learned implications from similar works that have been done so far.

Explanatory variables	Shorthand	Expected sign in productivity of land equations[14]	Expected sign in the selection equation
Liquidity in 1000s of birr	liquidity1000	+	Not applicable[15]
Value of fertilizer per hectare	vinorgferhectar	+	Not applicable
Log of parcel in hectare	lnparcelhectar	-	-
Male headed dummy	Maledummy	+	-
Age of the household head	Agehead	+	-
Age square of the household head	ageheadsqu	-	+
Household size	hh_size	+	Ambiguous [16]

[14] The expected sign of explanatory variables in the agricultural productivity equations across constrained and unconstrained households is expected to be similar with difference in level of significances and magnitude of marginal effects.

[15] The "Not applicable" command indicates that the variable is not included in that equation

[16] Ambiguous implies the sign of this coefficient is ambiguous in the literature and difficult to generalize

Explanatory variables (continued…..)	Shorthand (continued….)	Expected sign in productivity of land equations[17]	Expected sign in the selection equation
Informal education dummy[18]	Infoedudummy	+	-
Primary education dummy	Drimarydummy	+	-
High school and above dummy	dhschool	+	-
Dummy for households in Gojjam[19]	dwgojjam	+	-
Dummy for households in south Wollo	Dswollo	-	+
Dummy for households in north Wollo	Dnwollo	-	+
Risk averse household dummy	riskdummy	-	+
Number of oxen in the household	numberoxen	+	Not applicable
Hired labor dummy	hireddummy	+	
Average slope index[20]	Avslope	+	Not applicable
Average altitude index[21]	Avaltitude		Not applicable
Drought vulnerable dummy	droughtdummy	-	Not applicable
Muslim headed dummy	muslimdummy	Ambiguous	-
Enterprise ownership dummy	enterprisedummy	Not applicable	-
Livestock ownership in TLU	livestocktlu	Not applicable	-
Value of house	house1000	Not applicable	-
Bank account dummy	bankaccountdummy	Not applicable	-
Net saver dummy	aavedummy	Not applicable	-
Bank trust dummy	banktdummy	Not applicable	-
Kebele cooperative trust dummy	Kctdummy	Not applicable	-

[17] The expected sign of explanatory variables in the agricultural productivity equations across constrained and unconstrained households is expected to be similar with difference in level of significances and magnitude of marginal effects.

[18] In defining educational dummies, we used illiterate household head dummy as a base variable

[19] While defining zonal dummies, we used North Shewa Zone as our base variable without any criterion

[20] Weighted for each land type covered by thee selected cereals accordingly with weights in the questionnaire

[21] [21] Weighted for each land type covered by thee selected cereals accordingly with weights in the questionnaire

4. RESULTS AND DISCUSSION

4.1. Descriptive Analysis

Under this section we tried to discuss the status quo of credit rationing by using the direct elicitation or survey based approach, the market for agricultural credit in the selected zones, the snapshot of credit rationing status by geographical setting and the descriptive relationship between credit rationing status of households and different demographic and socio-economic variables.

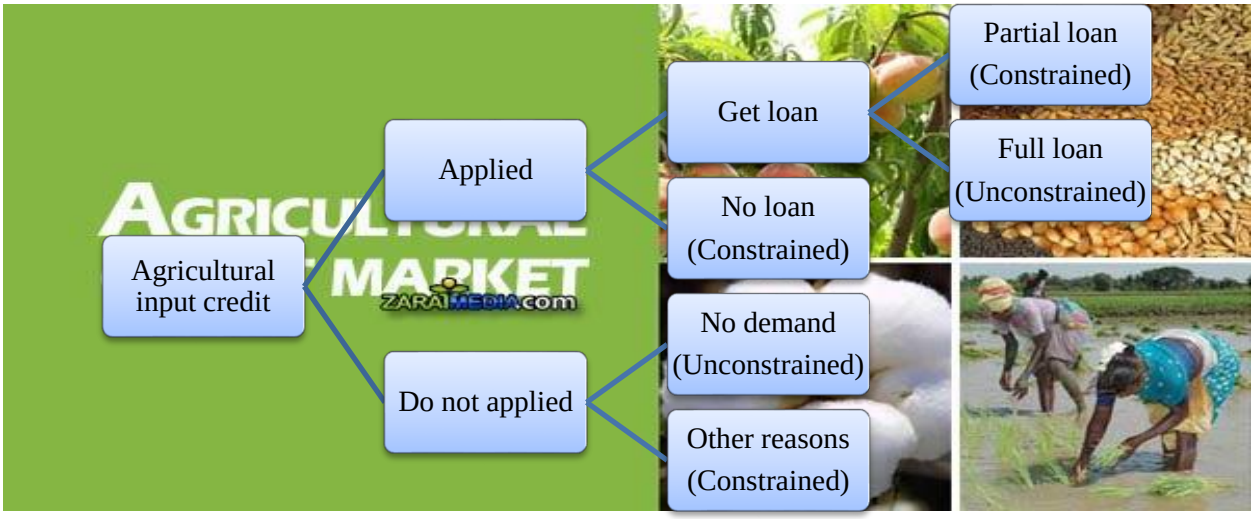
4.1.1 Access to and constraints of Agricultural credit

4.1.1.1 The survey based elicitation approach for EPIICA

This approach has been also called the direct elicitation procedure and it exploits household's survey to uncover the existing pattern of access to credit. More importantly, this approach helps us to differentiate credit constrained households from their unconstrained counter parts and give us the opportunity to see the characteristic explanations of each group. The following diagram clearly shows the contextual direct elicitation approach for agricultural credit in our study.

In the survey based elicitation procedure as indicated on Figure 4.1 below, farm households decide whether or not to apply for credit for agricultural production purposes. If applied, it may or may not get the will of the credit supplier. There will possibility be three mutually exclusive outcomes. One, the credit supplier may approve the application and deliver the full amount of loan asked. In this case the household is said to be credit unconstrained. Two, the household may get partial approval from the credit supplier getting only part of the loan. In this scenario the typical household is said to be credit constrained which is quantity constrained too.

Figure 4.1. The decision tree in the direct elicitation procedure for credit constraint status of households contextualized with EPIICA survey 2013



Finally, the application may be rejected at all. This also ends the household as quantity constrained. On the other hand, households may not apply to credit due to various reasons. There are two main possible aggregates of reasons that explain why the household didn't applied for agricultural credit. It may not applied because the household didn't have the demand at all which makes the typical household credit unconstrained. Or, the household may not applied for credit due to other various reasons that makes the household credit constrained. Depending on their reasons, these households are leveled as quantity rationed, transaction cost rationed and risk rationed; but all credit constrained. We saw this under the type of credit rationing part of the paper below.

Application for Agricultural Credit

As noted earlier, our first step in the survey based elicitation was seeing the agricultural credit application status of the household. It proceeded with another question for non-applicants to see the reasons why they are not applied as it will help us to observe if there are discouraged households[22].

[22] Discouraged households are those households which have the demand for credit but unable to apply due to some sorts of reasons like high transaction costs, institutional bottlenecks, fear of rejection and risk episodes.

Table 4.1. Agricultural input credit application status of households by administrative zones

Did you applied for any agricultural production credit during the last 12 months?	**North shewa**		**West Gojjam**		**South wollo**		**North wollo**		**Total**	
	Freq	%	Freq	%	freq	%	Freq	%	Freq	%
Applied	80	22.60	160	45.71	14	5.79	20	14.71	274	25.32
Not Applied	274	77.40	190	54.29	228	94.21	116	85.29	808	74.68
Total	354	100	350	100	242	100	136	100	1,082	100

Source; Authors computation form EPIICA 2013 Survey

As it is evident from the previous Table 4.1, among those households participated in the survey only 25.32 percent of them applied for agricultural production credit from all sources. The credit application pattern of households is not uniform for the four target zones where the study relies on. The sample administrative zones with a relatively higher application status of households are west Gojjam with 45.71 percent and North Shewa 22.60 percent of households applied for agricultural production credit. On the other hand the lowest application rate is registered in south Wollo with 5.79 percent and North Wollo 14.71 percent. The huge variation may be explained by the fact that west Gojjam and North Shewa are characterized by a relatively suitable agricultural agro-ecological zones where households mainly rely on farm income. Therefore, other things remain constant; to improve their farm income households demand different agricultural inputs which they hope will boost farm earnings. So it is reasonable to apply for credit to finance the purchase of these inputs. On the other hand, the lower application rate in North and South Wollo may be due to the relatively lower return of agricultural land and many of households engage in off farm activities. Both of the arguments above hold in line with the fundamental economic theory where households act rationally. But apart from the above weak reasons of more and less application status of households, the following part gives us the aggregated reasons for not applying which gave us the foundation to decide on households' groupings of being credit constrained or unconstrained.

Reasons of non-applicants for not applying

This is one of the strengths of survey based elicitation as it shows us reasons for not applying for agricultural credit. On the survey questionnaire non applicant households had been given options to choose among different reasons for not applying. By analyzing these reasons we reach on concluding remarks in the groupings of households, i.e. either constrained or unconstrained.

As clearly stated on Table 4.2 below, many of the households (52.10 percent) responded that they fail to apply for credit because the collateral requirement of credit is very high and unaffordable on their stake. It is known that in rural areas of many developing nations including Ethiopia, the poor property right system and combined with other factors limit households from earning credit since they didn't have a viable guarantee for lenders.

Table 4.2 Reasons for not applying for any agricultural production credit

If you didn't apply for agricultural production credit last year, what was the reason?	**Frequency**	**Percent**
I did not need a loan	205	25.37
Interest rate too high	17	2.10
Collateral asked too large	421	52.10
I prefer working with my own funds	11	1.36
I do not want to put my land and other assets at risk	8	1.00
I do not want to be worried; I am afraid	105	13.00
Formal lenders are too strict, and inflexible	13	1.61
Formal lenders do not offer refinancing	9	1.11
The bank branch is too far away	15	1.86
Too time consuming to deal with commercial or other bank	3	0.37
Others	1	0.12
Total	808	100

Source; Authors computation form EPIICA 2013 Survey

Land which is the main asset of Ethiopian small holders cannot be used as collateral even under the new land registration scheme. Though microfinance institutions are working in rural areas by

adapting the group lending methodology without asset collateral, the above figure speaks loudly that collateral requirement tied households from obtaining credit and engaged with productive agricultural activities. These groups of non-applicant households are parts of quantity rationed households.

Among the entire non applicants 25.37 percent of them responded that they didn't applied because they do have their own enough fund to finance whatever input they demanded in the year. On the other hand 2.10 percent of non-applicant households reported that they didn't apply because the interest rate the lenders charged is very high, meaning they didn't get it economically feasible as they would apply if so. These groups of households are called price rationed households. They are not credit constrained as they can still obtain loan on the ongoing market interest rate which they considered it very high. These are the only two reasons (having enough own fund and price rationed) of non-applicants that label them as credit unconstrained. The remaining all reasons for not applying for agricultural credit are associated with credit rationing in one way or the other.

Loan application Outcome

After applying for credit, the final outcome is up to the will of the credit supplier, i.e. all formal, semi-formal and informal sources of credit where the household applied. The following Table 4.3 portrait the response of credit suppliers for farm household's application.

Table 4.3. Agricultural loan application outcome for sample smallholders from any source

Agricultural loan application outcome	**Freq.**	**Percent**
Received the requested loan amount	199	72.63
Got approval only for some portion of the requested loan & received that amount	57	20.82
Loan request was rejected	18	6.55
Total	274	100

Source; Authors computation from EPIICA 2013 survey

Application of households may end up with three different answers from suppliers, i.e. they may get full approval, partial approval or rejected totally. It is encouraging that 72.63 percent of

households get the amount of credit they applied for. The remaining 27.37 percent of households are disaggregated in to those who get partial approval and rejected at all accounting 20.82 and 6.55 percent respectively. The last two groups of households are labeled as credit constrained while those households who are able to obtain the total amount of credit they demand are counted as unconstrained as there is no any excess demand for credit.

The response of credit suppliers for households seems positive as clearly observed on the above outcome table. It is far beyond our expectation. This shows there is a considerable progress in rural credit expansion. Perhaps this can be attributed to the growing microfinance sector working mainly in rural areas and for urban small and medium enterprises.

4.1.1.2. Loan Application and credit constraint Status of Households

Earlier, we saw the agricultural production credit application status and its outcome. Now this part explains the credit constraint status of applicants and non-applicants. Parts of households didn't apply because they did have their own enough funds while other non-applicants are considered as discouraged households. Therefore, didn't applied doesn't mean credit unconstrained as far as these households are discouraged, i.e. they are counted as credit constrained households. So let's see if application significantly reduces the possibility of being credit constrained.

Table 4. 4 Application for Credit and credit constraint status of households

Application Status of the household	Credit Constraint Status of the household					
	Unconstrained		Constrained		Total	
	Frequency	%	Frequency	%	frequency	%
Not Applied	233	63.66	575	80.31	808	74.68
Applied	133	36.34	141	19.69	274	25.32
Total	366	100	716	100	1,082	100

Source; Authors computation from EPIICA 2013 survey

In view of the above Table 4.4, among the unconstrained groups of households 63.66 percent of them are non-applicants while the remaining 36.34 percent are applicants. It doesn't mean that non-applicants have a relatively good probability of being unconstrained. Rather the variation comes from the highest number of non-applicants in the sample households and some of them are price rationed and have own funds which are counted as credit unconstrained. On the other hand

among credit constrained households, 80.31 percent of them are non-applicants while the remaining 19.69 percent are applicants. But if we see the relative possibilities of applicants and non-applicants to be credit constrained and unconstrained, applicants enjoy a considerable advantage.

4.1.1.3. Types of Credit Rationing

As we saw in the literature review part, there are four types of credit rationing. These are transaction cost rationing, risk rationing, quantity rationing and price rationing. A typical household experiencing the first three types of credit rationing is said to be credit constrained. On the other hand households which are counted to be price rationed are not constrained as they are able to obtain credit at the ongoing market interest rate.

Table 4. 5. Types of Agricultural credit constraints households tied with

Type of rationing	**frequency**	**%**
Transaction cost Rationed	32	2.957486
Risk Rationed	175	16.17375
Quantity Rationed	509	47.04251
Price Rationed	81	7.486137
Not rationed	285	26.34011
Total	1082	100

Source; Authors computation from EPIICA 2013 survey

From the entire households considered in the study, 47.04 percent of them are quantity rationed. This figure accounts 71.1 percent of constrained households. Quantity rationed households include those who are applied but totally rejected, partly accepted, didn't applied because the institutions they want to applied for needs collateral guarantee and didn't applied due to fear of rejection. The remaining types of rationing which are counted for credit constrained households are transaction cost rationing and risk rationing accounting almost 3 percent and 16.17 percent of households respectively. From the overall 716 credit constrained households, 29.9 percent of them are observed to be transaction cost and risk rationed households sharing 4.5 and 24.4 percent of households in the group. Therefore, we can say that quantity rationing is the most prevalent cause of credit rationing and it compels policy stakeholders to prioritize in this regard. Finally,

households in either of the last two rows leveled as price rationed and not rationed accounting 7.49 and 26.34 percent, respectively, are counted as unconstrained households.

4.1.1.4. Rural Households' Source of agricultural input Credit

As mentioned earlier, the survey by EPIICA in 2013 asked sample agricultural households about their application status for agricultural credit, from which type of institution/s they applied for, the application outcome and the amount they received if the application may partially or fully accepted. The following Table 4.6 presented sources for the realized main loan applications disaggregated by the type of the entity.

Table.4.6. Sources of realized agricultural credit for sample small holders

Sources of Agricultural Production credit	**Freq.**	**Percent**
Primary society or cooperative	171	66.8
Private trader or company	9	3.52
Relatives/friends	22	8.59
Microfinance institutions, RUSACCO or other credit association	43	16.8
Rotating credit and saving association	1	0.39
NGO or other non-government program	6	2.34
Government program	3	1.17
Other	1	0.39
Total	256	100

Source; Authors computation from EPIICA 2013 survey

It has been remembered that among the total 274 applicant households 256 of them were fully or partially accepted. The above Table 4.6 shows from whereabouts of agricultural credit for these households. The lion's share is pioneered by primary society or cooperatives. From the entire partially or fully accepted households 66.8 percent of them obtained credit from these sources. This is partly due to the fact that agricultural inputs are delivered by kebele cooperatives on cash or credit as per the ongoing strategy of the Ethiopian fertilizer and other agricultural input delivery system. The second higher supplier of agricultural credit is from MFIs, RUSACCOs and other credit cooperative accounting 16.8 percent of the number of credit transactions dispersed to smallholders. The remaining 16.4 percent of those fully or partially accepted households obtained

their credit from private trader or company, Relatives/friends, Rotating credit and saving association, NGO or other non-government program, Government program and others.

It has been known that private money lenders, relatives and friends are the main participants of many developing countries rural finance transactions. Though the share of these groups is relatively small here in our case their role in Ethiopian rural finance is never been underestimated. Their fair share is small in this paper context due to the fact that this paper is dealing with agricultural credit alone. Therefore, it is compelling to say that the role of informal financial institutions in the agricultural credit delivery in rural Ethiopia is very low. These financial institutions usually engaged in delivering credit for consumption smoothing, contingencies and other unproductive purposes

4.1.1.5. Geographic dispersion of credit rationing

Though all of the four sample administrative zones resides in Amhara region administrated by similar regional and federal rural development strategies including credit delivery schemes, there is a considerable difference in the concentration of credit rationing among the selected sample households within each Zonal administration. The following Table 4.7 shows how this noticeable dispersion looks like.

Table 4.7. Agricultural credit rationing situations by sample administrative zones

Agricultural credit rationing status	**North shewa**		**North Wollo**		**South Wollo**		**West Gojjam**		**Total**	
	Freq	%	Freq	%	freq	%	Freq	%	Freq	%
Unconstrained	114	32.20	58	42.65	40	16.53	154	44	366	33.83
Constrained	240	67.80	78	57.35	202	83.47	196	56	716	66.17
Total	354	100	136	100	242	100	350	100	1082	100

Source; Authors computation from EPIICA 2013 survey

We have already showed that 66.17 percent of households are credit constrained. The highest percentage of households, i.e. 83.47 percent, constrained in the credit market happens in South

Wollo Zone followed by North Shewa where 67.80 percent. On the other hand households from West Gojjam and North Wollo looks relatively less prone to credit constraints as 56 and 57.35 percent of households respectively are constrained. But the real question here is where did these variations come from? There might not be a universal compelling reason, but it can be argued that the highest percent of credit constrained households in South Wollo zone may be explained by the relatively low productivity of agriculture. This may prohibit credit suppliers from delivering credit for households, may be due to their risk aversion behavior developed from low level of agricultural yield in the area, even though there is a high demand for agricultural credit by farm households. On the other hand the relatively low level of constrained households in North Wollo can be explained by their low demand for agricultural credit due to severely low productivity agriculture stress. This zone is the region's highest receiver of food aid due to its unfavorable condition for agricultural production even when compared to South Wollo.

The relatively smaller magnitude of credit rationed households happened in West Gojjam. This zone is one of the region's areas which are conducive for agricultural production. This may insist credit suppliers to invest here through their credit delivery system believing households as productive and rate them with better expected repayment. And also the existing relatively better agricultural productivity condition may make households financially self-sufficient. The same can be argued for North Shewa Zone.

4.1.1.6. Credit constraints by demographic and socio-economic characteristics

The following discussion explains how credit constraint status of households related with demographic and socio-economic characteristics of households.

I. Credit constraint status and gender of the head

In developing countries, especially in rural areas of these groups of countries, many argue that gender matters socio-economic status. That is why gender empowerment is listed as one of the millennium development goals. Therefore, this paper tried to see if gender of the household head matters in credit constraint status of households. As depicted in the below mentioned Table 4.8, only 9.89 percent of households were female headed. The remaining 90.11 percent of sample households are administered by males.

Table 4. 8. Agricultural credit constraint status by gender of the household

Agricultural credit status	Gender of the household head				Total	
	Female		male			
	Freq	%	Freq	%	Freq	%
Unconstrained	34	31.78	332	34.05	366	33.83
Constrained	73	68.22	643	65.95	716	66.17
Total	107	100	975	100	1,082	100

Source; Authors computation from EPIICA 2013 survey

Table 4.8 above tried to show the gender based explanation of credit constraint status, first by grouping households by gender of the administrator. It is evident that 68.2 percent of female headed households and 65.95 percent of male headed households are credit constrained. The remaining 31.8 percent females and 34.05 percent of males are counted to be credit unconstrained. There is a considerable gender based variation (2.27 percentage gap) in likelihood of being credit constrained. Females are relatively vulnerable than their male counter parts. Though this is relatively small compared to the rumors of gender discrimination in rural areas, gender still matters in credit market outcomes. The relatively small gap can be explained by the role of the growing microfinance institutions and cooperative societies in enhancing the empowerment of females.

II. Credit constrained status by household size

Though the composition of the household matter, household size may have both direct and indirect relation with credit constraint status of households. The following Table 4.9 reveals how sub grouped household size is composed across credit constraint regimes.

Table 4.9. Credit constraint conditions by household size

Household size Subgroup	Credit constrained status				Total	
	Unconstrained		Constrained			
	Freq	%	Freq	%	freq	%
1-2	20	5.46	52	7.26	72	6.65
3-4	95	25.96	245	34.22	340	31.42
5-6	156	42.62	253	35.34	409	37.80
7-8	78	21.32	140	19.55	218	20.16
9and above	17	4.64	26	3.63	43	3.97
Total	366	100	716	100	1,082	100

Source; Authors computation from EPIICA 2013 survey

From the entire households under consideration, households having 3-4 and 5-6 members which can be called medium sized households accounted the relatively highest share of both credit constrained (34.22 and 35.34 percent respectively) and unconstrained (25.96 and 42.62 percent respectively) households. It can be observed that their share didn't come from their relatively high vulnerability to credit constraint determiners, rather from their relatively high representation in the selected sample households. The next higher share of households in both of the credit regimes comes from households having family size of 7-8 individual members.

If we saw the relative vulnerability of households to credit rationing across sub groups, the highest constraint index is registered in the first two groups, i.e. for households having size of 1-2 (72.22 constrained) and 2-4 (72.06 constrained). It seems obvious in this regard that lower household size may cause credit rationing status positively. Meaning, the less the household size the more vulnerable the household will be for credit rationing. This argument holds for the last three consecutive sub grouped households, accounting a within variation of 61.86, 64.22 and 60.46 percent of household credit constrained, respectively. This can be explained ashouseholds having higher household size may have relatively higher family labor which may boost both agricultural production and willingness of financial entities to lend to those households expecting better repayment as a result of a relatively high agricultural output. But still the extent of credit rationing is very high.

III. Credit constraint condition of households by age group

Many household models use age of the head of the household and its square as explanatory variables whatever their outcome variable is. This paper too tried to see both descriptive and econometric possible explanations that may arise between age of the household and credit constraint status of households. The following Table 4.10 shows the composition of both credit constrained and unconstrained households by and across age groups of the head.

Table 4.10. Credit constraint conditions by household head age group

Age group	Agricultural credit constraint condition				Total	
	Unconstrained		Constrained			
	Freq	%	Freq	%	freq	%
<= 30	18	4.918033	56	7.821229	74	6.839187
31-40	74	20.21858	140	19.55307	214	19.77819
41-50	96	26.22951	179	25	275	25.4159
51-60	94	25.68306	154	21.50838	248	22.92052
above 60	84	22.95082	187	26.11732	271	25.04621
Total	366	100	716	100	1082	100

Source; Authors computation from EPIICA 2013 survey

It can be observed on the above Table 4.10 that distribution of households across the two credit regimes by age group of the head is directly proportional to the number of households within each age group. The highest numbers of households, i.e. 25.41 percent of them are headed by individuals with age range of 41 up to 50 followed by above 60 accounting 25.05 percent of households. The lowest age group representation happened for those households headed by individuals aged equal or less than 30.

Finally, the table also presented the distribution of households across the two credit regimes among each of the age sub groups. In this regard there is evidence of variation in the relative vulnerability of each sub group headed households to credit constraint conditions. The most vulnerable household is found to be households headed by individuals having 30 or less years of age where 75.68 percent of households were credit constrained in the group. The possible explanation is that, these households have relatively low land holdings. This arises from their relatively younger age who didn't reach the land redistribution program by the government in 1996/97 which happened

in Amhara region. Though land cannot be used as collateral to credit, small land holding may relate with lower agricultural production and resulted segmentation or other sorts of credit rationing by the credit supplier.

The next highest percentage of within sub group credit constraint happened for the last two age groups of household heads accounting 69.00 and 66.17 percent respectively for the last two groups of households irrespective of other age groups. From this we can infer that age group of the head and credit constraint status has a non-linear relationship.

IV. Credit constraint status and Education status of the household head

The role of education in the development process cannot be underestimated. In the contemporary world, it seems obvious that development needs to come first on the minds of the people through education. By the same argument, here in the context of our paper, education of the head can have a profound role in shaping the behavior of households towards the credit market mainly though the financial literacy incentive effect of education. First, we grouped education of the head in to four distinct categories depending on the relative expected return of education in each hierarchy. These are heads with no education at all, with informal education (adult education and church or other religious education), primary education and high school and above. The descriptive link of each category of heads education with the credit constraint status of households is discussed as follows.

Table 4.11. Agricultural credit constraint status by household head's educational status

Educational status	**Agricultural credit constraint status**					
	Unconstrained		**Constrained**		**Total**	
	Freq	%	Freq	%	freq	%
No education at all	196	53.55	402	56.15	598	55.27
Informal education	92	25.14	176	24.58	268	24.77
Formal primary education	69	18.85	128	17.88	197	18.21
High school and above	9	2.46	10	1.40	19	1.76
Total	366	100	716	100	1,082	100

Source; Authors computation from EPIICA 2013 survey

We found that 55.27 percent of households are headed by individuals who didn't have any kind of education at all. The remaining 24.58, 17.88 and 1.40 percent of credit constrained households are headed by individuals with informal education, primary school attended and high school and above completed individuals. The relatively small percentage share of the last three educational groups comes from the lower number of members not just due to the education incentive effect.

When we tried to see the within distributions of households in each of the four subgroups between the two credit regimes, 66.22 percent of households headed by individuals with no education, 65.67 percent of households headed by informal educated, 64.97 percent households headed by primary school attended and 52.63 percent of households headed by individuals who attended high school and above are leveled to be credit constrained. These magnitudes are almost similar with only a slight difference in the first three subgroups. The good thing is that even the small variation comes hierarchically with the value of the education the head attended. If we compared the educational subgroup dispersion of credit status with the general distribution of credit constraint status among the entire households, there is no a huge variation though the latter group enjoys a relative relief from binding credit constraints. The slightly similar excess demand for credit among the first three educational subgroups cannot invalidate the value of education rather it can be explained by the role of development agents in the farmer's behavioral extension program and may be the peer spillover effect among farm households. Though the effect of education is not linear as evidenced from the relatively lower percentage of credit constrained households headed by households with high school or above educational attainment, the intensity of credit constraints among households headed by individuals who are illiterate, informally educated and those of who attended primary school didn't show a significant variation.

V. Credit constraint status and MFIs and RUSACCOs membership

It can be argued that households registered as members of MFIs, RUSACCOs and Kebele primary cooperatives have a better financial literacy and better social interaction which may affect the household's credit regime. In this regard we tried to show the institutional membership status and credit constraint situations.

Table 4.12. MFIs and RUSSACOs membership status by Agricultural credit constraint status

MFI and RUSSACO membership status	Agricultural credit constrained status					
	Unconstrained		Constrained		Total	
	Frequency	%	frequency	%	Frequency	%
None members	245	66.94	566	79.05	811	74.95
Members	121	33.06	150	20.95	271	25.05
Total	366	100	716	100	1,082	100

Source; Authors computation from EPIICA 2013 survey

As presented on the above Table 4.12, 74.95 percent of households didn't have at least one household member who is a member of MFIs and/or RUSCCOs. The remaining 25.05 percent of them did. Among constrained households 79.05 percent of households are none members and 20.95 percent of households are members. If we tried to see the within membership status subgroup dispersion of households in the two credit regimes, among none member households 69.79 percent of them were credit constrained. But among member households 55.35 percent of them are constrained which is relatively small compared with the former. From this we can learn that being memberships of MFIs and RUSCCOs have a relative incentive to be credit unconstrained may be because as you become you better know how to involve in the credit market or these institutions may have better access for members.

VI.Credit constraint status by Primary cooperative membership

As discussed earlier, kebele primary cooperatives membership can have a considerable link with credit constraint status of households. Though membership in kebele primary cooperatives is voluntary, their service usually biased for members if competing interests between members and none members appear. Actually, it is obvious; if members are not given priority, where could lie the importance of being a member?

Table 4.13. Agricultural credit constraint status by primary kebele cooperative membership

Membership status in kebele primary cooperatives	Agricultural credit constraint status				Total	
	Unconstrained		Constrained			
	Freq	%	Freq	%	Freq	%
Non Members	12	3.28	43	6.01	55	5.08
Members	354	96.72	673	93.99	1,027	94.92
Total	366	100	716	100	1,082	100

Source; Authors computation from EPIICA 2013 survey

From the total 1082 households which fitted our purpose in this paper, 1027 (94.92 percent) of them belong to agricultural cooperatives. The remaining 5.08 percent of them were none members. If we see the distribution of households in to each credit regime, credit constrained households comprised of 93.99 percent of households which are members of kebele cooperatives and the remaining 6.01 percent of them were none member households. From the total of 55 kebele cooperative none member households, 43 (78.18 percent) of them were credit constrained. On the other hand, from the total of 1027 member households, 673 (65.79 percent) of them were credit constrained. This once again showed that being member of primary kebele cooperatives have an incentive effect for member households to be relatively unconstrained compared to their non-member counter parts. This can be explained by the primary kebel cooperatives usually gave prioritization for member households, in line with first for members approach.

VII. Credit constraints by saving condition of households

For agricultural households, saving plays a crucial role in consumption smoothing, financing unexpected socks, self-financing of agricultural input purchases and other transactions. In theory it is arguable that households which have sufficient own savings can acquire what they want by themselves which reduced their vulnerability to the bad consequences of credit constraint conditions. Therefore, we say that the more saving the household owns the less will be their respective vulnerability to credit constraint problems.

Table 4.14. Households saving and credit constraint status

Saving status of households	**Credit constraint status**					
	Unconstrained		**Constrained**		**Total**	
	Frequency	%	Frequency	%	frequency	%
Net savers	193	52.73	417	58.24	610	56.38
Not savers	173	42.27	299	41.76	472	43.62
Total	366	100	716	100	1,082	100

Source; Authors computation from EPIICA 2013 survey

In the survey by EPIICA, the amount of savings was not quantified on the household's questionnaire. It only asked if they are net savers, whatever the magnitude is, and the range of saving rates which cannot help to obtain exact saving figures. Therefore, hereby we prefer to link net saver dummy with credit constraint status of households. As it is portrayed on the table above, 56.38 percent of the overall survey households were net savers and 43.62 percent of them were non-savers or ends at the equilibrium of zero balance at the end of the season.

When we tried to see how saving status linked with credit constraint status, 58.24 percent of constrained households were net savers. The remaining 41.76 percent of households were constrained and none savers. And more surprisingly, 68.36 percent of net saver households were credit constrained. But on the non-savers side 63.35 percent of them are constrained. It is contradictory with our theoretical premises at the beginning of this part of the discussion. This could be explained as these households use own savings for purposes other than agricultural production, like for health contingencies, social and cultural ceremonies which can be counted as extravagancy spending habit, as a guarantee for consumption shocks etc. And more generally, becoming net saver doesn't mean financially self-sufficient and no need credit. Rather it means net savers are relatively capable to meet their liquidity requirement fully or partially.

VIII. Credit constraint status and enterprise ownership

A study by Alie et.al (2014) in Rwanda revealed that household's participation in nonfarm activities relaxed the existent and extent of credit constrained status. To check is this argument holds in our setting, we tried to show if household's ownership of agricultural and nonagricultural enterprise may reduce household's vulnerability to credit constraint problems.

Table 4.15. Agricultural and non-agricultural enterprise ownership and credit constraint status

Enterprise ownership dummy	**Unconstrained**		**Constrained**		**total**	
	Freq	%	Freq	%	freq	%
No enterprise	329	89.89	628	87.71	957	88.45
Own enterprise	37	10.11	88	12.29	125	11.55
Total	366	100	716	100	1,082	100

Source; Authors computation from EPIICA 2013 survey

The households under this study experienced a very low ownership of at least one agricultural and/or nonagricultural business enterprise, accounting only 11.55 percent of households were owners. The remaining 88.45 percent of households were none owners. It is surprising that those households with enterprise ownership are more vulnerable to credit rationing (70.64 percent of owners). On the other hand, none enterprise owners are relatively none vulnerable compared with their enterprise owner counter parts. The argument that enterprise income which earned while owning at least one was first argued to relax credit rationing bottlenecks, but the exact opposite happens here. This might happened due to the following fundamental reasons. One, since households who owns enterprises trade off their labor hours between agricultural production and enterprise running agricultural yield might happen to slow. This would make these households less credit worthy borrowers as rated by creditors based on agricultural yield. Second, these households have competing investment opportunities. Like their trade off in allotting their working hours, these households are also tied with difficult decision in distributing their financial resources among the two activities, i.e. for agricultural production, for owned enterprises or sharing for both of them. Therefore, it is compelling that such financial decision trajectories make enterprise owner households more vulnerable to credit constraint problems, at least in the short run.

4.1.2. Access to credits with purposes other than agricultural inputs

Under this sub section, smallholders' access to none agricultural input loans is presented. Whether smallholders took none agricultural input loans or not and if they took the sources of the loans re discussed as follows. As evident from the following table 4.16, only 16.82 percent of households obtained none agricultural input loans. The remaining 83.18 percent of households didn't obtain any of none agricultural input loans.

Table 4. 16. Households' access to none agricultural input loans

Did you obtained none Agricultural input credit?	**Frequency**	**Percent**
Yes	182	16.82
No	900	83.18
Total	1082	100

Source; Own computation from EPIICA 2013 survey

The share of households with none input loan is significantly low compared to households which didn't make it. Though their demand for loan of this type is not analyzed at the beginning, the following table 4.17 presents what would happened if households have been applied for none agricultural input loans. The response illustrates what would be the outcome of the application on the expected view of households. Surprisingly, 84.56 percent of households think that they may obtain the loan if they would have been applied for it under different circumstances. Thus, if the household said "yes" it was possible to obtain none input loan doesn't mean that the loan is available unconditionally.

Table 4.17. None applicants by their possibility of getting credit if they would have been applied

If no none agricultural input loan, would you have been able to obtain a loan at the interest rate currently prevailing on the local market?	**Frequency**	**P%**
Yes	761	84.56
No	139	5.44
Total	900	100

Source; Own computation from EPIICA 2013 survey

Reasons for not taking loans, though there were the possibility

A very important thing we should have to understand here is that, these households didn't applied for none agricultural input loan doesn't mean they didn't have the demand at all. Some may be, but the majority didn't applied for that credit due to many reasons that discouraged them from applying for none agricultural input loan. Luckily, the survey by EPIICA dug the various reasons why households abstained themselves from taking loans if there was a way to realize them, though they do have the possibility.

Table 4.18. Reasons for not taking none agricultural input loans

Reasons for not taking loans	**frequency**	**percent**
I do not need a loan	417	54.8
Too high interest rate	80	10.51
collateral asked too high	13	1.71
I prefer working with my own funds	68	8.94
I do not want to put my land and other assets at risk	93	12.22
I do not want to be worried; I am afraid	53	6.96
Formal lenders are too strict and inflexible	1	0.13
Formal lenders do not offer refinancing	2	0.26
The bank branch is too far away	1	0.13
Too time consuming to deal with commercial or other bank	1	0.13
Group loan is risky	9	1.18
Do not finish loan I have	19	2.5
Do not provide the amount of loan I need	4	0.53
Total	761	100

Source; Own computation from EPIICA 2013 survey

Among non-applicants, 54.8 percent of them replied that they didn't want to take the loan as they didn't need it. Implying they didn't have demand for the non-agricultural input loan which they can get it if they want it. On the other hand 10.51 percent of non-applicant households didn't take loans because the interest rate charged was too high. Households with the above two reasons are not constrained for loans for non-agricultural inputs. But the remaining series of reasons constrained households from taking loans for purposes other than agricultural input purposes. But given the difference in the series of EPIICA's survey questionnaires for agricultural input and none

input credits, it was difficult to meaningfully define credit rationing status of households for none agricultural input loans. In this regard we are obliged to define credit constraint status of households for agricultural input loans as it is compatible with the survey based direct elicitation procedure.

Sources of none agricultural input loans

As we stated earlier, the rural financial market in Ethiopia is characterized by the coexistence of formal, semiformal and informal institutions that deliver financial services for smallholders residing in rural areas.

Table 4. 19. Sources of realized none agricultural input credit loans

Sources of Loan	Frequency	Percent
Money lender	10	4.59
friends/relatives	74	33.94
Bank	1	0.46
NGO	3	1.38
RUSACCO and MFIs	104	47.71
Primary or other cooperative	21	9.63
Other traditional organization	2	0.92
Religious Institution	3	1.38
Total[23]	218	100

Source; Own computation from EPIICA 2013 survey

Previously, we saw that primary kebele cooperatives, RUSACCOs and MFIs are the main sources of credit for agricultural input purposes. But for loans purposes other than agricultural inputs, the role of RUSACCOs and MFIs (47.71 %) and friends/relatives (33.94%) dominated other sources of loans. The role of money lenders is not as expected, making 4.59 percent of loans. This may be accounted for the growing role of MFIs and RUSACCOs which provides loans with a relatively

[23] This number exceeds the number of households that obtained none agricultural credit, i.e. 182. The reason is that 218 here indicates the number of none agricultural loans realized by the 182 households. This is because some households obtained more than one none agricultural loans.

lower rate of interest. Banks, NGOs and other financial service providers have little roles left from RUSACCOs, MFIs and primary kebele cooperatives.

4.2. Econometric Analysis of the Study

Under this sub part the empirical approach to identify determinants of credit constrains and the impact of credit rationing on agricultural productivity is presented. By using the binary outcome credit rationing criterion equation, determinants of agricultural yield for selected cereals has been incorporated in the endogenous switching regression. The model is estimated by using Full information maximum likelihood estimation procedure. This procedure helps us to check the overall robustness of the study's findings and it can also control both household level unobserved heterogeneity and Self-selection biases. In stata the full information maximum likelihood estimation is carried out by using the movestay user command developed by Lokshin and Sajaia (2004).

Though the model is simultaneously executed for both the agricultural yield and the criterion equation as indicated in Appendix I, we hereby separately presented the determinants of credit constraints (Table 4.20) and determinants of log of agricultural yield for selected cereals for both constrained and unconstrained households (Table 4.21) for ease of presentations and interpretations.

The Wald test of joint independence between the estimable production function for constrained and unconstrained smallholders rejects the null against the alternative, meaning the two regression equations are not independent. This validates our rationality to choose endogenous switching regression estimation procedure[24]. The dependency may arise from self-selection effects in credit market participations and the unobserved household level heterogeneities. Since the two groups of households are not independent, estimating the equation by using OLS procedure by treating credit rationing dummy as an explanatory variable would bias our estimates.

[24] Alternatively we can estimate determinants of credit rationing and its impact on agricultural productivity by using the heckman two step procedures. But endogenous switching regressions are much more efficient.

4.2.1. Determinants of Credit Constraints

As clearly stated in chapter two and three, credit rationing under this paper is broadly defined as the excess demand for agricultural credit by farm households. We had formulated a binary outcome model for credit rationing assuming a value of "1" for rationed households and "0" otherwise. This equation has a dual role in this paper. One, it used us a criterion equation in differentiating credit constrained households with their unconstrained counter parts. And, two, we used it as a dependent variable to find out the main determinants of credit rationing across smallholder farm households. In the endogenous switching regression the selection equation is treated as a probit binary outcome variable. Different demographic, socio-economic and institutional variables have been included as explanatory variables in the selection equation as reported in Table 4.16 below.

It is known that, for smallholder households agricultural land is the main determiner of economic status in Ethiopia. This variable happened to have an insignificant effect in determining the odds[25] of being credit constrained. This directly reflects the policy fact of tenure security in Ethiopia. Land cannot be sold or used as collateral for credit. Therefore, whatever hectare of land the household own, it doesn't have any significant role to relax credit constraint conditions. Though insignificant, the coefficient is yet negative indicating land ownership reduces the probability of being credit constrained.

[25]The Endogenous switching regression model didn't allow us to use the usual procedure to execute marginal effects. But we can still interpret our results by using the odds ratio easily.

Table 4.20. Determinants of credit constraint status of households

Explanatory variables	**Coefficient for the criterion equation**
Log of parcel in hectare	-0.03038 (0.07948)
Male headed dummy	0.060632 (0.141936)
Age of the household head	-0.03598*** (0.019496)
Age square of the household head	0.000326*** (0.00018)
Household size	-0.0041 (0.025782)
Informal education dummy	0.016586 (0.105216)
Primary education dummy	-0.05442 (0.116433)
Dummy for households in Gojjam	-0.32143* (0.119781)
Dummy for households in south wollo	0.181908 (0.167017)
Dummy for households in north wollo	-0.37958* (0.136801)
Risk averse household dummy	-0.03758 (0.084502)
Muslim headed household dummy	0.286375** (0.127465)
Enterprise ownership dummy	0.176923 (0.123712)
Tropical Livestock Unit	-0.00711 (0.015618)
Value of house in 1000s birr	0.000661* (0.000661)
Bank account dummy	-0.07624 (0.089433)
Net saver household dummy	-0.2524* (0.075517)
Bank trust dummy	-0.15673 (0.10443)

Kebele cooperative trust dummy	-0.31455* (0.117865)
Constant	2.011736* (0.560999)

Where *, ** and *** indicates variables that are significant at 1%, 5% and 10% level of significance. Values in parenthesis represent robust standard errors for each of the coefficients under consideration

The study also uncovered that gender of the household head is insignificant in determining a typical household's credit rationing status. This is a manifestation of improvements in gender discrimination. It may result from the due attentions given by the Millennium Development Goals and the progressing Microfinance and cooperative moments in Ethiopia which are part of the weapons for women empowerment. But still the male dummy has an insignificant negative coefficient which shows the negligible advantage of male headed households in reducing the probability of being credit constrained.

Age and age square of the household head are significant at 10 percent with an impact in different directions. This proves the none-linear effects of age of the head on the probability of being credit constrained. Initially, an increase in the age of the household is advantageous. This might arise due to the returns of experience which better allow the household to know how the credit market works and the experience incentive of productivity gain which pursue creditors to level these households as credit worthy which reduces the odds of being credit constrained. But these arguments don't have happy endings as the household head becomes too old. Lenders usually level old age individuals as risky borrowers. They think old aged farmers are less productive and they are also suspected for a risk of death which increases the probability of default. These arguments make aged farmers less welcomed by lenders which increases their probability of being credit constrained. Therefore, the negative impact of household head's age on the probability of being credit constrained goes up to the point at which the positive quadratic age coefficient outweigh the negative linear age coefficient

Educational dummies are found to be insignificant except dummy for high school and above complete farmers. In our definition of educational dummies, illiterate household head dummy was our base variable. Compared to households headed by illiterate farmers, households headed by farmers who attended high school and above level of education are less vulnerable for credit

rationing. So here one of the fruits of attending high school and above is proved to a relatively lesser vulnerability to credit rationing. This might arise from better investment behavior and the role of higher education to develop the trust of lenders by making them believe that these farmers may have a good financial literacy and level them as credit worthy. Therefore, the power of education is beyond reading and writing in shaping financial market outcomes. Because the study didn't observed a significant variation in the probability of households headed by individuals with informal education and those of who attended primary education compared to households administered by illiterate individuals. For the first three groups of households based on educational attainment, financial institutions didn't discriminate households based on education attainment in credit provision as evidenced from the insignificant coefficients of indicator variables.

Location dummies have been incorporated in our credit rationing criterion equation. Since this study is carried out in for zones of Amhara region, we do have four location dummies. But through our actual estimation procedure, we are obliged to treat one of the location dummy as a base dummy. In this regard, we selected North Showa location dummy as our base without any prior criterion. Compared to smallholders residing in Noth Showa, residents in West Gojjam and North Wollo have significantly lower vulnerability for being credit constrained. We can develop two different intuitive reasons for this result. For households in Gojjam, this zone is one of the highest productive areas in the country. And these samples reside around Bahir Dar town which gives meaning for location effects of financial services. The first reason makes farmers relatively capable to develop self-financing mechanisms and second one, the location effect, may benefit farmers to be well informed about financial institutions and the ways forward in acquiring credit services. The combined effect of these reasons make smallholders in West Gojjam to have lesser probability of being credit constrained compared to our base. But for residents in North Wollo, the reasons may attach with lesser demand for agricultural credit. The highest share of this area is less conducive to agriculture and many of the residents in this area depend on food aid programs. Therefore, it seems compelling to argue that lesser vulnerability to agricultural credit rationing for household in North Wollo mainly comes from lesser demand for agricultural credit compared to residents in North Shewa. There is no significant variation between households in North Shewa and South Wollo.

Religious dummy has been defined in the study to catch the distinction between Muslim headed household and others. The reason lies on the principles of Islam about credit and usury. Our financial institutions didn't work in line with the principles of Islamic banking. And in this paper it is evident that Muslim headed households are more vulnerable to credit rationing than non-Muslims which is significant at 5 percent.

Households' saving status happens to affect credit constraint status negatively. This result is similar to the findings in china by Feder et.al (1990) and Dong et.al (2010). This is consistent with our prior expectation that net saver households have better opportunity to acquire what they needs for better agricultural production. It doesn't mean that all net saver households are financially self-sufficient and didn't constrain in the credit market. It means they are relatively and significantly less vulnerable to credit constraints compared to non-savers.

As the value of the house owned by the smallholder increases, vulnerability to be credit constrained significantly increases. It is against to our prior expectation which asserted that highest value of house is a manifestation of better financial status of households and it may happen to decrease the probability of being credit constrained. But it didn't happen here. This finding is similar to the result of the study by Dong et.al (2010) which concluded that high valued house construction degrades the financial resources of the household which may end the household under binding credit constraint.

We included bank trust dummy and kebele primary cooperative trust dummy as instruments determining credit constraint status of households and affect production only indirectly through their impact on credit rationing. Households trust on primary cooperatives happens to determine the probability of being credit constrained negatively and significantly. This is straight forward to argue that trust and sense of confidentiality about the day to day activities, rules and regulations of kebele cooperatives harnesses the involvement of households with the services by kebele cooperatives which insists them to become members and they would finally relax credit constraint conditions. But bank trust dummy doesn't significantly affect credit constraint status, besides its negative signs. This may resulted from the lesser involvement and willingness of banks to serve households in rural areas due to high transaction costs and other risk related problems.

Variables like family size, bank account dummy and enterprise ownership dummy are incorporated in our criterion equation though they end up with insignificant effects. Some studies (see for example Ali et.al (2014) in Rwanda, argued that off farm income helps households to relax credit constraint conditions in the semiformal credit market. But in our estimation, apart from its insignificance, the coefficient assumes a positive value implying households that owns non-farm enterprises are more vulnerable to credit rationing compared to non-owners, though negligible. This may arise from the competing investment decisions of household funds as discussed earlier under the descriptive part of the paper. A typical farm household with enterprise ownership trades off its financial expenditure among farming and enterprise activities. This may make household fund relatively scarce which insist the household to demand for extra credit which contributes for more vulnerability to credit constrained.

4.2.2.The Effects of Credit Constraints on Agricultural productivity

Since the beginning we have been asserted that one of the main leading objectives of the study is to show if there is any considerable impact of credit rationing on agricultural productivity and quantify the loss of productivity resulted. To this end, log of agricultural yield per hectare of land for selected crops is estimated using the criterion equation as bases of separation across the two groups of households and estimation is carried out by using FIML procedure. The result for determinants of log of agricultural yield for the two groups of households is presented in the following Table 4.21. Different farm specific, household demographic characteristics, location dummies, production inputs, shock and risk dummies and liquidity variables have been involved among factors that determine log of agricultural yield. A significant variation on the impacts has been revealed across the two groups of households. These variations are accounted for credit constraint statuses of households, keeping other things remain constant. This implies that credit constraint conditions distorted the effect of explanatory variables across the two groups of households.

Table 4.21. Determinants of the natural log of agricultural yield for each credit regime

Explanatory variables	**Unconstrained Households**	**Constrained Households**
	Coefficient	**Coefficient**
Liquidity in 1000s of birr	-0.00388 (0.005521)	0.0002538 (0.0018304)
Value of fertilizer per hectare	0.0000517** (2.39E-05)	0.0000603* (0.0000177)
Log of parcel in hectare	-0.17037** (0.072669)	-0.1662441* (0.0514708)
Male headed dummy	0.075526 (0.12934)	-0.0595764 (0.080186)
Age of the household head	0.013511 (0.018997)	0.0097714 (0.0102241)
Age square of the household head	-0.00012 (0.000176)	-0.000093 (0.0000926)
Household size	0.010667 (0.022957)	0.0017922 (0.0139336)
Informal education dummy	0.035105 (0.085234)	-0.0057409 (0.0545741)
Primary education dummy	-0.01323 (0.09341)	0.0532089 (0.0633887)
High school and above dummy	0.151937 (0.262047)	0.0108553 (0.1949644)
Dummy for households in Gojjam	-0.01096 (0.11789)	-0.0887214 (0.0681869)
Dummy for households in south Wollo	-0.23869 (0.17026)	-0.4489922* (0.0707785)
Dummy for households in north Wollo	-0.11362 (0.11982)	-0.1652335** (0.0775115)
Risk averse household dummy	0.055941 (0.069644)	0.000653 (0.043128)
Number of oxen in the household	0.041077 (0.033147)	0.0716576* (0.0224831)
Hired labor dummy	0.124232*** (0.070026)	0.0966781** (0.0486531)
Average slope index	0.156621***	0.0902973

	(0.088486)	(0.0619381)
Average altitude index	-0.06716 (0.069142)	-0.0547112 (0.042706)
Drought vulnerable dummy	-0.31487* (0.096781)	-0.2579769* (0.0686555)
Constant	8.978427* (0.693172)	8.501819* (0.3505022)
Sigma	0.7039488	0.5854295
Rho	0.7854659	0.5437635

Where *, ** and *** indicates variables that are significant at 1%, 5% and 10% level of significance. Values in parenthesis represent robust standard errors for each of the coefficients under consideration

From the beginning we have been argued that liquidity[26] may have different marginal effects on productivity across the two groups of households. Its impact was expected to be positive and significant for credit constrained households and insignificant for unconstrained ones. But the actual estimation revealed that the impact of marginal increases in liquidity is insignificant but positive for constrained farmers and insignificant and negative for unconstrained households. The interesting insight here is the variation in the sign of coefficients. Though insignificant, extra liquidity has a positive impact in raising productivity of constrained and hurts productivity of unconstrained farmers. The negative sign for unconstrained farmers may reflect the fact that an improvement in the financial resources of unconstrained farmers may increase their aspiration in none farm activities which will hurt their agricultural yield finally. The insignificant coefficient for constrained farmers may further reflect the presence of financial illiteracy. Financially illiterate households may have the demand for credit but the reward for credit may not sound great due to their poor financial utilization which is believed to be prevalent among households in many parts of the country. But still we can firmly argue that better financial deepening for finance constrained households will improve agricultural productivity conditions if we happen to apply them

[26] Since the survey by EPIICA didn't disclose the amount of saving for net saver households, under this study we are obliged to define liquidity weakly as the sum of non-farm income and amount of credit. We count this as part of the reasons that makes the effect of liquidity insignificance in the highly credit constrained economy of rural Ethiopia.

complementarily with other behavioral extension programs that improve the state of financial literacy of households.

In this paper, there should be a clear understanding that liquidity is not the only variable which shows the effect of credit constraints on agricultural productivity across the two groups of households. Because credit constraint conditions of households affect how other variables behave in the estimation of the agricultural productivity equation (both the direction of the effect and level of significances). The variable for intensity of fertilizer consumption per hectare of land is positive and significant at 1% and 5% level of significances for constrained and unconstrained households respectively. The marginal effect is lightly greater for constrained farm households. If a typical household increases expenditure in fertilizer by 1000 birr, per hectare output will grow by 5.17 and 6.03 percent for unconstrained and constrained households respectively. This implies that there is a room for better productivity agriculture through intensive use of fertilizer which will only met via better access to credit for credit constrained households.

The prevalent of land size-productivity puzzle is evident for both groups of households as the negative sign indicates for log of parcel of land in hectare owned by households. It is significant at 1% for constrained and at 5% for unconstrained households. A 1 percent increase in the land holdings of a typical household reduces land productivity by a slightly similar 17 percent for both unconstrained and constrained households. It would be soundly persuasive, if the adverse effect is worse for constrained farmers as expansion in land use under credit constraints obliges households to engage in less technology intensive production procedures due to the binding financial problems. But the story is almost similar across both constrained and unconstrained households.

Location dummies are found to be insignificant for credit unconstrained households compared to our base dummy, North Shewa. The implication is that as far as farmers are not credit constrained, they can raise their land's productivity by applying alternative procedures irrespective of agro-ecological settings. Though natural topography and climate variables matter in agricultural production, farmers can still pursue alternative mechanizations that make them productive wherever they are as far they are free from constraints in the credit market. But on the other way around, location dummies are found to be negative and significant at 1% and 5% for households in South Wollo and North Wollo respectively for credit constrained households. But for West

Gojjam zone, though the coefficient is negative, there is no significant yield variation in relation to North Shewa. The situation in North and South Wollo can be explained as, these Zones are characterized by lesser productive agriculture due to their agro-ecological variables. Compared to households in North Shewa Zone, the value of agricultural output is lesser by 44.9 percent in North Wollo and 16.5 percent in South Wollo. But as we saw earlier, these variables didn't significantly appear to determine location biases in productivity under credit unconstrained conditions, though they assume negative coefficients. That is an indication for the possibility of better productive agriculture conducive to the existing agro-ecological conditions if farmers didn't happen to be credit constrained. But this didn't work if households are constrained. Our firm argument is that there is no incentive in investments for agro-ecological friendly agriculture under financial market failures.

Number of oxen owned by the household significantly improved the value of agricultural yield for credit constrained households, but insignificant for their unconstrained counter parts. It is evident that an extra ox acquired by a typical credit constrained household improves yield by 7.2 percent. This result is consistent with the findings of Ali et.al (2012). They argued that this is an indication of the existence of positive shadow price for oxen. Given that households are credit constrained, it is difficult for them to acquire the extra ox/en they may want. This shows the existence of unmet productivity potential for credit constrained households due to failure to get the optimal number of oxen.

Dummy for hired labor is positive and significant for both groups of households. The value of agricultural production for households that used hired labor is greater than those who are not by 12.4 and 9.6 percentage points for unconstrained and constrained households respectively. The effect is lesser for credit constrained households may be due to the problem that credit constrained households face difficulties in acquiring other inputs which may raise labor productivity. If these inputs have labor productivity incentive effect, labor productivity for constrained households will be lower and that is what exactly happens in our result.

The other variable which is significant at 1% for both groups of households is dummy for drought. Though the intensity of drought may differ within and across administrative zones, our estimate shows that on average those individuals who were prone to drought have been lost 31.5 and 25.8

percent of per hectare value of agricultural yield for unconstrained and constrained households respectively. Our final significant variable is average slope index of agricultural land owned by the household. This variable is significant only for unconstrained households. This supports the argument that relatively flat lands are relatively suitable and are productive than relatively steeper land holdings.

The remaining variables included in the productivity equation are insignificant for both constrained and unconstrained households. It is surprising that none of the household demographic characteristics are significant.

4.2.2.1. Quantifying the productivity Impact of binding credit constraints

Finally, a quantitative estimate of the impact of credit rationing on agricultural productivity is estimated which indicates by how much smallholders will be better off if all types of credit constraints are eliminated. In doing so, we used an estimation strategy first developed by Guirkinger and Boucher (2008) and later used by Dong et.al (2010) in china, Ali et.al (2012) in Ethiopia and Ali et.al (2014) in Rwanda. The effect is quantified by using the following mathematical model.

$$\Delta Y_i = X_i\left(\hat{B}^U - \hat{B}^C\right) \quad \ldots\ldots\ldots\ldots \quad 4.1$$

Where ΔY_i represents the percentage change in agricultural yield for constrained households, i.e. an increase in the productivity of credit constrained farmers after relaxing all types of credit constraints; X_i's are vector of explanatory variables whereas $\hat{B}^U$ *and* $\hat{B}^C$ are slope coefficients of the unconstrained and constrained groups of households respectively. After fitting the values of each of the respected beta coefficients in the model and executing the process, finally we observed a productivity gap of 17.94 percent due to credit constraints. This is a huge productivity loss. Given 66.17 percent of households are credit constrained, it is easy to guess how painful the overall productivity loss for the country at large is. If we were happen to relax all types of credit constraints, credit constrained households would enjoy a 17.94 percentage increase in their annual

agricultural yield which is around 1410.17[27] birr per hectare of land. This calls for an appropriate policy intervention towards reducing credit constraints that tied smallholders from getting adequate timely credit to acquire productive agricultural inputs that are going to boost agricultural yield. Given agriculture is the primal means of survival for rural residents and the country's economy at large, polices that tackle agricultural credit constraints will have significant implications in reducing poverty by improving the living conditions of agriculturalists.

[27] We have calculated that the per hectare value of agricultural yield for constrained and unconstrained households are 9763.281 and 7856.085 Ethiopian birr respectively. Therefore, the monetary value of the expected productivity gain for credit constrained households if all types of credit constraints happen to be eliminated is calculated as 7856.085 birr * 0.1794= 1410.17 birr.

5. Conclusion and Policy Implications

5.1. Conclusion

The Ethiopian economy is characterized by the persistence of low technology intensive less productivity agriculture dominated by smallholder farm households. Many empirical evidences justified that better agricultural productivity can be achieved through technology adoption complemented with better financial infrastructure that fills the financial gaps of smallholder farmers by creating better provision of agricultural credit. Crediting to these evidential justifications, our effort so far was devoted to achieve the main objectives of this study, i.e. to show the status quo of access to credit and the impact of credit rationing on agricultural productivity in Ethiopia. To this end, the paper exploited a 2013 household survey by EPIICA.

By using the survey based direct elicitation approach, the paper first tried to observe households' demand for agricultural credit. And then if they do have the demand, their agricultural credit application status was considered. Through this due procedure, the paper uncovered that only 25.32 percent of smallholders applied for agricultural credit. The acceptance rate of loan applications is encouraging given 72.63 percent of applicants got full loan approval while 20.82 percent of them got partial approval. The applications of the remaining 6.55 households have been rejected totally. Among non-applicants, 52.10 percent of them didn't apply because the collateral requirement is too high and 25.37 percent of them abstained from credit application because they didn't want loans at all. The reasons for the remaining non-applicant smallholders are associated with high interest rate, want to work with their own funds and other risk and transaction cost related restraints. The paper further investigated the presence of widespread agricultural credit rationing among smallholder farm households. We found that 66.17 percent of households are credit constrained. Among credit constrained households, 71.1 percent of them are quantity rationed. The remaining is covered by transaction cost and risk rationing each accounting 4.5 and 24.4 percent respectively. This shows the relatively high prevalence of quantity and risk rationing agricultural credit demand bottlenecks of smallholder farmers.

All formal, semi-formal and informal sources of credit were considered in the study. Moreover, the analysis of the study indebted itself for agricultural production credit, leaving other loans for non-agricultural production purposes. The structure of the survey questionnaire by EPIICA

allowed us to deal with credit rationing for agricultural production alone since information for the two types of loans from smallholders obtained separately. Primary societies and cooperatives are found to be the main sources of agricultural credit accounting 66.8 percent of realized number of loans. Microfinance institutions, RUSACCOs and other credit associations accounted for 16.8 percent making them the second highest sources of agricultural credit.

Surprisingly, the effect of liquidity on value of crop productivity per hectare of land is found to be insignificant for both constrained and unconstrained households with a negative sign for the latter group of households. This is a shocking result given we are working with a highly credit constrained rural economy of Ethiopia. We believed that this came from our weak definition of liquidity, since the survey by EPIICA fail to disclose the amount of savings for net saver households which obliged us to define liquidity as the sum of cash from nonfarm activity and amount of credit realized by households. This may underestimated the magnitude and significance of liquidity on agricultural productivity for both constrained and unconstrained households, but it still better proxied the effect given the dataset we have.

The study found a variation on the intensity of credit rationing among the sample zones. The highest percentage of within zone credit rationing observed in South Wollo, where 83.47 percent of households are credit constrained followed North Shewa with 67.80 percent. Proportion of credit constrained households accounted 56 and 57.35 percent of sample households in West Gojjam and North Wollo.

The result from the empirical estimation revealed that age of the household head, households trust on kebele cooperatives and saving status of household reduces the probability of being credit constrained. Compared with households in North Shewa, households in West Gojjam and North Wollo are found to be less vulnerable to credit rationing. The study didn't observe a significant household's head gender based credit rationing biases. Education level of households significantly minimizes the probability of being credit constrained if the household head go beyond primary education. There were no significant variation in the probability of credit rationing between illiterate household heads compared to those who attend informal education and primary education. On the other hand age square of the household's , Muslim headed household dummy and value of house which used as a proxy for households asset holding status are found to be

significant with positive signs. Implying age of the household head has a non-linear effect on credit rationing. And Muslim headed households and households with higher value of houses are associated with higher vulnerability to credit rationing.

The agricultural productivity equation for both constrained and unconstrained households have been estimated simultaneously and presented separately. The most notable result is that the effect of liquidity for both groups of households is insignificant with negative and positive sign for unconstrained and constrained households respectively. We believed that the insignificance of liquidity can be explained by our weak definition of liquidity and partly might be due to the presence of lower financial literacy among rural households. The intensity of fertilizer use is found to be significant for both groups of households with a slightly different marginal contribution. The land-size productivity paradox holds for both constrained and unconstrained households. Ownership of larger parcel of land is associated with less productivity agriculture. Variation in agricultural productivity due to location dummies is observed only for credit constrained households. Using hired labor, for both constrained and unconstrained households, significantly improves productivity.

Finally, the paper investigated the persistence of a considerable agricultural productivity gap between constrained and unconstrained households. We have estimated that if all types of credit constraints prevalent among credit constrained households are eliminated, credit constrained households will enjoy a 17.94 percentage increase in their annual agricultural yield. This gain is estimated to be an additional 1410.17 birr per hectare of credit constrained households, if they are lucky enough to be rescued binding credit constraints. This is a huge deal for the highly subsistence low productivity and credit constrained rural economy of Ethiopia and the national economy at large.

5.2. **Policy Implications**

Building a systematic and practical method of financing smallholder agriculture has been and continues to be a difficult goal in Ethiopia in spite of the remarkable progresses that has been achieved through the growing microfinance revolution over the past two decades. To create a prosperous rural society free of poverty and its byproducts, the country need to formulate appropriate measures to develop the agricultural sector in which the life of the rural poor

predominantly depends. If not the only, creating a financial system with effective delivery of efficient, demand driven financial services compatible with the needs of smallholder framers must be the government's rural development top priority. Because a well-developed financial system enables money to be used in the right place at the right time for the right purpose which missed in the Ethiopian overall financial system in general and the agricultural sector in particular. If the economically active smallholder farmers are armed with credit services which allowed them to acquire agricultural inputs timely, they will undoubtedly end with a better productivity agriculture which will create better income and finally lesser vulnerability to poverty and that is what poverty stricken farm households urgently in need off. In line with the major findings of our study, we recommend the following policy options hoping to foster better access to agricultural credit by reducing the various forms of credit constraints.

As revealed on our study, RUSACCOs and MFIs are found to be the major sources of agricultural credit. Therefore, improving the capacity of these institutions must be at the front sight of the government's rural finance policy agenda. In doing so, the government must work in creating new strategic linkages between banks, microfinance institutions and RUSACOOs. This may create opportunities to share the experiences of microfinance institutions and RUSACCOs on how to deliver financial services in rural areas and the financial resources of banks. This new win-win paradigm shift in the rural finance delivery system will undoubtedly fill each other's institutional, financial and knowledge gaps. This can be done by giving credit guarantee schemes for MFIs and RUSACCOs to get more loans from commercial banks and relax their liquidity constraints in delivering financial services for the economically active rural households.

In contemporary policy debate, may argue that the foundation of effective rural development policies needs to be grounded from the typical rural community itself. This comes from the growing view that policy should prioritize on best fits than best experiences, though the power of experience is not underestimated if complemented with indigenous knowledge and institutions. That is what makes us to pledge politically independent MFIs and RUSACCOs as top priority by helping them in their institutional development and financial mobilization. To meet their liquidity constraint, the government should bring a way to give them credit guarantee schemes to make them eligible for commercial bank loan which is limitedly available for MFIs and totally missed for RUSACCOs. For better ends the government need to have frequent expertise supervision to

help them build better risk management skills, effective management information, accounting and auditing systems. And also strict supervision and clear message about the credit for smallholder farmers should be disseminated backed up by strong legal enforcement mechanisms for defaulters.

We recommend the government to revise its policies regarding land ownership issues, though complex in their very nature need also be keenly scrutinized and accordingly give smallholders an opportunity to use their land as collateral to obtain loans from formal financial institutions, as they have nothing in their disposal except their farm land to be used as collateral.

Moreover, the government through its various levels should work to;

- Ensure farmers and financial institutions accessibility to market-enabling physical and information infrastructure to reduce transaction cost rationing
- To keep people informed on the availability of credit services through agricultural development agents or other approaches.
- Better dissemination of information and technology for improved decision making regarding use of credit, i.e. improving financial literacy
- Help institutions develop insurance products as they will play a lot in the effectiveness of agricultural credit programs.
- Develop value chain finance which links financial institutions to the agricultural value chain, offering financial services to support the product flow and building on the established relationships in the chain.
- Develop the active involvement of development agents to help smallholders on how to use agricultural credit through higher input use leading to higher productivity.

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Appendix I. Descriptive statistics of variables used under the econometric estimation procedure

Variable Name	Number of Observations	Mean	Std. Dev.
Yield	1082	8501.218	5244.185
liquidi~1000	1082	3.871312	10.75317
vinorgferh~r	1082	1500.843	1876.377
Parcelhectar	1082	1.163014	.6447197
Maledummy	1082	1.163014	.2986536
Agehead	1082	50.3586	13.72092
Ageheadsqu	1082	2724.078	1451.821
hh_size	1082	5.195009	1.842015
Infoedudummy	1082	.2476895	.4318701
Primarydummy	1082	.1820702	.3860809
Dhschool	1082	.0175601	.1314065
Dwgojjam	1082	.323475	.4680186
Dswollo	1082	.2236599	.4168894
Dnwollo	1082	.1256932	.3316565
Riskdummy	1082	.5619224	.4963802
Numberoxen	1082	1.773567	1.03836
Hireddummy	1082	.2550832	.4361095
Avslope	1082	2.596403	.311675
Avaltitude	1082	3.065327	.4720794
Droughtdummy	1082	.8595194	.3476456
Muslimdummy	1082	.2855823	.4519002
enterprise~y	1082	.1155268	.3198044
Livestocktlu	1082	3.950545	2.548302
house1000	1082	30.42052	52.53212
bankaccoun~y	1082	.2255083	.4181099
Savedummy	1082	.4362292	.4961459
Banktdummy	1082	.8410351	.3658124
Kctdummy	1082	.8521257	.3551395

Source; Own computation from EPIICA survey 2013

Appendix II. The Endogenous switching estimation result of the effect of credit constraints on agricultural productivity

Endogenous switching regression model			Number of obs = 1082
			Wald chi2(19) = 74.62
Log pseudolikelihood = -1505.456			Prob> chi2 = 0.0000
Explanatory variables	**Unconstrained**	**Constrained**	**Selection Equation**
	Coefficient	**Coefficient**	**Coefficient**
liquidity1000	-0.0038768 (0.0055205)	0.0002538 (0.00183)	
Vinorgferhectar	0.0000517** (0.0000239)	0.0000603* (1.77E-05)	
Lnparcelhectar	-0.170368** (0.0726686)	-0.166244* (0.051471)	-0.0304 (0.07948)
Maledummy	0.0755261 (0.12934)	-0.059576 (0.080186)	0.06063 (0.14194)
Agehead	0.0135111 (0.0189966)	0.0097714 (0.010224)	-0.036*** (0.0195)
Ageheadsqu	-0.0001236 (0.000176)	-0.000093 (9.26E-05)	0.00033*** (0.00018)
hh_size	0.0106668 (0.0229568)	0.0017922 (0.013934)	-0.0041 (0.02578)
Infoedudummy	0.0351049 (0.0852342)	-0.005741 (0.054574)	0.01659 (0.10522)
Primarydummy	-0.013228 (0.0934097)	0.0532089 (0.063389)	-0.0544 (0.11643)
Dhschool	0.1519366 (0.2620465)	0.0108553 (0.194964)	-0.7021** (0.32505)
Dwgojjam	-0.0109578 (0.1178898)	-0.088721 (0.068187)	-0.3214* (0.11978)
Dswollo	-0.2386942 (0.17026)	-0.448992* (0.070779)	0.18191 (0.16702)
Dnwollo	-0.1136211 (0.1198203)	-0.165234** (0.077512)	-0.3796* (0.1368)
Riskdummy	0.0559411 (0.0696441)	0.000653 (0.043128)	-0.0376 (0.0845)
Numberoxen	0.0410766 (0.0331466)	0.0716576* (0.022483)	
Hireddummy	0.1242318*** (0.0700261)	0.0966781** (0.048653)	

Avslope	0.1566207*** (0.088486)	0.0902973 (0.061938)	
Avaltitude	-0.0671562 (0.0691422)	-0.054711 (0.042706)	
Droughtdummy	-0.3148669* (0.0967814)	-0.257977* (0.068656)	
Muslimdummy			0.28637** (0.12747)
Enterprisedummy			0.17692 (0.12371)
Livestocktlu			-0.0071 (0.01562)
house1000			-0.0018* (0.00066)
Bankaccountdummy			-0.0762 (0.08943)
Savedummy			-0.25249* (0.07552)
Banktdummy			-0.1567 (0.10443)
Kctdummy			-0.3145* (0.11787)
_cons	8.978427* (0.6931723)	8.501819* (0.350502)	2.01174* (0.561)
/lns (correlation coefficient between selection equation and the value of crop productivity function)	-0.3510496* (0.1176329)	-0.5354094* (0.0438182)	
/r0corr(e_{ij}, $u_{i)}$	1.059483* (0.2556739)	0.6094836 (0.1297742)	
Sigma	0.7039488 (0.0828075)	0.5854295 (0.0256524)	
Rho	0.7854659 (0.0979342)	0.5437635 (0.0914027)	
Wald test of independent equations :			chi2(2) = 45.09 Prob> chi2 = 0.0000

Where *, ** and **** indicates significant variables at 1 %, 5% and 10% levels of significance. The values in parenthesis are robust standard errors for each of the respective coefficients.

Declaration

I the under signed, declare that this is my original work and has not been presented in other universities; all sources of materials used have been duly acknowledged.

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