修　士　論　文

Evaluating the Impact of Market Information System on Coffee Producers' Revenues and Profits in Ethiopia

市場情報システムがエチオピアのコーヒー生産者の収入および利益に及ぼす効果分析

東京大学　新領域創成科学研究科

国際協力学専攻

学籍番号　47－136774

氏名　李　根雨

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東京大学大学院 新領域創成科学研究科

環境学研究系　国際協力学専攻

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List of Abbreviations

2SLS ..... two-stage least squares

ATT ..... average treatment effect on the treated

DST ..... Direct Specialty Trade

EBC ..... Ethiopian Broadcasting Corporate

ECX ..... Ethiopian Commodity Exchange

IVR ..... Interactive Voice Response

MIS ..... Market Information System

MPE ..... marginal probability effects

NMA ..... National Meteorology Agency

OCFCU ..... Oromia Coffee Farmers Cooperative Union

OLS ..... ordinary least squares

RE ..... random effects

SCFCU ..... Sidama Coffee Farmers Cooperative Union

SIMA ..... Mozambique's Agricultural Market Information System

SMS ..... Short Messaging Services

Acknowledgement

I have just finished writing my master thesis on the Ethiopia's market information system. I would like to extend a few words of thanks to those who have supported me throughout it all.

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Abstract

Market information is important in determining production and marketing behavior for farmers, particularly for commodities whose price fluctuation is extreme. However, the majority of smallholder coffee farmers in developing countries have difficulty in accessing market information at the central wholesale markets.

Theoretically, having little market information may affect producers negatively at least by two ways. Firstly, the coffee farmers may suffer from information asymmetry, i.e., farmers, who are uninformed of market coffee prices, may be offered lower prices than fair prices by traders. Secondly, without accurate market information, farmers may overinvest or underinvest in coffee farming, leading to a loss.

To solve this situation, Ethiopia introduced the market information systems (henceforth, MIS) and provided all market actors and market intermediaries with market prices. While the MIS may improve smallholder farmers' welfare in theory, whether a large number of smallholder farmers, especially those who are illiterate, are able to benefit from using the new technologies is not clear.

Therefore, this paper tries to examine the effect of MIS on the smallholder coffee farmers' profits and productivities empirically using the primary data collected from 546 smallholder coffee farmers in Ethiopia.

To examine the characteristics of respondents that relate to the use of MIS, I evaluate marginal probability effects (MPE) of explanatory variables in probit model

and odds ratios in logit model with MIS usage as a dependent variable. To estimate the impact of MIS on coffee producers' revenues and profits, I employ the ordinary least squares (OLS) estimator, random effects (RE) panel models, the two stage least squares (2SLS) estimation, and a kernel-based matching estimator to estimate the average treatment effect on the treated (ATT).

Through these estimations, I find that MIS users indeed obtain higher revenues and profits than non-MIS users, in magnitude, a 37 percent increase for profits and a 25 percent increase for revenues. The results were robust to the different estimation methods employed, including models which consider endogeneity of the use of MIS.

In addition, I find that this increase could be more attributed to an increase in harvest volumes and in sales volumes by MIS users rather than an increase in their selling prices. Although farm size is not statistically different between MIS and non-MIS users, MIS users harvest higher amounts of coffee relative to non-MIS users. Another finding is that this positive effect of MIS on the farmers' performance is magnified further with more years of education, indicating that more educated benefit more from using MIS. This suggests that how you use the information matters in improving the performance, not just the fact of having the information.

My findings suggest that the price information obtained by MIS users can be used to improve both their investment and farm management decisions and increase their productivity levels. Furthermore, although admittedly a crude estimate, I also found that MIS may also benefit traders as MIS users also exhibit higher sales volumes.

1. Introduction

Market information is an important input farmers use when determining production and marketing behavior, particularly for commodities facing extreme price fluctuations, such as coffee (ICC 2003). However, in fact, the majority of smallholder coffee farmers in developing countries have difficulty accessing market information regarding central wholesale markets (Getnet, et al. 2011). Osborne (2005) claims that the productivity of smallholder coffee farmers is negatively affected by this lack of information on coffee prices.

Theoretically, having scant market information may affect producers negatively in at least two ways. First, the coffee farmers may suffer from information asymmetries, i.e., farmers uninformed of market coffee prices may suffer a loss when they transact with traders who are superior to the farmers in terms of market information access. Second, it is highly likely that smallholder coffee farmers lacking sufficient information to predict the coffee price fluctuations may overinvest or underinvest in their coffee farms. As a result, they can be burdened with a heavy debt and possibly even abandon their coffee farms.

In order to tackle such problems due to inaccurate information and information asymmetries, several African countries introduced the market information systems (MIS) and provided information regarding market prices to all market actors and intermediaries (Mader 2002; Muto 2013). MIS may improve smallholder farmers'

welfare in theory, but it remains unclear if the majority of smallholder farmers, especially illiterate ones, will be able to benefit from using the new technologies. Thus, the question remains as to whether these MIS exert a positive effect on the farmers' farming and livelihood in practice. This study performs a quantitative estimation of the effects of MIS using the case of the Ethiopian coffee industry.

Although several studies have shown that MIS users are able to obtain higher revenues than non-MIS users (Muto 2013; Mukhebi 2004), their analyses are not complete as they did not evaluate other important outcomes, such as profits or productivity. Thus, this study tries to emprically examine the effect of an MIS on the smallholder coffee farmers' profits and productivity levels using primary data collected from 546 farmers in Ethiopia.

I find that MIS users indeed obtain higher revenues and profits than non-MIS users, in magnitude, a 37 percent increase for profits and a 25 percent increase for revenues. The results were robust to the different estimation methods employed, including models which consider endogeneity of the use of MIS.

In addition, I find that this increase could be more attributed to an increase in harvest volumes and in sales volumes by MIS users rather than an increase in their selling prices. Although farm size is not statistically different between MIS and non-MIS users, MIS users harvest higher amounts of coffee relative to non-MIS users. Another finding is that this positive effect of MIS on the farmers' performance is magnified further with more years of education, indicating that more educated benefit

more from using MIS. This suggests that how you use the information matters in improving the performance, not just the fact of having the information.

My findings suggest that the price information obtained by MIS users can be used to improve both their investment and farm management decisions and increase their productivity levels. Furthermore, although admittedly a crude estimate, I also found that MIS may also benefit traders as MIS users also exhibit higher sales volumes.

The next chapter describes price fluctuations in the coffee industry and their impact on Ethiopian farmers, coffee production systems, and Ethiopian coffee supply value chain while chapter 3 reviews the literature on market competition, information asymmetries, and MIS usage in African countries. Chapter 4 explains the data used and presents summary statistics. Chapter 5 explains the estimation methods used, and the results are presented in Chapter 6. A conclusion follows in Chapter 7.

2. An Overview of Ethiopian Coffee

2.1 Ethiopian Coffee Industry and Smallholder Coffee Farmers

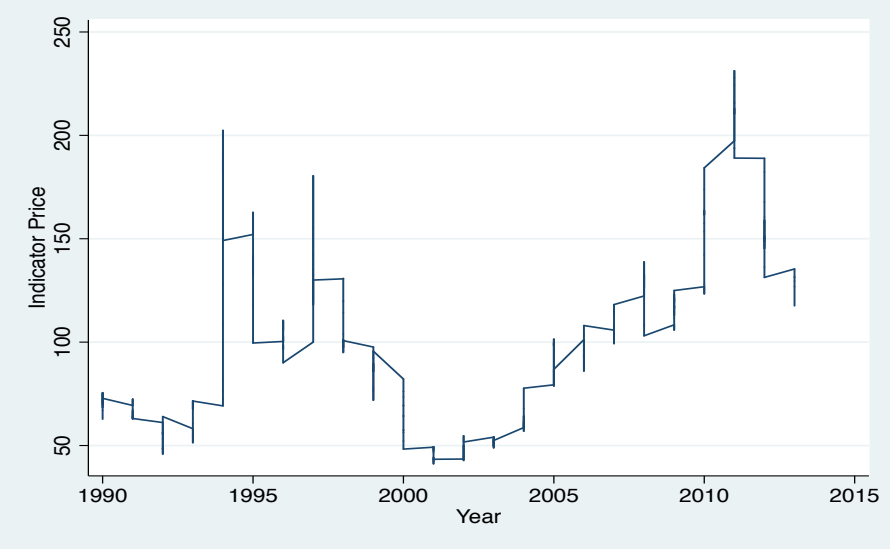
Coffee production is a mainstay of the Ethiopian economy, and accordingly, the Ethiopian government has striven to improve the productivity, quality, and market efficiency of its domestic coffee crops since liberalizing its agricultural market in 1990. As a result, Ethiopia became the world's fifth largest coffee producer and Africa's top producer, with a production of 4 million metric tons during the crop year 2011–2012 (ODI 2009; ICO 2014). Coffee accounted for more than 50 percent of Ethiopia's export revenues in 2006, and about 25 percent of total export earnings in the marketing year 2012–2013 (Cheng 2007; Tefera and Tefera 2013). More than one million coffee-growing households and the livelihood of over 15 million people, directly or indirectly, depend on this commodity crop (Labouisse et al. 2008; LMC 2000; ODI 2009). Ethiopia's coffee crop currently holds a significant position as one of the national economy's major export commodities.

Smallholder coffee farmers, most of whom farm less than half a hectare of land, produce more than 95 percent of the country's total coffee output. Although Ethiopian coffee producers play an important role in the national economy, the majority still live in extreme poverty. According to a study conducted by the ODI (2009), poverty incidence among coffee producers was 40 percent in 1999, slightly higher than the

national average of 38.5 percent.

Figure 2-1 shows the high volatility of coffee prices between 1990 and 2013. In September 2001, coffee prices hit a historic low of 41.17 US cents/lb. The lowest coffee price this year was less than half the average price during the 1990s. This global coffee crisis had a significant impact on the lives of more than 125 million people worldwide who work in the coffee industry, both directly and indirectly. The imbalance between the supply and demand for coffee was a principal cause of this observed slump in coffee prices (Osorio 2002).

Figure 2-1 The Indicator Prices of Coffee (US cents per 1b)

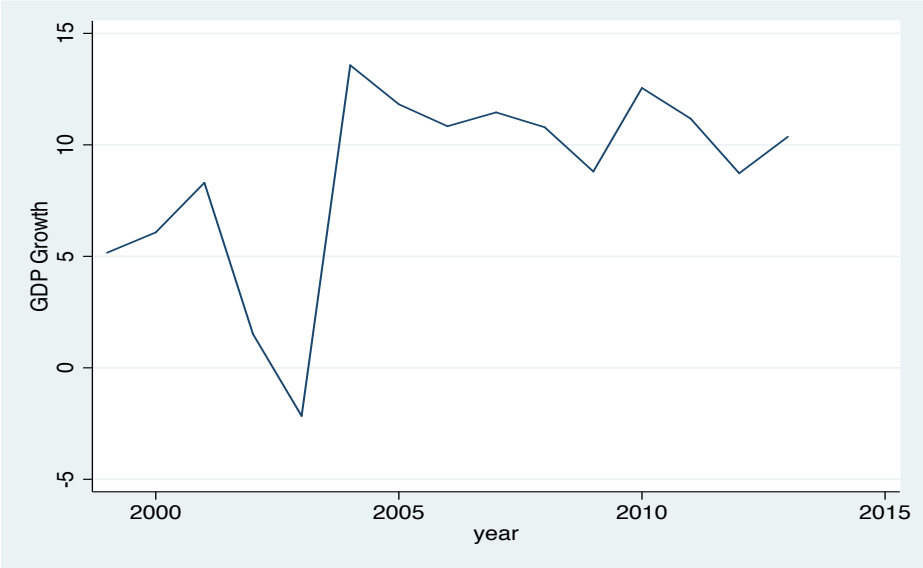


Source: ICO (2014)

In Ethiopia, the GDP growth rate dropped more than 6.5 percent in 2001 relative to the previous year, and the economy experienced a negative growth by 2.2 percent in 2002 due to the drop in coffee prices as depicted by Figure 2-2. In addition, Ethiopia's export revenues from coffee fell by 42 percent, from US$257 million to US$149 million. In the aftermath of this coffee crisis, the Ethiopian government suffered from severe fiscal constraints for that period and was forced to reduce the budgets for education, health programs, and ability to make debt repayments as a tight fiscal policy (Cheng 2007).

During the same period, some Ethiopian coffee farmers sold their coffee at prices below production costs, earning less than US$ 1 per day. As a result, some coffee growers, with their livelihoods in jeopardy, abandoned their coffee farms and attempted to migrate to Addis Ababa, Ethiopia's capital city, to seek jobs. Furthermore, a large number of smallholders were unable to pay for their children's education or basic medicines and had to cut back on food consumption, thereby increasing incidences of malnutrition (Osorio 2004; ICC 2003).

Figure 2-2 The GDP Growth of Ethiopia (Annual %)



Source: World Bank (2014)

These cases provide sufficient evidence to conclude that coffee price fluctuations can adversely affect coffee growers' livelihood as well as financial status in Ethiopia. Although stabilizating coffee prices is considered a solution to the problem, in practice, this would prove extremely difficult as all coffee producing countries would need to build a cooperative system to enact such a plan. Reintroduction of a quota system,[1] which had been implemented by the ICO from 1962 to 1989, has been discussed by ICO member states. However, because both coffee producing countries and global coffee trade volumes have significantly increased since the agreement's breakdown, the cost of the quota system seems to be too high in practice to implement (Seo 2009).

[1] The International Coffee Agreement was first signed in 1962. The agreement was designed to maintain exporting countries' quotas and keep coffee prices high and stable, but the quota system was abrogated in 1989 due to failure to agree on quota distribution (ICO n.d.).

2.2 Requisites for Improving Productivity, Quality, and Price of Coffee

Ethiopian coffee producers mainly produce Arabica coffee. In order to produce high-quality Arabica coffee, geographical conditions must be satisfied as given below. Firstly, the volcanogenous soil is apt for the coffee growing because the soil contains plenty of organic matter and coffee trees take up the nutrient from the soil. The volcanogenous soil is a reddish-brown color as shown in Figure 2-3. Secondly, an average annual rainfall of between 1,600 and 1,800 mm is a necessary condition for growing Arabica coffee. While on the one hand the average rainfall is a crucial factor to improve both productivity and quality of coffee, on the other hand, there are instances when heavy rain in a harvest season damages both coffee quality and productivity. Since fallen coffee cherries by heavy rain may be decayed on the ground and the harmful elements can be absorbed into coffee tree roots, coffee producers have to protect against heavy rain in the harvest season. Another geographical condition is an elevation of between 600 and 2,500 meters. One of the difficulties in growing the type of Arabica coffee is that the coffee is particulary vulnerable to diseases and insects. Therefore, coffee farms should be located from 600 and 2,500 meters above sea level to mitigate the risk of blight and insects (Hirose, Maruo and Hosida 2007).

In addition to these conditions, the age of a tree affects the productivity of coffee tree. The coffee trees become the most productive between the ags of 6 and 15 years old. They do not bear coffee cherries much when they are over 20 years old or 30 years old.

In that event, coffee farmers cut back the trunks of the old coffee trees by 30 cm as a measure to recover the productivity of old coffee trees. About 2 or 3 years after this cutting, the coffee trees start to bear cherries again.

Furthermore, picking mature cherries is important to produce high-quality coffee. Producers have to pick red cherries carefully to obtain beans which are uniform in size, shape, and color as shown in Figure 2-4; these beans are graded from 1 to 5 and exported to European countries, Japan, South Korea, and the USA. If green cherries are picked, the beans may be ununiform as depicted in Figure 2-5 and be graded from 6 to 9 or under-grade. Coffee beans above grade 5 are sold to the domestic consumers.

Above and beyond these conditions, production systems and pulping processes are considered as vital factors to improve both the qualities and the prices of coffee beans. Also, it seems that supply value chain simplification is another key ingredient to raise the farm-gate price. Hence, this paper focuses on these factors in two Subsections below (ECX 2009; Hirose, Maruo and Hosida 2007).

Figure 2-3 Volacanogenous Soil in a Coffee Farm in the Sidama Zone

Source: Author's Survey (2014)

Figure 2-4 Coffee Beans between Grade 1 and 5

Source: Author's Survey (2014)

Figure 2-5 Coffee Beans between Grade 6 and 9 or Under-grade

Source: Author's Survey (2014)

2.2.1 Ethiopian Coffee Production Systems and Pulping

Almost all coffee producing countries have two types of coffee production systems such as garden coffee and plantation coffee. On the other hand, Ethiopian coffee production systems can be divided into four principal categories according to the characteristics of methods of cultivation (ESC 2002).

The first category is called forest coffee, which accounts for about 10 percent of total coffee production in Ethiopia. The Southern and Southwest parts of Ethiopia are major producers of forest coffees. The system is characterized by self-sowing seeds of coffee and growing under the shade of trees in primeval forests. Farmers do not have to fertilize any materials and slash weeds, but they do have to pick coffee cherries for the forest coffee. While the productivity of forest coffee is the lowest among four types of production, the genetic diversity of forest coffees has an important role in developing new types of coffee.

The second category is called semi-forest coffee, which accounts for about 35 percent of total coffee production in the country. The Southern and Southwest parts are also well-known semi-forest coffee-producing regions. Coffee farmers who produce semi-forest coffee plant forest trees on their own farms and create a growing condition that is similar to those in primeval forests. This production system has the advantage of cultivating the coffee in the mountainous areas, but the yield of this system is only from 100 to 200 kg per hectare, about a third of the garden coffee's output, because of the

limited usable area of the farmland relative to the garden coffee system.

The third category is called garden coffee. This type of coffee is mainly produced in the Southern and Eastern part of the country. The largest number of Ethiopian coffee producers, about 50 percent of the total coffee production in the country, prefer to grow thier own coffees with this system since the output is the highest among coffee production systems by smallholder coffee farmers about 400 to 500 kg per hectare. For the garden coffee, a flatland is necessary to set intervals between coffee trees uniformly as shown in Figure 2-6 unlike both forest coffee and semi-forest coffee. Garden coffee farmers plant from 1,000 to 1,800 coffee trees per hectare that is 5 times more than the average number of trees planted under the semi-forest coffee.

The last category is called plantation coffee because the coffee is mainly produced by state farms and private investors. Whereas most smallholder coffee farmers do not use chemical fertilizers, plantation coffee uses chemical fertilizers and herbicides. The yield of plantation coffee is from 450 to 570 kg per hectare and the coffee accounts for about 5% of the total coffee production in the country (ESC 2002; Paromar Consulting 2010).

After harvesting, these four types of coffee commonly pass through dry or wet process to remove its outer pulp. Dry process, which produces what is called unwashed coffee, is a traditional coffee pulping processes which has existed, as long as coffee has been drunken. Another process is called wet process, which produces what is called washed coffee, as shown in Figure 2-7. Farmers decide which process to adopt,

considering the benefits and costs of each process. For dry process, the operation does not require special equipments such as a coffee pulper machine required for wet process, but plenty of sunshine is needed. This process has another advantage that farmers can operate outside their house as shown in Figure 2-8. According to an expert who belong to the Sidama Coffee Farmers Cooperative Union (SCFCU), if farmers do not have enough time to convey the harvested coffee cherries from their own farms to a place where the wet process is provided, they may select dry process because coffee pulps have to be removed within 12 hours after picking cherries to obtain higher grade coffee beans. Dry process has advantages as mentioned above, but the unwashed coffee commonly has lower prices than the washed coffee on average, around 46 U.S cents per 1b less (ECX 2011). For this reason, Ethiopian government has encouraged coffee farmers to operate wet process to increase the volume of washed coffee and to gain more foreign-exchange earning. As a result, washed coffee has nearly quadrupled since 1980, rising from 9 to 35 percent in 2011 (Paromar Consulting 2010).

To sum up, forest coffee, semi-forest coffee, and garden coffee are produced by small-coffee farmers. Among the, I focus on semi-forest and garden coffee in this thesis because the farmers' decisions on production, investment, and marketing are important under these types of coffees. Forest coffees are gathered in forests owned by the government and productivity is mostly determined by nature. Thus, there is little room for farmer to invest in forest coffee by using market information. Under semi-forest and garden coffee systems, Ethiopian farmers do not use non-organic fertilizers, herbicides

and pesticides generally. It is evident from this feature that labor costs in farming seasons and harvest seasons are major expenditures on coffee cultivation by smallholder coffee farmers in Ethiopia. Although the farm expenditure of the two types of coffee has a similarity, the productivity of garden coffee is absolutely higher than semi-forest coffee because of significant differences in the density of coffee trees. Another difference between these coffee is that most washed coffee are produced in garden coffee areas; the Sidama zone represents garden coffee and posesses 89 percent of total coffee pulper machines in Ethiopia (Paromar Consulting 2010). These differences are likely to lead to the income gap between farmers who produce garden coffee and semi-foreset coffee.

Figure 2-6 A Garden Coffee Farm in the Sidama Zone

Source: Author's Survey (2014)

Figure 2-7 A Wet Process Facility

Source: Author's Survey (2014)

Figure 2-8 Dry Process

Source: Author's Survey (2014)

2.2.2 Ethiopian Coffee Supply Value Chain after the Establishment of the Ethiopia Commodity Exchange

In May 2008, the Ethiopian government launched a commodity exchange (henceforth, ECX), and changed a hub of its coffee distribution from auction centers in Addis Ababa to the ECX with the goal of creating an efficient marketing system for coffee. For the purpose, the government also reformed its distribution structure as shown in Figure 2-10.

Figure 2-9 shows the Ethiopian coffee supply value chain before the ECX era. 95 percent of smallholder coffee farmers consigned their products to cooperatives, suppliers, legal collectors and illegal collectors. Since most of coffees were delivered to the auction centers and sold to private exporters for export and wholesalers for domestic consumption at auctions, the share of transportation costs in the final price was higher than current market structure.

Figure 2-10 is a figure which shows current coffee supply value chain. The figure is different from Figure 2-9 in that the Ethiopian government replaced auction centers with the ECX and proscribed legal collectors and illegal collectors' business activities. The government also amended legislation on coffee trading to ban the trade of coffee outside of the ECX. Although direct specialty trade (DST) was launched in 2010, most of Ethiopian coffees are still traded on the ECX trading floor. Comparing previous to current supply value chain, one of the most noticeable changes is direct

delivery system. If coffee beans are auctioned off to a exporter, the ECX will directly deliver coffee from its warehouse locations around the country as shown in Figure 2-11 to the final successful bidders (ECX 2009; ESC 2002). Accoring to Gabre-Madhin (2012), farmers' farm-gate prices raised from 38 percent to 70 percent of the final price due to reduction in transportation cost and change in supply structure by the ECX. Due to this structural change, moreover, most of private collectors, both legal and illegal, who used to purchase from smallholders directly, disappeared and the share of coffee sold to the Ethiopian coffee cooperatives increased significantly.

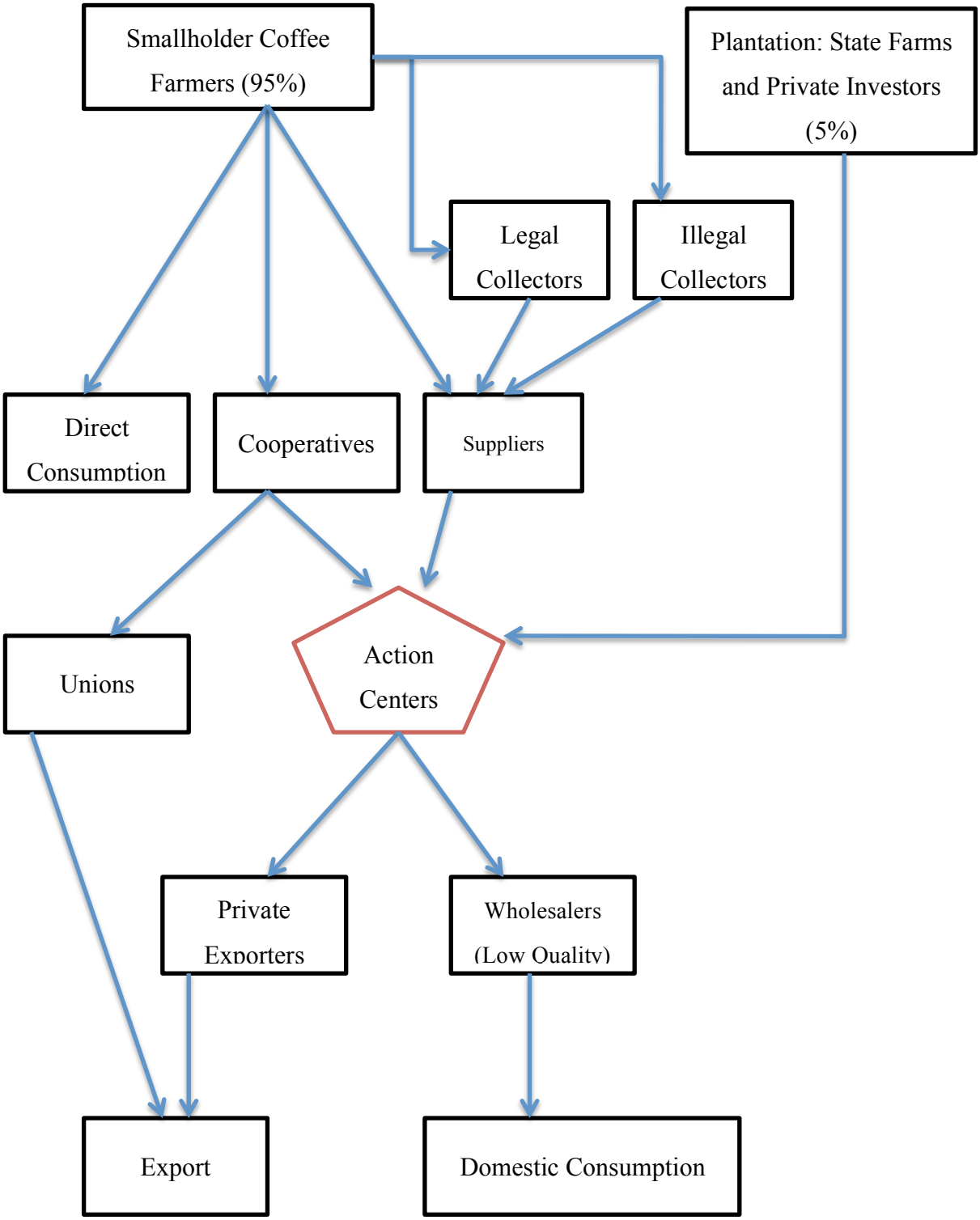
One interpretation of the change is that cooperatives and the ECX play a central role in Ethiopian coffee industry. Cooperatives transfer farming technologies to farmers as shown in Figure 2-12 and provide coffee pulping processes on condition that farmers sell their coffee. Also, cooperatives make organic fertilizers from coffee's outer pulps and offer the composts without charge. All coffee farmers are able to receive these services from local cooperatives even if a farmer is a non-member of cooperative. However, cooperatives' profits are allocated to only the members of the cooperative after settlement of sales accounts. The membership is open to all coffee farmers, but members of the cooperative have to pay union fees.

Considering the structural change, it can be presumed two features of the Ethiopian coffee industy. Firstly, since cooperatives in each kebele buy smallholder coffee farmers' coffee uniformly,[2] it may be unusual for Ethiopian coffee farmers to

[2] The purchse price is determined by the estimated contract price for the year.

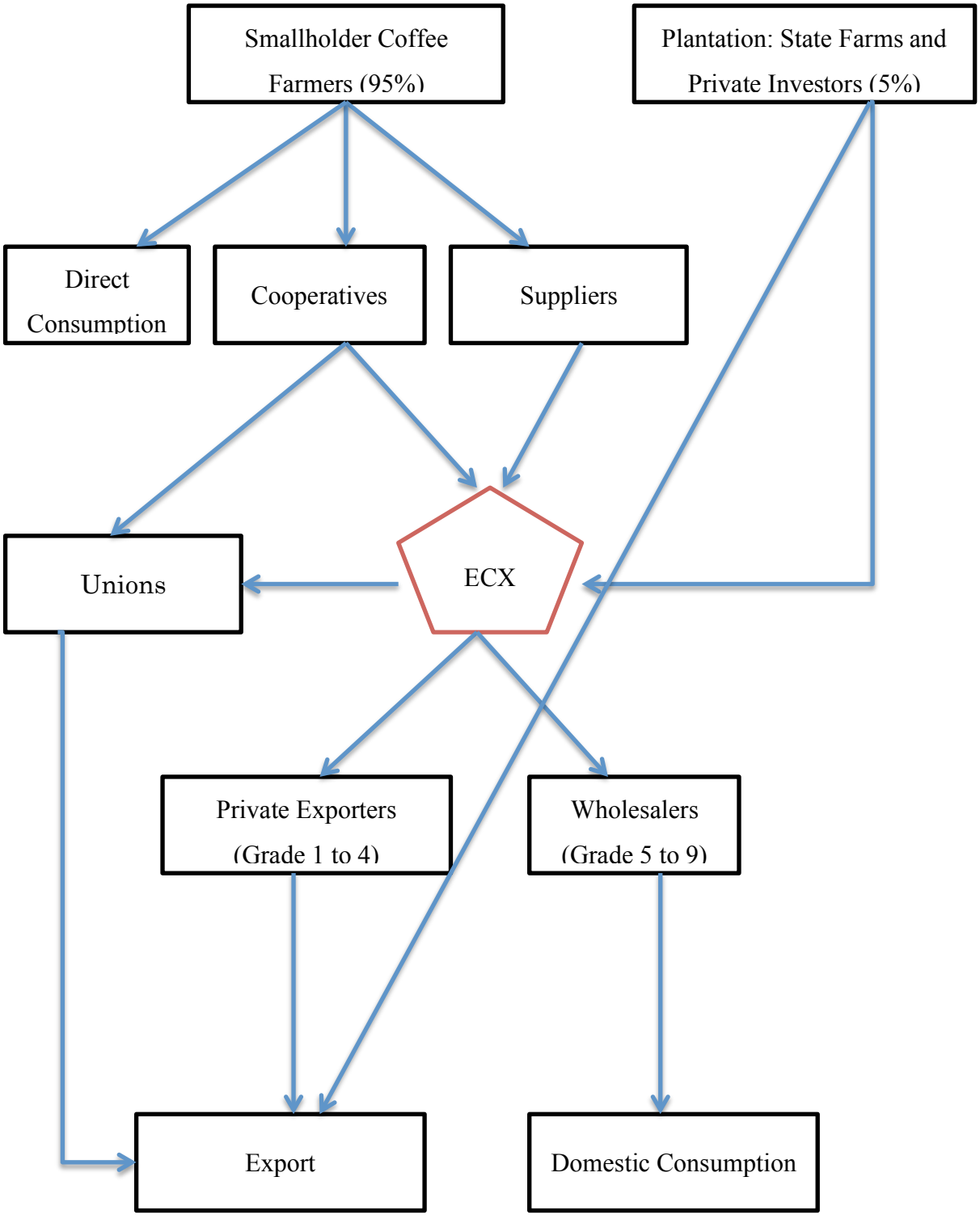
bargain with dealers over the price of coffee. Secondly, most of coffees are traded at the ECX, thus the ECX's information on market prices may be more accurate than other information sources.

Figure 2-9 Ethiopian Coffee Supply Value Chain before the Establishment of the ECX



Source: USAID (2010)

Figure 2-10 Ethiopian Coffee Supply Value Chain after the Establishment of the ECX



Source: Aderajew (2013)

Figure 2-11 The ECX's Warehouse in the Jimma Zone

Source: Author's Survey (2014)

Figure 2-12 Farmer Support Program by a Cooperative in Limu Seka

Source: Author's Survey (2014)

3. Market Competition, Information Access, and MIS

3.1 Market Competition and Information Asymmetries

Market inefficiency has been reported and discussed in the context of many developing countries. For example, Osborne (2005), studying staple marketing in Ethiopia, found that traders' margins are higher in rural areas relative to the central market. Fafchamps and Hill (2008), studying coffee marketing in Uganda, found that price fluctuations in international markets are not transmitted to the local producer level. These studies empirically confirm the existence of imperfect competition in developing countries.

One major reason for the existence of imperfect competition is the presence of information asymmetries between buyers and sellers. Theories have been developed ever since Akerof's seminal paper (1970), and empirical studies have also followed. Recently, studies have evaluated whether the introduction of infrastructure, such as mobile phones, can overcome the problem of information asymmetry. Aker (2010) finds that producers with access to mobile phones receive better prices. Muto and Yamano (2009) find that the effect from introducing mobile phones on producers' prices is higher for perishable commodities relative to the impact on prices for storable staple crops.

This study attempts to add to this body of literature by focusing on the MIS,

which has been introduced in several African countries to improve producers' access to information, using the case of Ethiopian coffee farmers.

3.2 A Study on Information Asymmetries and Lack of Information in Ethiopian Coffee Producers

Coffee price fluctuations are an important issue for both coffee producers and the Ethiopian economy. If coffee producers have the ability to forecast approximate coffee prices over the next year, they would be able to use this information to adjust the amount they spend on coffee cultivation, including inputs such as fertilizers, herbicides, pesticides, and personnel. These decisions regarding farming inputs may lead to higher profits, and those producers who use this knowledge may then invest their surplus money in adopting improved technologies to grow higher quality crops or shift from coffee cultivation to a higher value-added business.

However, Ethiopian coffee producers currently have difficulty accessing market information at central wholesale markets since the majority of smallholder coffee farmers are geographically isolated from such central markets.[3] Therefore, most Ethiopian coffee growers gather information from unofficial sources such as neighbors, friends, or traders and generally base their production decisions on expected future prices in order to optimize their price expectations by utilizing currently available price

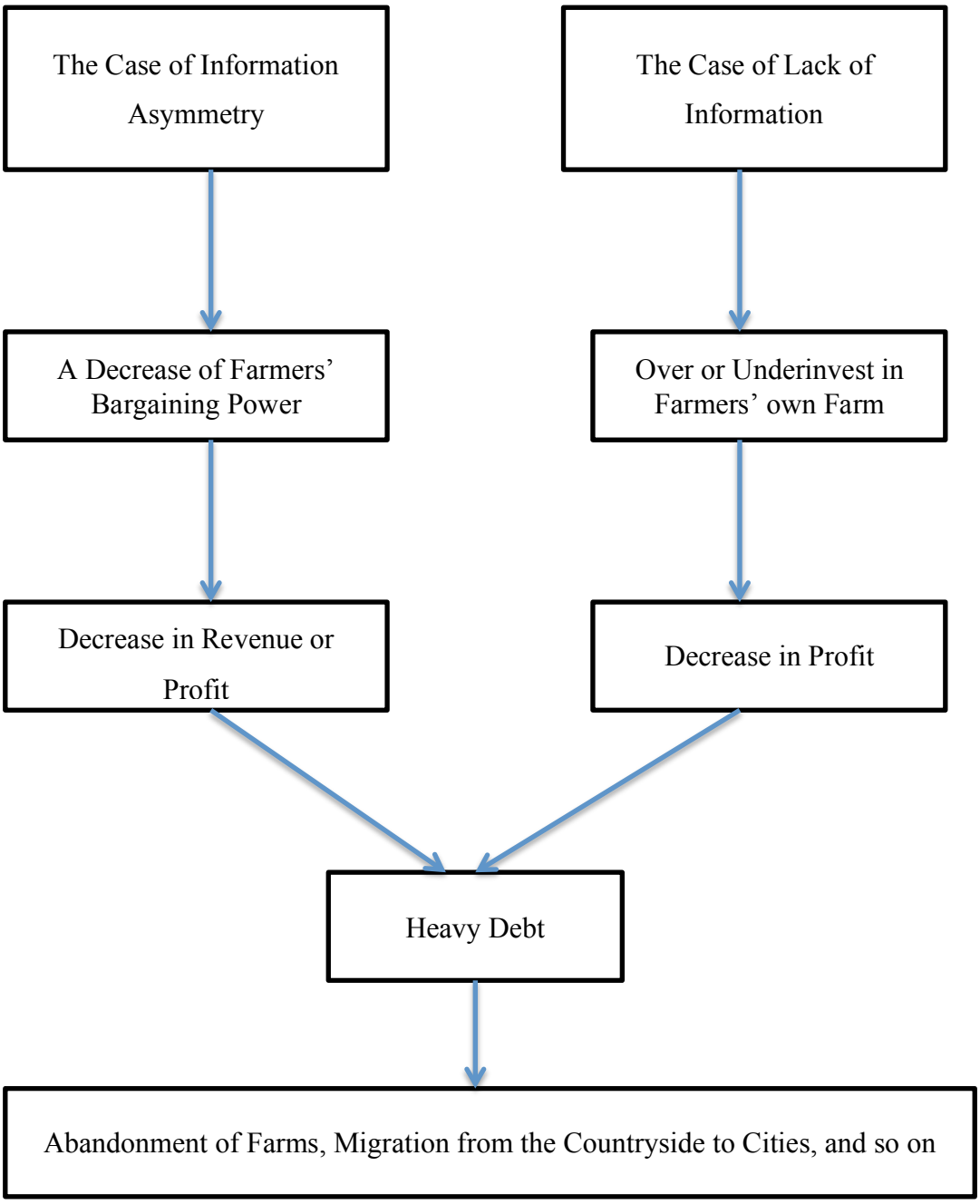
[3] Approximately one-third of the rural population and more than a quarter of the total population are estimated to be engaged in coffee production (ODI 2009).

information (Getnet, Verbeke, et al. 2011).

Considering the above circumstance, it is highly likely that Ethiopian coffee producers make uninformed decisions. Moreover, an environment with imperfect information, such as the Ethiopian coffee market, may cause farmers to incur tremendous losses as shown in Figure 3-1. Thus, a lack of regular and accurate market information can be considered a major obstacle facing not only Ethiopia's coffee market, but also its grain market (Wolday 2002; Getnet, Verbeke and Viaene 2005).

Furthermore, such an environment, in which producers depend on conversations with traders for market information, may magnify these problems because of information asymmetries between traders and producers. Since neighbors also obtain market information from traders, the information asymmetry problem is hard to solve even if a producer exchanges information on market prices with neighbors. According to a study by Osborne (2005), grain traders cheat farmers by paying too low a price for their grain. This phenomenon leads me to presume that producers who mainly use unofficial information may have weaker bargaining power relative to traders, and thus earn lower revenue than official information users.

Figure 3-1 Expected Farming Situation regarding both Information Asymmetry and Lack of Information



Source: Author (2014)

3.3 Ethiopia's MIS

In order to solve problems due to information asymmetries and lack of information and to promote businesses with overseas buyers, the ECX offers real time information on central wholesale prices to all market actors, including smallholder farmers. This market information includes prices for commodities in different markets and commodity offers to sell and bids to buy, as well as short extension messages (ECX, Market Data 2009).

The key market dissemination channels for ECX are rural-based market information tickers, mobile phone Short Messaging Services (SMS), Interactive Voice Response (IVR) services, mass media (TV, radio, and newspaper), and the ECX's own website.

Firstly, the market information ticker indicates information on trade dates, volumes, and the market prices for each grade of coffee as soon as coffee beans are traded on the ECX's trading floor. The tickers are currently located in 21 locations such as Addis Ababa, Jimma, Hawassa, and so on. During the survey in the Jimma zone and the Sidama zone, I found around 7 tickers, but all tickers did not work as shown in Figure 3-2 due to the problems of telecommunications network and electric power supply.

Figure 3-2 Market Information Tickers

Source: Author's Survey (2014)

Secondly, subscribers to SMS are able to obtain market information on market prices, commodity related news, and weather forecasts using two functions, called push and pull. Push is that the ECX send its information to subscribers' mobile phones and pull means that the users send a message to the ECX to inquire of market information.

Thirdly, IVR services operate 24 hours a day, 365 days a year. In 2011, 70 percent of total users called from non-capital regions. However, I disagree with the announcement by the ECX in that in a survey of 546 smallholder coffee farmers conducted in 2014 by me, 7 out of 546 smallholder coffee farmers own a telephone and only 1 respondent uses this service. In this respect, the IVR seems to be not a major source of information to coffee farmers who live in remote areas.

Fourth, the latest news of market information on coffee is broadcast on AM and FM radio, four times a day, and the Ethiopian Broadcasting Corporate (EBC), three times a day. Also, the ECX publishes its market information in daily, weekly, and biweekly newspapers. Since most smallholder coffee farmers live in rural areas where telecommunication or electronic infrastructure is not available and the total adult literacy rate is 38 percent (Unicef 2013), radio seems to be the most popular among various MIS media by smallholder coffee farmers to obtain central wholesale coffee prices.

Lastly, market information on traded coffee via the ECX is updated in real time on the ECX's own website. In 2011, overseas buyers accessed the website from 107 countries. Despite these benefits, however, 0 household of all respondents accesses the ECX's website according to my household survey data. The result leads me to presume that coffee farmers, especially in remote areas, do not access the website because of the poor network environment (ECX 2009; Gabre-Madhin 2012).

3-3 The ECX's own Website

Source: ECX (2014)

Getnet, Verbeke et al. (2011) used a quasi-rational expectation formation to provide convincing evidence on the potential benefit of real-time price information dissemination to farmers to assist farm-level forecasting and production, technology adoption, and marketing decisions. While this existing study suggests that Ethiopia's MIS is significantly able to improve farmers' forecasts, they do not examine the possibility that MIS can strengthen smallholder coffee farmers' bargaining power when negotiating with traders over the price of coffee.

3.4 MIS of other African Countries

Muto (2013) evaluates the impact of an MIS-based program in Ghana on farmers' marketing performances and found that MIS users were able to sell maize at a price 10 percent higher than non-MIS users. This result indicates that the use of an MIS is able to increase farmers' bargaining power.

Another study, which researched Mozambique's Agricultural Market Information System (SIMA), found that people who have access to market information show greater participation in the marketing of cereals, beans, and peanuts (Mader 2002).

While these existing researches suggest that MISs are significant terms of increasing users' bargaining power and farmers' market participation, they do not fully analyze the benefits of MIS. For example, MIS may have an advantage in supporting producers' decisions on investments in production, which may lead to higher revenue and profit. In a study on SIMA, subjects' individual characteristics should also have been treated in order to identify the difference in market participation between MIS and non-MIS users due to the strong probability that people who use MIS are active in marketing even prior to the introduction of the MIS.

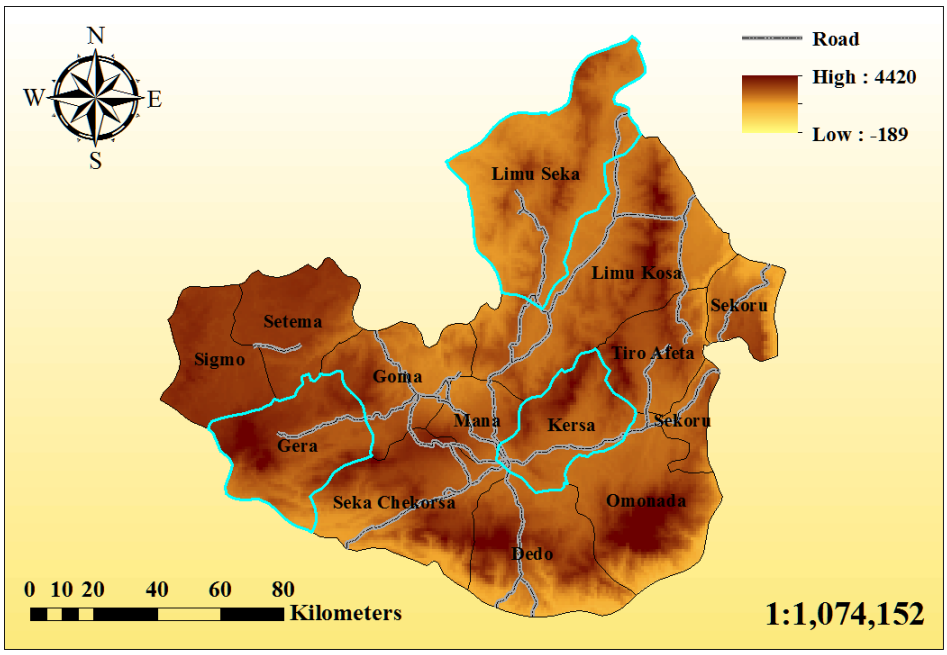
4. Data and Summary Statistics

In order to evaluate the impact of MIS on coffee producers' revenues and profits in Ethiopia, I conducted household surveys in March 2014 in the Jimma zone and in November 2014 in the Sidama zone. I chose these zones, firstly, as a focus for my study due to its distance to Addis Ababa, which may make information access difficult for smallholders. Secondly, the Jimma zone is one of the Ethiopia's largest coffee exporters with about 20 percent of total coffee exports in 2013 and represents semi-forest coffee. The Sidama zone is another largest coffee exporters with about 40 percent of total coffee exports in 2013 and represents garden coffee (Bart et al. 2014; ESC 2002).

Figure 4-1 presents a map of research areas in the Jimma zone. The surveys covered 9 villages in 3 woredas, Limu Seka, Gera, and Kersa, which are 98 kilometers, 73 kilometers, and 13 kilometers from Jimma special zone,[4] respectively. Figure 4-2 presents a map of research areas in the Sidama zone. The surveys also covered 9 villages in 3 woredas, Aleta Wendo, Dale, and Shebedino, which are 60 kilometers, 37 kilometers, and 25 kilometers from Hawassa,[5] respectively. These were chosen considering their distance from Jimma special zone or Hawassa because the diffusion of market information is likely to be correlated with distance.

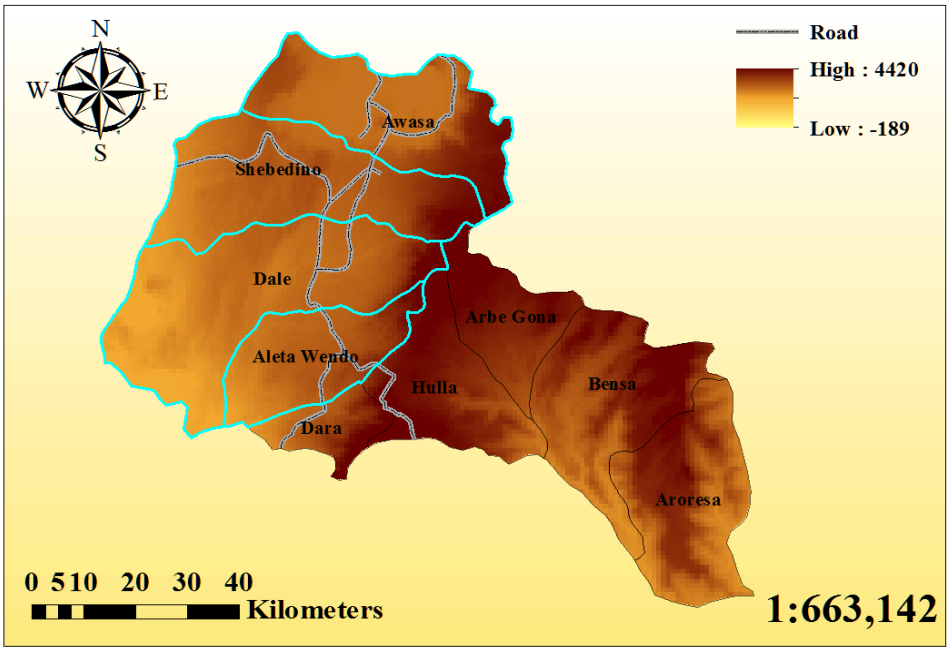
[4] Jimma special zone is a major town of the Jimma zone.
[5] Hawassa is the largest city of the Sidama zone.

Figure 4-1 The Map of Jimma Zone



Source: DIVA-GIS

Figure 4-2 The Map of Sidama Zone



Source: DIVA-GIS

With the help of local enumerator, I collected information from 546 households in the study villages. Those 546 respondents were chosen randomly among inhabitants on the population lists which were obtained from the Oromia Coffee Farmers Cooperative Union (OCFCU) and Sidama Coffee Farmers Cooperative Union (SCFCU).[6] The data includes information on coffee sales and input purchases from 2013 to 2014 as well as farmers' socio-economic characteristics. Questionnaires used are included in the appendix. I also relied on publicly-available climate data obtained from National Meteorology Agency (NMA).

Table 4-1 shows the share of sample farmers by location. I interviewed 304 households in the Jimma zone, 96 households in Gera, 108 households in Limu Seka, and 100 households in Kersa, and 242 households in the Sidama zone, 86 households in Aleta Wendo, 75 households in Dale, and 81 households in Shebedino. Each location has approximately the same share.

[6] The cooperatives not only had a list of cooperative members, but also the list of all small-coffee farmers in the Oromia region and in the SNNPR region.

Table 4-1 The Characteristics of Farmers, Share of Total Observations

Zone	Woreda	Village	Number of households	Share (%)
Jimma	Gera	Kola Sulaja	31	5.68
		Loya Kerebe	20	3.66
		Tuma Teso	45	8.24
	Limu Seka	Yaddo	30	5.49
		Siso	28	5.13
		Kiln Cheba	50	9.16
	Kersa	Babboo	43	7.88
		Marawaa	38	6.96
		Ginju	19	3.48
Sidama	Aleta Wendo	Shiecha	27	4.95
		Gidibo	29	5.31
		Woto	30	5.49
	Dale	Ajawo	8	1.47
		Gane	38	6.96
		Chume	29	5.31
	Shebedino	Taremesa	30	5.49
		Morocho	25	4.58
		Midregemet	26	4.76
		Total	546	100

As Table 4-2 indicates, coffee farmers in the Jimma zone and in the Sidama zone spent around 1 birr (which is about 5 US cents) per 0.1 hectare on fertilizer, pesticide, and herbicide. This result can be interpreted that those farmers are able to grow coffee without chemical fertilizers and pesticides since both zones' coffee farms are usually located on volcanogenous soil and about 1,500 meter above sea level. Also, farmers do not prefer to use herbicides for the organic coffee certification. However, the difference in the harvest yield between Jimma and Sidama is 110 kg per 0.1 hectare even if annual expenditures on fertilizers, pestcides, and herbicides are similar levels. One interptetation of the differences is that the density of coffee trees in the Sidama zone (garden coffee) is significantly higher than the Jimma zone (semi-forest coffee) as described in Subsection 2.2.1. Moreover, the producer price for Sidama coffee is 1.73 birr higher than that for Jimma because most Sidama's coffee farmers produce washed coffee. Consequently, the average revenue per 0.1 hectare is 1,417 birr higher and profit is 1,001.6 birr higher in Sidama than in Jimma. The decrease of nearly 416 birr in the profit resulted from the difference in labors cost between both zones.

Table 4-2 Production Sales Performances of the Jimma Zone and the Sidama Zone in 2013/2014

		Jimma		Sidama		Dif
Variable	Unit	Obs	Mean	Obs	Mean	(t-value)
Harvest yield	kg/0.1ha	294	79.86	231	189.99	-110.1***
			(66.14)		(136.25)	(-12.16)
Sales volume	kg/0.1ha	268	65.32	231	153.95	-88.63***
			(62.05)		(98.1)	(-12.22)
Coffee price	birr/kg	269	11.97	231	13.70	-1.73***
			(4.51)		(4.44)	(-4.31)
Expenditure on fertilizer	birr/0.1ha	303	1.01	242	0.67	0.33
			(12.91)		(4.25)	(-0.39)
Expenditure on pesticide	birr/0.1ha	303	0	239	0.10	-0.10
			(0)		(1.55)	(-1.13)
Expenditure on herbicide	birr/0.1ha	303	1.15	239	0.15	0.1*
			(6.49)		(1.54)	(-2.32)
Expenditure on labors	birr/0.1ha	303	11.35	242	138.41	-127.1***
in the farming season			(40.28)		(555.59)	(-3.97)
Expenditure on labors	birr/0.1ha	303	19.51	242	299.31	-279.8***
in the harvest season			(74.96)		(1025.74)	(-4.73)
Revenue	birr/0.1ha	268	676.94	231	2094.38	-1417.4***
			(490.5)		(1451.01)	(-15.03)
Profit	birr/0.1ha	268	641.93	231	1643.57	-1001.6***
			(511.42)		(2034.21)	(-7.78)

t statistics in parentheses * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 4-3 describes information sources in coffee cultivation. For the questions, respondents selected all applicable answers. 73.53 percent of all respondents answered that they obtained information from friends or neighbors, 45.04 percent of all respondents obtained information from relatives, and 42.83 percent of all respondents depend on information from cooperatives for coffee production, but only 29.04 percent of all respondents, or 158 smallholder coffee farmers among 546 respondents, used the MIS provided by the ECX. 58 of 304 households who live in the Jimma zone, about 19.08 percent, obtained information from MIS. 100 of 242 households who live in the Sidama zone, about 41.67 percent, answered that they used the MIS. The number of MIS users in the Sidama zone is nearly twice more than the users in the Jimma zone.

Table 4-3 Types of Information Sources for Coffee Cultivation in each Household (Multiple answers allowed)

	Total		Jimma		Sidama	
Information Sources	Number	Share	Number	Share	Number	Share
Family member	233	42.83%	203	66.78%	30	12.5%
Friend	400	73.53%	282	92.76%	118	49.17%
Relative	245	45.04%	229	75.33%	16	6.67%
Broker	31	5.7%	29	9.54%	2	0.83%
Buyer	229	42.1%	221	72.7%	8	3.33%
Extention worker	34	6.25%	28	9.21%	6	2.5%
Collector	78	14.34%	52	17.11%	26	10.83%
MIS	158	29.04%	58	19.08%	100	41.67%
Exporter	41	7.54%	40	13.16%	1	0.42%
Cooperative	233	42.83%	23	7.57%	210	87.5%

Table 4-4 describes the ECX's market information dissemination channels. Again, all applicable answers were selected by respondents. 99.37 percent of all respondents, 157 of 158 households who used the MIS, obtained information from radio. Contrary to the above result, the ECX's website was answered 0 percent of all respondents. The answers in both zones have similarities to the total results, i.e., approximately 100 percent of MIS users in the both zones preferred radio and the number of MIS users in both zones who obtained information from the ECX's website was 0.

Table 4-4 Types of MIS Sources for Coffee Cultivation in each Household (Multiple answers allowed)

	Total		Jimma		Sidama	
ECX's MIS	Number	Share	Number	Share	Number	Share
Website	0	0%	0	0%	0	0%
Radio	157	99.37%	57	98.28%	100	100%
TV	18	11.39%	4	6.9%	14	14%
Newspaper	1	0.63%	1	1.72%	0	0%
IVR	1	0.63%	1	1.72%	0	0%
SMS	25	15.82%	10	17.24%	15	15%
Electronic ticker	9	5.7%	1	1.72%	8	8%

Table 4-5 summarizes the respondents' socio-economic characteristics. The average age of respondent coffee farmers is 46 years old, and most of them are male. About half of the respondents are literate and have an average of about 14 years' coffee farming experience. Coffee farms averaged about 0.8 hectare. I did not find much difference between MIS and non-MIS users in these characteristics. The significant differences were found in possession of radios, head of households' literacy and years of schooling, the numbers of adult family members, and the average monthly rainfall between 2013 and 2014, which were higher for MIS users than non-users. Distance from each respondent's dwelling to the Jimma special zone or Hawassa was a significant, which was farther for non-MIS users than MIS-users.

Table 4-5 Socio-economic Characteristics of Farmers in 2013/14

Variable	Unit	Total Mean	Non-MIS Mean	MIS Mean	Dif. (t-value)
HH_Age	Years	45.98	46.85	46.27	-0.42
		(11.35)	(11.66)	(10.58)	(-0.55)
HH_Gender	Female=0	0.98	0.98	0.98	0
	Male=1	(0.14)	(0.13)	(0.14)	(-0.09)
HH_Experience	Years	14.27	14.18	14.5	-0.31
		(8.09)	(8.67)	(6.52)	(-0.57)
HH_Literacy	No=0	0.46	0.43	0.55	-0.12***
	Yes=1	(0.5)	(0.49)	(0.5)	(-3.62)
HH_Years of	Years	3.8	3.53	4.47	-0.94***
Schooling		(3.2)	(3.16)	(3.19)	(-4.41)
Adults	Number	3.56	3.47	3.78	-0.31**
		(1.78)	(1.73)	(1.9)	(-2.63)
Coffee Farm Size	Ha	0.78	0.78	0.76	0.03
		(0.55)	(0.57)	(0.52)	(-0.69)
Crop Damage	Number	2.37	2.37	2.39	-0.02
by Diseases or Insects		(1.56)	(1.54)	(1.63)	(-0.16)
Distance	km	50.33	51.55	47.44	4.23*
		(29.29)	(31.18)	(23.8)	(2.16)
The Average Monthly	mm	47.43	39.04	67.97	-28.93***
Rainfall		(50.12)	(47.63)	(50.22)	(-8.94)
Family Size	Number	5.89	5.93	5.79	0.13
		(1.85)	(1.79)	(2.01)	(-1.08)
Dummy_Radio	No=0	0.73	0.66	0.91	-0.256***
	Yes=1	(0.44)	(0.48)	(0.29)	(-8.91)

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 4-6 indicates the characteristics of those respondents' coffee cultivation patterns. MIS users' sell their coffee for prices approximately 0.33 birr higher than non-MIS users, but the difference between two groups is not statistically significant. The revenue[7] of MIS users averages 4,149 birr higher in comparison with non-MIS users' revenue since the MIS group sold averagely 315 kg higher than the non-MIS group. Furthermore, the profits[8] of MIS users average 3,205 birr higher than those of non-MIS users. This is attributed to a marked difference in total expenditure on coffee cultivation[9] between the two groups. The MIS group's total expenditure on coffee cultivation was approximately 936 birr higher than that of the non-MIS group. This may indicate that MIS users are responding better than non-MIS users to changes in input costs as hypothesized.

[7] The reduced form of the equation for those respondents' revenues is: $\text{Revenue}_i = \text{Sv}_i \times \text{Cp}_i$

[8] The reduced form of the equation for those respondents' profits is: $\text{Profit}_i = \text{Revenue}_i - \text{Total expenditure}_i$

[9] The reduced form of the equation for those respondents' total expenditure on coffee farming is: $\text{Total expenditure}_i = \text{Eof}_i + \text{Eop}_i + \text{Eoh}_i + \text{Eolf}_i + \text{Eolh}_i$

Table 4-6 Production Sales Performances of Farmers in 2013/2014

Variable	Unit	Total Mean	Non-MIS Mean	MIS Mean	Dif. (t-value)
Size of coffee farms	ha	0.78	0.78	0.76	0.02
		(0.55)	(0.56)	(0.58)	(-0.35)
Harvest yield	kg	846.45	785.89	994.67	-208.8
		(1620.99)	(1889.31)	(547.44)	(-1.34)
Sales volume	kg	666.26	572.13	886.71	-314.6***
		(489.95)	(437.8)	(534.42)	(-6.86)
Coffee price	birr/kg	12.75	12.66	12.99	-0.33
(Cp)		(4.55)	(4.49)	(4.68)	(-0.75)
Expenditure on fertilizer	birr	18.40	20.93	12.21	8.72
(Eof)		(305.78)	(360.37)	(69.82)	(-0.3)
Expenditure on pesticide	birr	0.11	0	0.38	-0.38
(Eop)		(2.57)	(0)	(4.77)	(-1.57)
Expenditure on herbicide	birr	5.84	7.88	0.85	7.03*
(Eoh)		(35.39)	(41.66)	(6.29)	(-2.11)
Expenditure on labors in the	birr	294.63	176.61	582.97	-406.4***
farming season (Eolf)		(768.71)	(695.98)	(859.05)	(-5.76)
Expenditure on labors in the	birr	551.08	392.79	937.78	-545***
harvesting season (Eolh)		(1422.67)	(1387.50)	(1437.77)	(-4.12)
Total expenditure	birr	870.06	598.21	1534.19	-936***
		(1930.06)	(1830.18)	(2011.04)	(-5.26)
Revenue	birr	8297.34	7055.81	11205.34	-4149.5***
		(6801.34)	(5967.61)	(7710.67)	(-6.49)
Profit	birr	7379.3	6420.34	9625.46	-3205.1***
		(6509.4)	(5863.76)	(7361.7)	(-5.16)

Notes:
* p<0.05, ** p<0.01, *** p<0.001

$\text{Accuracy}_{it} = \mid \text{Cp}_{it} - \text{Expected price}_{it} \mid$

$\text{Total expenditure}_{it} = \text{Eof}_{it} + \text{Eop}_{it} + \text{Eoh}_{it} + \text{Eolf}_{it} + \text{Eolh}_{it}$

$\text{Revenue}_{it} = \text{Sv}_{it} \times \text{Cp}_{it}$

$\text{Profit}_{it} = \text{Revenue}_{it} - \text{Total expenditure}_{it}$

5. Estimation Methods

To examine whether having better market information improves farmers' welfare, this study statistically analyzes 1) the respondent characteristics that relate to the use of MIS, 2) the impact of MIS usage on coffee producers' revenues, and 3) the impact of MIS usage on coffee producers' profits.

First, to examine the abovementioned hypothesis 1, I evaluate the marginal probability effects (MPE) of explanatory variables in a probit model and the odds ratios in a logit model with MIS usage as a dependent variable. Through the result of this analysis, I intend to define what factors are related to the use of MIS and suggest a policy which is able to boost the usage rate of MIS such as the diffusion of radios and mobile phones. I estimate

$$\begin{cases} \dfrac{\mathrm{P}(Dmis_{it}=1|\mathrm{x}_{it})}{\partial \mathrm{x}_{itj}} = \phi(\mathrm{x}_{it}'\beta)\beta_j & \text{MPE in probit} \\ \dfrac{\exp(\mathrm{x}_{it}'\beta)}{(1+\exp(\mathrm{x}_{it}'\beta)} \Rightarrow \dfrac{\mathrm{p}_{it}}{1-\mathrm{p}_{it}} = \exp(\mathrm{x}_{it}'\beta) \Rightarrow \ln\left(\dfrac{\mathrm{P}_{it}}{1-\mathrm{P}_{it}}\right) = \mathrm{x}_{it}'\beta & \text{Odds ratios in logit} \end{cases}, \quad (1)$$

where t implies the year of 2013 and 2014; $Dmis$ = 1 denotes the use of MIS and $Dmis$ = 0 denotes the non-use of MIS; x_{itj} contains household characteristics relevant to the use of the MIS between 2013 and 2014; β is the vector of coefficients to be estimated; and $\phi(\mathrm{x}_{it}'\beta)$ is the value of the standard normal probability density function at $\mathrm{x}_{it}'\beta$. $\mathrm{P}_{it}/(1-\mathrm{P}_{it})$ in the logit model measures the probability that $Dmis$

= 1 relative to the probability that $Dmis$ = 0 and is called the odds ratio. If the odds ratio is 2, the odds of the use of MIS are twice as high as those concerning the non-use of MIS (Cameron and Trivedi 2005).

Second, to estimate the abovementioned hypotheses 2 and 3, I employ several methods. First, I use the ordinary least squares (OLS) estimator with cross-sectional data as Equation (2) and random effects (RE) panel models as Equation (3):

$$\mathrm{Y}_i = \beta_0 + \beta_1 x_{ik} + \beta_2 \mathrm{Dmis}_i + \beta_3 \mathrm{Dmis}_i \times \mathrm{Schooling}_i + u_i \quad , \tag{2}$$

$$\mathrm{Y}_{it} = \beta_0 + \beta_1 x_{itk} + \beta_2 \mathrm{Dmis}_{it} + \beta_3 \mathrm{Dmis}_{it} \times \mathrm{Schooling}_{it} + \alpha_i + u_{it} \quad , \tag{3}$$

where Y_{it} is revenue and profit by head of household *i*; χ_i contains head of household *i*'s age, coffee farming experience, sex, the years of schooling, coffee farm size, number of adults among family members, number of males among family members, distance from each respondent's dwelling to the Jimma special zone or Hawassa, and the average monthly rainfall in *k* village. Dmis_i is a dummy variable that indicates whether the *i* is an MIS user or non-MIS user. $\mathrm{Dmis}_{it} \times \mathrm{Schooling}_{it}$ is an independent variable to examine the combined effect of the MIS usage and the years of schooling. α_i is the unobserved effect. u_i is the error term. Statistical significance of β_2 and β_3 will show the effect of MIS.

Third, because Dmis_i may be considered an endogenous explanatory variable in the simple regression model, I also conduct two-stage least squares (2SLS) estimations. The first-stage regression is as follows:

$$\mathrm{Dmis}_{it} = \pi_0 + \pi_1 x_{itk} + \pi_2 \mathrm{hrdaio}_{itk} + \pi_3 \mathrm{di}_{it} + \nu_{it} \quad , \tag{4}$$

$$\mathrm{Dmis}_{it} = \pi_0 + \pi_1 x_{itk} + \pi_2 \mathrm{hrdaio}_{itk} + \pi_3 \mathrm{di}_{it} + \alpha_i + \nu_{it} \quad , \tag{5}$$

where χ_{itk} in Equations (4) and (5) contain the same explanatory variables as Equation (2) above. For the instrumental variables, I use hrdaio_{itk}, radio holders' rate in *k* village, and di_{it}, the number of crop damage by diseases or insects in the past 10 years. These are considered to affect Dmis, but not revenues and profits directly. Hence both those variables are selected as instrument variables for Dmis_{it}.

Fourth, this study employs a kernel-based matching estimator to estimate the average treatment effect on the treated (ATT), because the method has features to eliminate potential selection bias and to combine a small number of treated cases and a large number of non-treated cases (Guo and Fraser 2010; Heckman, et al. 1997, 1998; Lee 2005). I perform the logistic regression to match MIS and non-MIS users with similar characteristics. After the regression, I compute the differences between the outcomes of the treatment group and the weighted average of the outcome for the

controlled group. In addition, bootstrapping is used to draw statistical inferences. The strategy to test both hypotheses 2 and 3 is shown below:

$$\text{ATT} = \frac{1}{n_1} \sum_{i \in I_1 \cap S_P} \left[Y_{1i} - \sum_{j \in I_0 \cap S_P} W\,(i,j)\, Y_{0j} \right] \quad , \tag{6}$$

where n_1 is the number of treated cases; $\mathrm{I_0}$ and $\mathrm{I_1}$ denote the set of indices for non-MIS users and MIS users; $\mathrm{Y_1}$ includes MIS users' revenue and profit; $\mathrm{Y_o}$ is non-MIS user s' outcome; $\sum_{j \in I_0 \cap S_P} w(i,j)\, Y_{0j}$ is an element to estimate the weighted average of the outcome for all non-MIS users.

6. Estimated Results

I first perfom MPE in the probit model and determine odds ratios in the logit model to examine the hypothesis 1 stated in Chapter 5 regarding which respondent characteristics relate to MIS usage. Table 6-1 indicates that literacy (whether the *i* can read Amharic alphabet or not) and the numbers of adults are positive and statistically significant. While distance from each respondent's dwelling to the Jimma special zone or Hawassa is positive and significant in the probit model, the explanatory variable is not significant in the logistic model. The dummy variables on possession of a radio, possession of a mobile phone, and living in the Sidama zone have positive and significant impacts. On the other hand, the dummy variable on being a member of a cooperative has negative and significant impacts on MIS usage.

Table 6-1 Determinants of the MIS Usage

Variable	Marginal Effects in Probit	Odds ratios in Logistic
HH_Age	0	0
	(0)	(0.01)
HH Experience	0	0
	(0)	(0.01)
HH Yeasrs of Schooling	0	0.01
	(0.01)	(0.03)
HH Literacy	0.09***	0.45***
	(0.03)	(0.15)
No. Adults	0.03**	0.14**
	(0.01)	(0.07)
No. Crops	0.02	0.09
	(0.02)	(0.08)
No. Males	-0.02	-0.14
	(0.02)	(0.1)
Family Size	-0.02	-0.09
	(0.01)	(0.07)
Coffee Farm Size	0.00	0.01
	(0.03)	(0.15)
Distance	0.001*	0
	(0)	(0)
Dummy Member of Cooperative	-0.2***	-1.09***
	(0.06)	(0.35)
Dummy Radio	0.23***	1.44***
	(0.03)	(0.25)
Dummy Mobile Phone	0.12***	0.73**
	(0.04)	(0.29)
Dummy Sidama Zone	0.36***	1.91***
	(0.06)	(0.38)
Constant		-3.44***
		(0.55)
Observations	1,029	1,029
Wald chi2(13)	115.42	112.25
Pseudo R2	0.13	0.14
Log-likelihood	-544.18	-542.39

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Second, I use an OLS estimator with cross-sectional data to evaluate the impact of MIS usage on farmers' revenues and profits in 2014. The OLS results shown in Table 6-2 confirm that the dummy variable on MIS usage is significant at the 1 percent level and increases farmers' revenues by 2,496 birr and profits by 1,824 birr. In percentage, MIS is associated with a 33 percent increase in revenue and a 23 percent increase in profit. In addition, the variables of average monthly rainfall in 2013, head of household's coffee farming exeperience, and coffee farm size have positive and siginificant impacts on both of the above. Meanwhile, head of household's years of schooling significantly increase only their revenues.

To examine whether the effect of MIS on performance vary according to education level, the models in Table 6-3 contain an interaction term of duumy_MIS x HH_years of Schooling in addition to the models estimated above. The interaction term of the MIS usage and the years of schooling on MIS users' profits and revenues are positive and significant. The result indicates that the impact of MIS on revenue and profit will grow by 388.8 birr and 355.6 birr according to an increase in the years of the schooling. In other words, the impact of MIS on performance is higher for the more educated farmers, possibly indicating how you use the market information matters, rather than simply having the information. For other variables, similar to the OLS results in Table 6-2, the variables of average monthly rainfall in 2013, head of household's coffee farming exeperience, and coffee farm size have positive and siginificant impacts on both revenues and profits. I test the joint significance of

variables of dummy_MIS x HH years of schooling, dummy_MIS, and HH_years of schooling and confirm that these variables are jointly significant.

Table 6-2 Determinants of Farmers' Revenues and Profits: OLS without Dummy_MIS x HH_Years of Schooling

Variable	Revenue	Log Revenue	Profit	Log Profit
HH_Age	29.87	0.01**	21.3	0.01***
	(28.97)	(0)	(33.19)	(0)
HH_Experience	109.9**	0	121.8**	0.00
	(51.92)	(0.01)	(49.95)	(0.01)
HH_Gender	667.6	0.36	1274	0.41*
	(1287)	(0.23)	(1423)	(0.25)
HH_Years of Schooling	175.5**	0.01	89.11	0
	(83.38)	(0.01)	(89.32)	(0.01)
No. Adults	-149.1	-0.03	-156.4	-0.04
	(219.8)	(0.03)	(225.7)	(0.03)
No. Males	24.45	-0.01	30.46	-0.03
	(239.1)	(0.03)	(229.6)	(0.04)
Coffee Farm Size	3,649***	0.54***	3,169***	0.5***
	(862.5)	(0.11)	(795.2)	(0.11)
Distance	1.01	0	4.67	0
	(6.6)	(0)	(7.35)	(0)
Rainfall	73.11***	0.01***	57.56**	0.01**
	(21.87)	(0)	(23.12)	(0)
Dummy_MIS	2,496***	0.33***	1,824***	0.23***
	(568.9)	(0.07)	(587.6)	(0.08)
Dummy_Sidama	-1669	0.26	-819.3	0.09
	(2442)	(0.29)	(2565)	(0.34)
Constant	-2509	6.98***	-2601	6.809***
	(1824)	(0.3)	(2016)	(0.32)
Observations	481	481	481	466
R-squared	0.395	0.403	0.313	0.303

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6-3 Determinants of Farmers' Revenues and Profits: OLS with Dummy_MIS x HH_Years of Schooling

Variable	Revenue	Log Revenue	Profit	Log Profit
HH_Age	33.15	0.01**	24.3	0.01***
	(28.78)	(0)	(32.85)	(0)
HH_Experience	104.6**	0	117**	0
	(51.82)	(0.01)	(50.18)	(0.01)
HH_Gender	1211	0.39	1771	0.43*
	(1262)	(0.24)	(1395)	(0.24)
HH_Years of Schooling	49.98	0.01	-25.65	0
	(101.7)	(0.01)	(109.2)	(0.02)
No. Adults	-167.5	-0.03	-173.2	-0.04
	(219.1)	(0.03)	(225.6)	(0.03)
No. Males	24.68	-0.01	30.67	-0.03
	(238.6)	(0.03)	(230)	(0.04)
Coffee Farm Size	3,659***	0.544***	3,178***	0.5***
	(864.4)	(0.11)	(797.2)	(0.11)
Distance	-0.44	0	3.34	0
	(6.64)	(0)	(7.42)	(0)
Rainfall	78.74***	0.00642***	62.71***	0.01**
	(22.23)	(0)	(23.36)	(0)
Dummy_MIS	868	0.264***	335	0.17
	(740.1)	(0.1)	(808.3)	(0.13)
Dummy_MIS x	388.8**	0.02	355.6*	0.02
HH_Years of Schooling	(179.1)	(0.02)	(184.5)	(0.03)
Dummy_Sidama	-2332	0.23	-1426	0.06
	(2488)	(0.29)	(2598)	(0.34)
Constant	-2519	6.975***	-2610	6.81***
	(1780)	(0.3)	(974)	(0.32)
Observations	481	481	481	466
R-squared	0.401	0.403	0.319	0.304
Joint Significance Test	0.00	0.00	0.01	0.06

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Third, both Table 6-4 and Table 6-5 illustrate the result of RE panel models using the same explanatory and explained variables as the OLS. Table 6-4 indicates that MIS dummy is significant at the 1 percent level and increases farmers' revenues by 2,253 birr and profits by 1,665 birr. In percentage terms, MIS increase revenue by 29 percent and profit by 20 percent. When the interaction term between MIS and education is introduced in Table 6-5, I observe that statistical significance on the dummy is absorbed by the interaction term. This indicates the strong role of education on the impact of MIS on performance. The interaction term in Table 6-5 increases MIS' users revenues and profits significantly by 411.4 and by 402.1 birr and is jointly statistically significant at the 0.01 level and 0.05 level. The RE results in Table 6-4 show several differences from the OLS in that, firstly, sidama dummy and increasing coffee farm size significantly increase farmers' revenues and profits. Secondly, increasing the number of adults among family members decreases farmers' profits significantly.

Table 6-4 Determinants of Farmers' Revenues and Profits: A Random Effects Panel Model without Dummy_MIS x HH_Years of Schooling

Variable	Revenue	Log Revenue	Profit	Log Profit
HH_Age	28.33	0	20.37	0.01*
	(26.47)	(0)	(28.83)	(0)
HH_Experience	80.16*	0	101.8**	0.01
	(45.84)	(0.01)	(43.98)	(0.01)
HH_Gender	433	0.33	811.80	0.35
	(1596)	(0.22)	(1765)	(0.25)
HH_Years of Schooling	161.5**	0.02	70.27	0
	(67.05)	(0.01)	(73.84)	(0.01)
No. Adults	-299	-0.02	-314.8*	-0.04
	(182)	(0.02)	(189.5)	(0.03)
No. Males	354.2*	0.04	364.6*	0.02
	(199.7)	(0.03)	(193.8)	(0.03)
Coffee Farm Size	3,461***	0.49***	3,085***	0.45***
	(990.1)	(0.13)	(927.8)	(0.13)
Distance	16.06**	0.003***	14.33**	0.003**
	(6.8)	(0)	(6.98)	(0)
Rainfall	35.99***	0.002*	33.05***	0.002*
	(10.01)	(0)	(10.22)	(0)
Dummy_MIS	2,253***	0.29***	1,665***	0.2**
	(511.5)	(0.06)	(531.7)	(0.08)
Dummy_Sidama	2,980***	0.71***	2,306**	0.69***
	(1069)	(0.16)	(1108)	(0.16)
Constant	-2752	6.836***	-2601	6.762***
	(1957)	(0.27)	(2153)	(0.31)
Observations	974	974	974	943
Number of Households	506	506	506	497

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6-5 Determinants of Farmers' Revenues and Profits: A Random Effects Panel Model with Dummy_MIS x HH_Years of Schooling

Variable	Revenue	Log Revenue	Profit	Log Profit
HH_Age	31.04	0	23.03	0.008*
	(26.16)	(0)	(28.39)	(0)
HH_Experience	73.41	0	95.32**	0.01
	(45.79)	(0.01)	(44.12)	(0.01)
HH_Gender	1009	0.34	1375	0.35
	(1538)	(0.22)	(1704)	(0.25)
HH_Years of Schooling	31.90	0.01	-56.27	0
	(76.47)	(0.01)	(84.34)	(0.01)
No. Adults	-312.3*	-0.02	-327.7*	-0.04
	(181.9)	(0.02)	(190.2)	(0.03)
No. Males	352.6*	0.04	363.1*	0.02
	(199.6)	(0.03)	(194.5)	(0.03)
Coffee Farm Size	3,502***	0.486***	3,122***	0.45***
	(993.5)	(0.13)	(932)	(0.13)
Distance	15.47**	0.003***	13.8**	0.003**
	(6.79)	(0)	(7)	(0)
Rainfall	37.52***	0.002*	34.43***	0.002*
	(10.11)	(0)	(10.29)	(0)
Dummy_MIS	530.50	0.27***	-17.99	0.2*
	(673)	(0.09)	(715.6)	(0.11)
Dummy_MIS x	411.4***	0.01	402.1**	0
HH_Years of Schooling	(152.9)	(0.02)	(160.4)	(0.02)
Dummy_Sidama	2,793***	0.71***	2,136*	0.69***
	(1081)	(0.16)	(1117)	(0.15)
Constant	-2813	6.835***	-2662	6.76***
	(1896)	(0.27)	(2092)	(0.31)
Observations	974	974	974	943
Number of Households	506	506	506	497
Joint Significance Test	0.00	0.00	0.00	0.06

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Fourth, Table 6-6 describes the IV-2SLS results regarding the impact of each variable on farmers' revenues and profits in 2014. As indicated in Table 6-6, farmers' revenues and profits both increase significantly by 4,044 birr and by 2,248 birr, respectively, when MIS is used supporting hypotheses 2 and 3 in Chapter 5.[10] Similar to the OLS results, rainfall, coffee farm size, and coffee farming exeperience increase farmers' revenue and profit significantly. Again, as in the OLS results, increasing the years of schooling significantly increase farmers' revenues. The results of the under- and over-identification test are presented in Table 6-6.

The results in Table 6-7, which are estimated using IV-2SLS for panel-data models, are similar to the preceding estimator. For instance, MIS dummy increases farmers' revenues and profits significantly by 3,795 birr and by 2,122 birr. Furthermore, the variables of rainfall, coffee farm size, and coffee farming exeperience are positive determinants of farmers' revenues and profits.[11] The results of the over-identification test are shown in Table 6-7.

[10] In the first-stage regressions of MIS for hypotheses 2 and 3, hrdaio_{ik} and di_i are significant at 1 percent level, sidama dummy and distance are significant at the 5 percent level, and a variable of rainfall is significant at the 10 percent level. Other independent variables are insignificant.

[11] In the first-stage regressions of MIS for hypotheses 2 and 3, hrdaio_{ik}, di_i, and sidama dummy are significant at 1 percent level, male is significant at the 5 percent level, and distance is significant at the 10 percent level. Other independent variables are insignificant.

Table 6-6 Determinant of Farmers' Revenues and Profits: IV-2SLS

Variable	Revenue	Log Revenue	Profit	Log Profit
HH_Age	30.53	0.01**	32.43	0.01**
	(28.66)	(0)	(29.62)	(0)
HH_Experience	105**	0	114.9**	0
	(51.78)	(0.01)	(49.61)	(0.01)
HH_Gender	746.2	0.37	1355	0.4*
	(1206)	(0.23)	(1387)	(0.24)
HH_Years of	170.5**	0.01	89.29	0
Schooling	(84.03)	(0.01)	(87.97)	(0.01)
No. Adults	-159)	-0.03	-179.5	-0.04
	(220.5	(0.03)	(220.2)	(0.03)
No. Males	41.8	-0.01	-3.98	-0.03
	(237.5)	(0.03)	(222.8)	(0.04)
Coffee Farm Size	3,616***	0.54***	3,145***	0.5***
	(873.6)	(0.11)	(787.9)	(0.11)
Distance	0.59	0	4.49	0
	(6.45)	(0)	(7.16)	(0)
Rainfall	71.93***	0.01***	57.08**	0.01**
	(21.71)	(0)	(22.9)	(0)
Dummy_MIS	4,044***	0.4***	2,248**	0.21
	(1027)	(0.12)	(1018)	(0.15)
Dummy_Sidama	-1851	0.25	-872.1	0.09
	(2424)	(0.28)	(2522)	(0.33)
Constant	-2817	6.97***	-2939	6.85***
	(1736)	(0.29)	(1903)	(0.32)
Observations	478	478	478	464
R-squared	0.385	0.402	0.315	0.301
Underidentificatio	0.00	0.00	0.00	0.00
Overidentification	0.1	0.75	0.16	0.82
Robust standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		

Table 6-7 Determinants of Farmers' Revenues and Profits: IV-2SLS for Panel-data Models

Variable	Revenue	Log Revenue	Profit	Log Profit
HH_Age	28.64	0	28.55	0.007*
	(26.88)	(0)	(27.09)	(0)
HH_Experience	74.34**	0	94.07***	0.01
	(32.85)	(0)	(33.09)	(0.01)
HH_Gender	519	0.33	874	0.33
	(1619)	(0.21)	(1631)	(0.26)
HH_Years of Schooling	156.2*	0.02	70.99	0
	(80.12)	(0.01)	(80.73)	(0.01)
No. Adults	-304.6*	-0.02	-328.8*	-0.04
	(182.4)	(0.02)	(183.8)	(0.03)
No. Males	367*	0.04	336.6	0.02
	(214.8)	(0.03)	(216.4)	(0.03)
Coffee Farm Size	3,432***	0.49***	3,081***	0.46***
	(406)	(0.05)	(408.1)	(0.06)
Distance	15.39*	0.003***	13.89	0.003**
	(8.82)	(0)	(8.88)	(0)
Rainfall	34.36***	0.002*	32.56***	0
	(11.12)	(0)	(11.12)	(0)
Dummy_MIS	3,795***	0.3**	2,122*	0.04
	(1094)	(0.14)	(1102)	(0.17)
Dummy_Sidama	2,812**	0.71***	2,246*	0.7***
	(1234)	(0.16)	(1236)	(0.18)
Constant	-3019	6.85***	-2843	6.84***
	(2029)	(0.26)	(2045)	(0.32)
Observations	968	968	968	939
Number of Households	503	503	503	495
Overidentification	0.09	0.78	0.15	0.68
Robust standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		

Fifth, to examine productivity, I replace dependent variables of total revenue and total profit with revenue per 0.1 hectare and profit per 0.1 hectare and perfom the same estimations again. The results of each model are summarized in Table 6-8 and indicate that MIS dummy of each estimator has mostly significant impact on farmers' revenues per 0.1 hectare and profits 0.1 hectare except the OLS model with MIS x HH_years of schooling and RE model with MIS x HH_years of schooling. This agrees with the results acquired from previous models, which are used total revenue and total profit as dependent variables, and supports that the hypothesis 2 and 3 are statistically significant. These show that not only the overal perfomance but also productivity is improved with the use of MIS.

Table 6-8 The Impact of MIS on Farmers' Revenues / 0.1ha and Profits / 0.1ha : OLS, RE, IV-2SLS, and Panel-IV

Models	Revenue/0.1	Log Revenue	Profit/0.1	Log Profit
OLS (1)	287.2***	0.22***	71.87	0.436***
	(108.4)	(0.08)	(179)	(0.09)
OLS with MIS x	-78.3	0.13	-284.8*	0.24*
HH_Years of Schooling (2)	(139.1)	(0.12)	(171.9)	(0.14)
IV-2SLS (3)	988.0***	0.306*	461.5*	0.626***
	(223.5)	(0.16)	(262.5)	(0.18)
RE (4)	271.3**	0.18**	179.3	0.37***
	(107.7)	(0.08)	(111.9)	(0.08)
RE with MIS x	104.4***	0.02	103.7***	0.05*
HH_Years of Schooling (5)	(34.86)	(0.03)	(36.11)	(0.03)
Panel-IV (6)	961.4***	0.23	608.1***	0.55**
	(226.3)	(0.17)	(227.3)	(0.22)
R-squared (1)	0.38	0.29	0.14	0.36
R-squared (2)	0.38	0.29	0.14	0.36
Joint Significance Test (2)	0.01	0.08	0.09	0
R-squared (3)	0.32	0.29	0.13	0.36
Underidentification (3)	0	0	0	0
Overidentification (3)	0.06	0.95	0.08	0.16
Joint Significance Test (5)	0.01	0.17	0.04	0
Overidentification (6)	0.13	0.91	0.3	0.14
Robust standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		

Sixth, in order to obtain the ATT, I estimate the propensity score of whether a farmer will use the MIS (Table 6-9). Using the logit, I match the MIS group with the non-MIS user group using kernel-based matching method. Figures 6-1 and 6-2 show a overlap of treated and untreated cases distribution and matching situation. 325 untreated

cases and 143 treated cases are located in the region of common support. Through the matching, average bias decreases from 19.5 percent to 4.7 percent as depicted in Figure 6-3. Thus, I confirm that my matching is valid for further estimation.

Table 6-9 Logit Results for Propensity Score Matching

Variable	Logit	Standard Errors
HH_Age	0	0.01
HH_Experience	0	0.02
HH_Literacy	0.42**	0.21
No. Adults	0.19**	0.08
No. Crops	-0.14	0.1
No. Males	-0.25**	0.1
Coffee Farm Size	-0.12	0.2
Distance	0	0
Dummy_Mobile Phone	0.89**	0.39
Dummy_Radio	1.57***	0.32
Constant	-2.55***	0.69
Observations	521	

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

Figure 6-1 Propensity Score

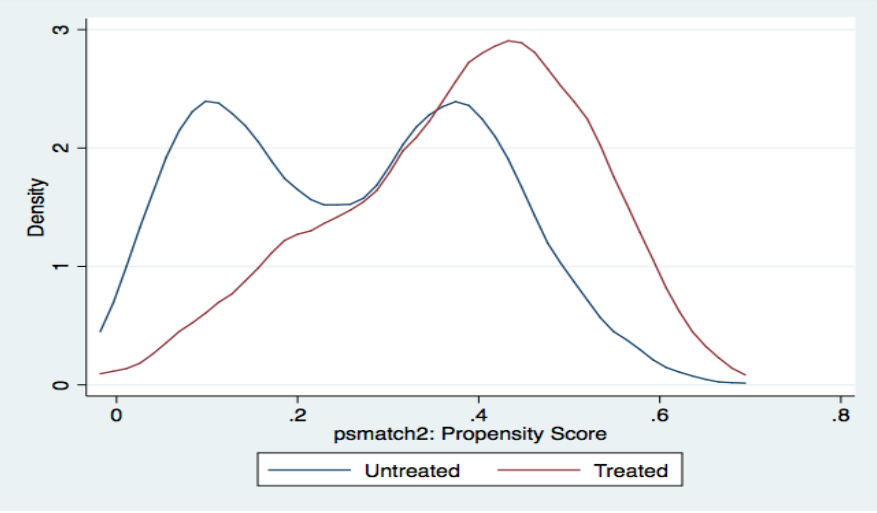


Figure 6-2 Matching Result

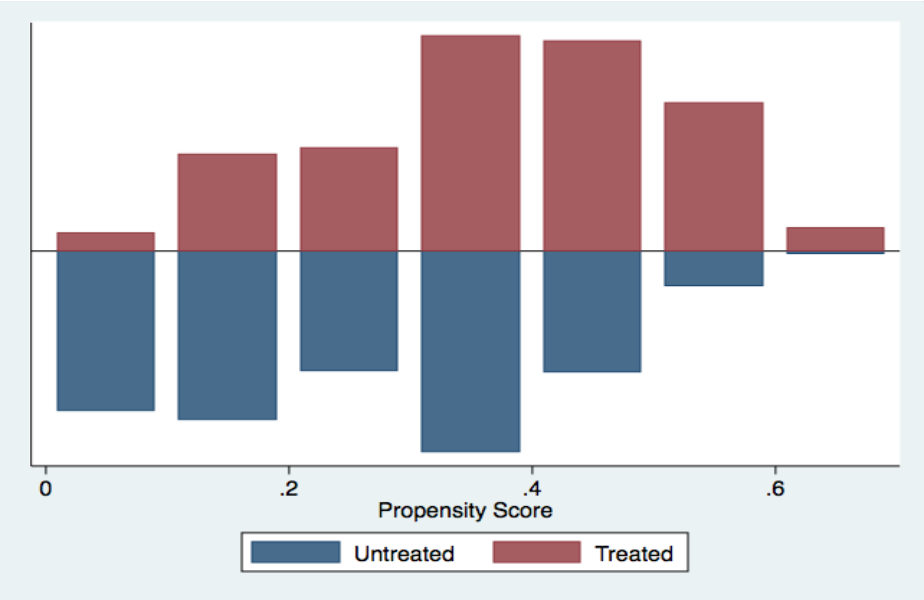


Figure 6-3 Standard % Bias

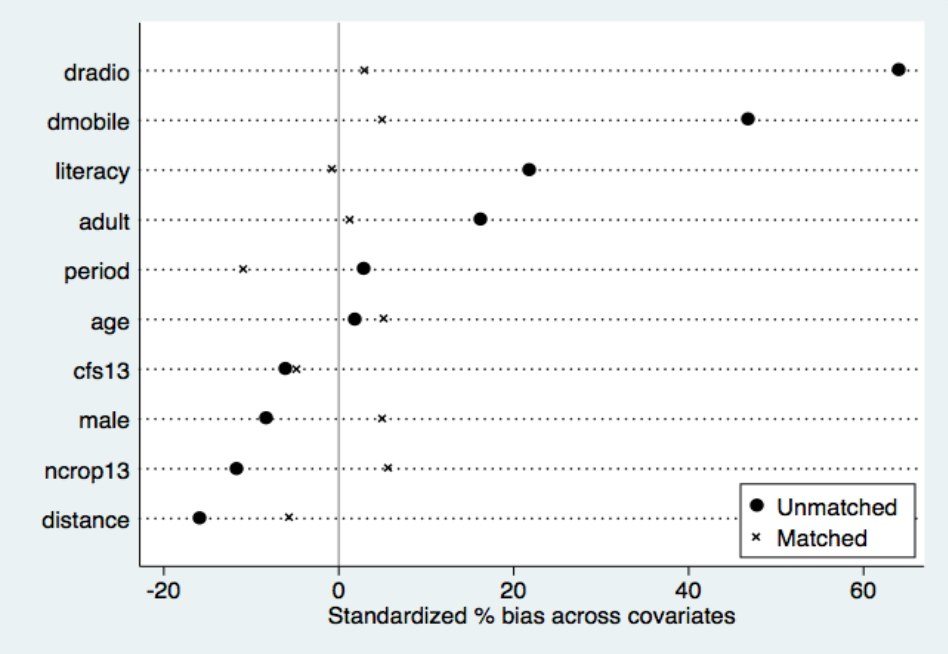


Table 6-10 shows the results from the kernel-based matching estimator regarding hypotheses 2 and 3. I find that the difference in revenue between MIS and non-MIS users is 2,791.71 birr and MIS users' revenues are 38 percent higher. The difference in profit between both groups is 1,961.55 birr and MIS users' profits are 25 percent higher than those of non-MIS users'. These differences are statistically significant.

Table 6-10 Determinants of Farmers' Revenues and Profits: PSM

Variable	Revenue		Log Revenue		Profit		Log Profit	
Sample	Unmatch	ATT	Unmatch	ATT	Unmatch	ATT	Unmatch	ATT
Treated	11361.5	11361.50	9.08	9.08	9945.57	9945.57	8.87	8.87
Controls	7229	8569.79	8.54	8.7	6789.22	7984.03	8.46	8.61
Difference	4132.5	2791.71***	0.54	0.38***	3156.35	1961.55***	0.4	0.25**
S.E.	659.68	788.60	0.09	0.09	623.60	739.62	0.09	0.11
T-stat	6.26	3.54	6.36	4.09	5.06	2.65	4.33	2.37

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

I also perform bootstrapping as a robustness check on these hypotheses. The results in Table 6-11 show that the difference in revenue between MIS and non-MIS users is 2,677 birr, a finding significant at the 1 percent level. MIS users obtain 37 percent higher revenue, a result also significant at the 1 percent level. The difference in revenue between both groups is 2,009 birr, which is significant at the 5 percent level. MIS users' profits are 25 percent higher, which is significant at the 1 percent level. To sum, using various methods, I find the same result, i.e., MIS usage has a positive effect of improving revenue and profit.

Table 6-11 Determinants of Farmers' Revenues and Profits:

PSM using Bootstrapping

Variable	Revenue	Log Revenue	Profit	Log Profit
ATT	2677***	0.37***	2009**	0.25***
	(711.6)	(0.1)	(928.4)	(0.09)
Observations	485	485	485	468

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Lastly, I attempt to examine the effect of MIS on traders. Although a lack of trader data prevents me from fully calculating the benefit, I utilize available data to obtain a rough estimate. Assuming that a trader only purchases from one farmer, I compute the change in a trader's profit between the case in which he trades with an MIS-user and the case in which he trades with a non-MIS user. Using average prices and volumes sold, I compute

$$\Delta_1 \widehat{Y}_0^T = \widehat{Y}_1^T - \widehat{Y}_0^T = \widehat{P}^M(\overline{S}_1 - \overline{S}_0) + (\overline{S}_0\overline{P}_o^{FG} - \overline{S}_1\overline{P}_1^{FG}) \quad , \tag{7}$$

where $\Delta_1 \widehat{Y}_0^T$ is the expected revenue of the difference between a trader 1 trading with MIS users, and trader 0 who trades with non-MIS users. $\widehat{P}^M$ is the expected market price of coffee, whose price is uniformly set at 20birr. $\overline{S}_1$ is the average sales volume of MIS users and $\overline{s}_0$ is the average sales volume of non-MIS users. $\overline{P}_1^{FG}$ is the average farm-gate price for the MIS user and $\overline{P}_o^{FG}$ is the average farm-gate price for the

non-MIS user. I find that the profit of traders who trade with MIS users is 2,016.4 birr higher than that of traders who trade with non-MIS users, suggesting that traders may have also benefitted due to the introduction of MIS. This is because MIS users produce and sell significantly larger amount of coffee than non-MIS users.

7. Conclusion

Solving problems arising due to asymmetric information between producers and traders is considered as an important strategy to improve smallholder farmers' welfare and market efficiency in developing countries. In Ethiopia, the ECX has been providing all market and market intermediaries with market prices using its own MIS to help ensure information symmetry. Although the MIS's introduction is indeed a remarkable attempt to solve the aforementioned problems, only a few studies have examined the impact of this MIS in Ethiopia.

For the above reason, I conducted a survey to collect information from 546 farmers in Ethiopia and verified statistically that the MIS had significant and positive effects on smallholder coffee farmers' revenues and profits. In magnitude, using MIS improves the revenue by 2,677 birr and the profit by 2,099 birr.The results were robust to various estimation methods employed, including models which consider endogeneity of the use of MIS. Another finding is that this positive effect of MIS on the farmers' performances is magnified further with more years of education, indicating that more educated benefit more from using MIS. This suggests that how you use the information matters in improving the performances, not just the fact of having the information.

The remaining question is how the MIS can lead to better performances. Theoretically, the MIS improves smallholder farmers' bargaining power; thus if farmers use MIS, they may sell their products at a farm-gate price higher than that obtained by a

non-MIS user. My finding in Ethiopia is that the MIS users' average farm-gate prices are only 0.33 birr higher than that of non-MIS users, moreover, this result is insignificant statistically. From the fieldwork, I learned that after the establishment of ECX, most of private collectors, both legal and illegal, who used to purchase from smallholders directly, disappeared and the share of coffee sold to the Ethiopian coffee cooperatives increased significantly. The cooperatives purchase coffee at a uniform price from smallholder coffee farmers. Furthermore, because the cooperatives buy out most of smallholder farmers' coffee cherries, the farmers have less opportunity to negotiate with buyers for higher sales prices. These features of the Ethiopian coffee industy are held responsible for the slight difference between the users' farm-gate prices and that of non-users. Judging from this finding, the MIS does not seem to have a positive effect on users' farm-gate prices in a market where few wholesalers have an oligopsony on products such as Ethiopia.

The other avenue to raise revenue and profit is to increase the quantity sold. Indeed, I find that MIS users have considerably higher average yields and sales volumes than those of non-MIS users. In regression models, I also find that the MIS has a positive effect improving users' productivity. The size of coffee farms are not different between the MIS users and non-users, but the MIS users tend to produce and sell more coffee by investing more, particularly in labor. The higher productivity of MIS users may be attributed to their decision-making given the information they obtain from MIS. One example I heard from farmers is that when the coffee prices are expected to

maintain at a high level the following year, it is better not to cut back the trunks of the old coffee trees for the revival of productivity because the productivity of trees will be zero for the following two to three years before it starts to increase again. Thus, cutting the trunks of trees should be done when the prices are expected to be low. Because MIS users can obtain more accurate market price information through MIS, they have an advantage in acting more strategically to adjust their investment decisions. The finding that education increases the positive effect of MIS also supports this conjecture.

In addition to this advantage, the MIS is likely to increase traders' profits due to the increase in MIS users' sales volume and competitive selling prices. It should be noted that the MIS has another advantage of increasing the profits of both farmers and traders.

Despite these benefits, however, only 29.12 percent of all respondents use the MIS. This unpopularity of MIS can be attributed to non-user respondents not knowing the system or not realizing the advantages of the MIS. Taking this matter into account, the discussion now turns to what steps can be taken to boost the use of MIS.

Based on my findings, I suggest that the Ethiopian government should introduce its advantages and supply radios to smallholder farmers, especially those who live in remote areas, to induce farmers to use the MIS. It can be seen from the evidence in this study that these policies have significant and positive effects on both household and national finances.

Lastly, one of the limitations of this study is that the result of this study does

not fully reflect farmers' long-term strategies, i.e., increase in coffee farm size, the number of coffee trees, and so on, because the data for this study includes information on coffee sales and input purchases between only two time points. Hence, the further study should use long-term panel data to clarify how MIS affects farmers' long-term decision making and how that improves their welfare.

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Appendix

HHID _____

Date of Interview (ddmmyy)_____

Evaluating The Impact of Market Information on Farmer's Production Decision

Head of Household Name _____

Respondent Name _____

Relationship to HH _____

Village Name _____

GPS Point North _____ East _____

Interviewed by _____ Interviewee's Signature _____

Q1. What does the head of household do in coffee production? (Mark)

1. Running their own coffee farm
2. Working in other people's coffee farms
3. Broker
4. Buyer
5. Exporter
6. Collector
7. Working at the ECX
8. Other ( )

Q2. If he/she grows coffee, what type of coffe? 1= Organic 0=Chemical

Q3. If he/she is a coffee farmer, is he/she a member of coffee cooperative? 1=Yes 0=No

Q4. If Q3=Yes, How much money does he/she pay a cooperative? Birr/ year

Q5. For the past 10 years, has coffee tree been damaged by disease and insects? (Mark)

1. Once
2. Twice
3. Three times
4. Four times
5. More than four times
6. Other( )

Section1a. Market Information

HHID _____

Information ID	1	2	3	4	5
MI1. From whom do you obtain market information now? (See Codes below)					
MI2. Prioritize them (Ranking)					
MI3. How often do you get information from them? (See Codes below)					
MI4. Do you have any reasons to obtain information from them? (See Codes below)					
MI5. If MI1 does not include" Code 8(ECX)", Have you ever used the ECX information?					1=Yes 0=No

Codes for obatining market information (MI1)	Codes for frequency (MI3)	Codes for the reasons (MI4)
1. Family Member	1. Everyday	1. Speed, Accuracy and Easily Access
2. Friends	2. Once a week	2. Speed and Accuracy
3. Relative	3. Twice a week	3. Speed and Easily Access
4. Broker	4. Three times a week	4. Accuracy and Easily Access
5. Buyer	5. Once a month	5. Speed
6. Extention Worker	6. Twice a month	6. Accuracy
7. Collector	7.Three times a month	7. Easily Access
8. ECX	8.Other(specify)	8. Other(specify)
9. Exporter		
10. Cooperative		
11. Other(spercify)		

Section1b. Market Information

HHID _____

**If MI1 includes "Code 8(ECX)", ask questions below.*

Information ID	1	2	3	4	5
MI6. How do you obtain the ECX market information? (See Codes below)					
MI7. Prioritize them (Number)					
MI8. How could you know each information service? (See Codes below)					
MI9. Since when have you used each of the ECX information? (yyyy)					
MI10. Do you have any reasons to obtain information from them? (See Codes below)					
MI11. Have you ever introduced each of the ECX information to someone?	1=Yes 0=No	1=Yes 0=No	1=Yes 0=No	1=Yes 0=No	1=Yes 0=No
MI12. If MI11=Yes, How many people did you introduce each service? (Number)					

Codes for the kind of information (MI6)		Codes for the source (MI8)		Codes for the reasons (MI10)	
1. The ECX Website	6. Mobile Phone SMS	1. Family	6. Extention worker	1. Speed, Accuracy and Easily Access	
2. Radio	7. Electronic Ticker	2. Friends		2. Speed and Accuracy	7.Easily Access
3. TV	8. Other(specify)	3. Relative	7. Buyer	3. Speed and Easily Access	8.Other(specify)
4. Newspaper		4. Campaign by ECX	8. Broker	4. Accuracy and Easily Access	
5. Interactive Voice Response		5. Collector	9. Cooperative	5. Speed	
			10. Other(specify)	6.Accuracy	

Section1c. Market Information

HHID _____

**If MI5=Yes, Ask questions below.*

Information ID	1	2	3	4	5
MI13. How did you obtain the ECX market information? (See Codes below)					
MI14. Since when have you used the ECX information? (yyyy)					
MI15. Since when have you quited using the ECX information? (yyyy)					
MI16. Do you have any reasons to quit the information service? (See Codes below)					

Codes for the kind of information (MI13)	Codes for the reasons (MI16)
1. The ECX Website	1. Speed, Accuracy and Difficult Obtaining
2. Radio	2. Speed and Accuracy
3. TV	3. Speed and Dfficult Obtaining
4. Newspaper	4. Accuracy and Difficult Obtaining
5. Interactive Voice Response	5. Speed
6. SMS	6. Accuracy
7. Time Ticker	7. Difficult Obtaining
8. Other(specify)	8. Other(specify)

Section2. Social Network

HHID _____

*Please answer the questions below about people who you mainly communicate market information and knowledge.

Person ID	Person1	Person2	Person3	Person4	Person5
SN1. Name(Full Name)					
SN2. Relationship (See Codes)					
SN3. Job (See Codes below)					
SN4. Does he/she use the ECX information?	1=Yes 0=No ?=don't know	1=Yes 0=No ?=don't know	1=Yes 0=No ?=don't know	1=Yes 0=No ?=don't know	1=Yes 0=No ?=don't know
SN5. How many times do you meet him/her?(Circle a week or month and Write number)	a week/ a month	a week/ a month	a week/ a month	a week/ a month	a week/ a month

Codes for Relationship (SN2)	
1. Friend	4.Family
2. Relative	5.Other(specify)
3. Coworker	

Codes for Job (SN3)		
1. Coffee Farmer	4. Broker	7. Extention Worker
2. Farmer(not coffee)	5. Exporter	8. Cooperative
3. Buyer	6. Collector	9. Other(specify)

SN6. Does each person know each other? (Circle yes or no)

	Person1	Person2	Person3	Person4
Person1				
Person2	Yes/No			
Person3	Yes/No	Yes/No		
Person4	Yes/No	Yes/No	Yes/No	
Person5	Yes/No	Yes/No	Yes/No	Yes/No

Section3a. Coffee Production

*Please ask about his/her farming activities between 2005 and 2006.

HHID _____

CP1. Total Farm Size _____ ha

CP2. Coffe Farm Size (in 2005)	ha	CP10. How much was your expected price before sales ? (in 2005)	Birr/quintal
CP3. Coffee Farm Size (in 2006)	ha	CP11. How much was your expected price before sales ? (in 2006)	Birr/quintal
CP4. Quantity Harvested (in 2005)	quintal	CP12. How many years have you been producing coffee	years
CP5. Quantity Harvested (in 2006)	quintal	CP13. How old is the coffee trees?	years
CP6. Quantity Sold (in 2005)	quintal	CP14. Are you going to quit producing?	1=Yes 0=No
CP7. Quantity Price (in 2005)	Birr/quintal	CP15. If CP14=Yes, when will you quit producing?	years later
CP8. Quantity Sold (in 2006)	quintal	CP16. If CP14=Yes, reason to quit the crop (See Codes below)	
CP9. Quantity Price (in 2006)	Birr/quintal	CP17. If CP14=No, reason to continue (See Codes below)	

Codes for Quiting the Coffee (CP16)		Codes for Continuing the Coffee (CP17)	
1.Lower price	4.The coffee was damaged by disease or insects.	1.Higher price	3.Self consumpetion
2.Lower productivity	5.The coffee trees ages	2.Higher productivity	4.Other(specify)
3.Lower profit	6.Other(specify)	3.Higher profit	

Section3b. Coffee Production (Fertilizer)

**Please ask about activities between 2004 and 2005.*

CP18. Have you used fertilizer for your coffee?	1=Yes 0=No
CP19. If CP18 =Yes, how many years have you been using the fertilizer for coffee?	years
CP20. If CP18 =Yes, reason to use the fertilizer (See Codes below)	
CP21. If CP18 =No, why don't you use any fertilizer? (See Codes below)	
CP22. If CP18 =Yes, quantity of fertilizer (in 2004)	kg
CP23. If CP18 =Yes, quantity of fertilizer? (in 2005)	kg
CP24. If CP18 =Yes, how much is 1kg of fertilizer? (in 2004)	Birr/kg
CP25. If CP18 =Yes, how much is 1kg of fertilizer? (in 2005)	Birr/kg

Section3c. Crop Production (Pesticide)

CP26. Have you use pesticide for your coffee?	1=Yes 0=No
CP27. If CP26 =Yes, how many years have you been using the pesticide for the coffee?	years
CP28. If CP26 =No, why don't you use any pesticide? (See Codes below)	
CP29. If CP26 =Yes, quantity of pesticide (in 2004)	kg
CP30. If CP26 =Yes, quantity of pesticide (in 2005)	kg
CP31. If CP26 =Yes, how much is 1kg of pesticide? (in 2004)	Birr/kg
CP32. If CP26 =Yes, how much is 1kg of pesticide? (in 2005)	Birr/kg

Codes for "CP20"	Codes for "CP21", "CP28"	
1. In order to improve crop productivity	1.Cost Benefit Balance	4. For the quality
2. In order to improve crop quality	2.Don't feel the need	5. Other(specify)
3. Other(specify)	3. Because of Organic certification or Fair trade	

Section3d. Coffee Production (Herbicide)

HHID _____

**Please ask about activities between 2004 and 2005.*

CP33. Have you use herbicide for your coffee?	1=Yes 0=No
CP34. If CP33=Yes, how many years have you been using the herbicide for the coffee?	years
CP35. If CP33 =No, why don't you use any herbicide? (See Codes below)	
CP36. If CP33 =Yes, quantity of herbicide (in 2004)	kg
CP37. If CP33 =Yes, quantity of herbicide (in 2005)	kg
CP38. If CP33 =Yes, how much is 1kg of herbicide? (in 2004)	Birr/kg
CP39. If CP33 =Yes, how much is 1kg of herbicide? (in 2005)	Birr/kg

Codes for No Using herbicide (CP35)
1. Cost Benefit Balance
2. Don't feel the need because of weeding with a tool
3. For the quality
4. Other(specify)

Section3e. Coffee Production (Farm Worker)

**Please ask about activities between 2005 and 2006.*

CP40. Have you hired or been hiring regular workers? 1=Yes 0=No

CP41. If CP40=Yes, how many regular workers did you hire in 2005? people

CP42. If CP40=Yes, how many regular workers have you been hiring in 2006? people

** If CP40=Yes, ask questions from CP43 to CP47*

Labor ID	Labor 1	Labor 2	Labor 3	Labor 4	Labor 5
CP43. Gender	0=Female 1=Male	0=Female 1=Male	0=Female 1=Male	0=Female 1=Male	0=Female 1=Male
CP44. Age (Number)					
CP45. How long has he/she been working in your farm? (Number)	years	years	years	years	years
CP46. How much money did you averagely pay them per month? (in 2005)	Birr	Birr	Birr	Birr	Birr
CP47. How much money do you averagely pay them per month? (in 2006)	Birr	Birr	Birr	Birr	Birr

Section3e-2. Coffee Production (Farm Worker)

HHID _____

*Farming Season (Please ask about activities between 2004 and 2005.)

CP48. Have you hired any temporary workers during the farming season? 1=Yes 0=No in 2004 1=Yes 0=No in 2005

CP49. IF CP48 =Yes, how did you pay them? 1= Birr/day 2=Birr/contract in 2004 1= Birr/day 2=Birr/contract in 2005

CP50. If CP49=1, how many temporary workers and how many days did you hire during the farming season? people(2004) days(2004) people(2005) days(2005)

CP51. If CP49=1, How much money did you pay a person per day during the farming season? Birr in 2004 Birr in 2005

CP52. If CP49=2, how many temporary workers did you hire during the farming season? people in 2004 people in 2005

CP53. If CP49=2, How much money did you pay them in total during the last farming season? Birr in 2004 Birr in 2005

*Harvest Season (Please ask about activities between 2005 and 2006.)

CP54. Have you hired any temporary workers during the harvest season? 1=Yes 0=No in 2005 1=Yes 0=No in 2006

CP55. IF CP54 =Yes, how did you pay them? 1= Birr/day 2=Birr/contract in 2005 1= Birr/day 2=Birr/contract in 2006

CP56. If CP55=1, how many temporary workers and how many days did you hire during the harvest season? people(2005) days(2005) people(2006) days(2006)

CP57. If CP55=1, How much money did you pay 1 person per day during the harvest season? Birr in 2005 Birr in 2006

CP58. If CP55=2, how many temporary workers did you hire during the harvest season? people in 2005 people in 2006

CP59. If CP55=2, How much money did you pay 1 person per day during the harvest season? Birr in 2005 Birr in 2006

CP60. If you had worked in the other farms during the farming season in 2004, how much money have you taken per day? Birr

CP61. If you had worked in the other farms during the farming season in 2005, how much money have you taken per day? Birr

CP62. If you had worked in the other farms during the harvest season in 2005, how much money have you taken per day? Birr

CP63. If you had worked in the other farms during the harvest season in 2006, how much money have you taken per day? Birr

Sectoin 4. Household Information

HHID _____

Family ID	HI1.Relationship to you See Codes below	HI2. Gender 0=Female 1=Male	HI3. Age Number	HI4.Years of Schooling Number	HI5. Mother tongue See Codes below	HI6. Does he/she Speak Amharic?	HI7. Can he/she read Amharic alphabet?
1						1=Yes 0=No	1=Yes 0=No
2						1=Yes 0=No	1=Yes 0=No
3						1=Yes 0=No	1=Yes 0=No
4						1=Yes 0=No	1=Yes 0=No
5						1=Yes 0=No	1=Yes 0=No
6						1=Yes 0=No	1=Yes 0=No
7						1=Yes 0=No	1=Yes 0=No
8						1=Yes 0=No	1=Yes 0=No
9						1=Yes 0=No	1=Yes 0=No
10						1=Yes 0=No	1=Yes 0=No

Codes for Relationship (HI1)	
1.HH	3.Child
2.Wife	4. Other(specify)

Codes for Mother tongue (HI5)		
1.Oromo	4.Tigrinya	7.Other(specify)
2.Amharic	5.Sidamo	
3.Somali	6.Wolaytta	

Section 5a. Household Assets & Expenditure

HHID _____

Item	HE1. Number of items currently owned	HE2. When did you buy the itme? (Circle year or month)	HE3.How long or big is it?	HE4.How much was it?(Total)
Stove		years/months ago		Birr
Refrigerators		years/months ago		Birr
Mobile Phones		years/months ago		Birr
Telephones		years/months ago		Birr
Vehicles		years/months ago	meters	Birr
Tractors		years/months ago		Birr
Radio		years/months ago		Birr
Goats		years/months ago		Birr
Cattle		years/months ago		Birr
Chickens		years/months ago		Birr
Sheep		years/months ago		Birr
Farm Irrigation Hoses		years/months ago		Birr
Coffee Hand Pulpers		years/months ago		Birr
Water Pumps		years/months ago		Birr
Water Tank		years/months ago	liters	Birr

Section 5b. Household Assets & Expenditure

HHID _____

Asserts	HE5. Saving, Loan, Lending	HE6. From whom	HE7. To whom	Expenditure	HE8. Amount of Money	HE9. Size
	Total Amount	See Codes	See Codes		Total Amount	Number
Saving	Birr			Education	Birr/year	
Saving	Birr			Food	Birr/month	
Saving	Birr			Leases of Land	Birr/month	ha
Saving	Birr			Renting Land	Birr/month	ha
Loan	Birr			Dwelling (home)	Birr/month	
Loan	Birr			Clothing	Birr/year	
Loan	Birr			Transpertation	Birr/month	
Loan	Birr			Communication (e.g Telephone, Mobile Phone)	Birr/month	
Lending Money	Birr					
Lending Money	Birr			Medical (Last year)	Birr/yaer	
Lending Money	Birr					
Lending Money	Birr					

Codes for HE6 and HE7					
1. Bank	3. Family	5. Buyer	7.Exporter	9. Collector	11. Cooperative
2. Friend	4. Relative	6. Broker	8. Extention Worker	10. Private loan	12. Other(specify)

Section 6. Other Crops

	1	2	3	4	5	6
1.Name of Crop (in 2004)?	Coffee					
2.Farm Size (in 2004)?		ha	ha	ha	ha	ha
3.Quantity Sold (in 2005)?		queantal	queantal	queantal	queantal	queantal
4.Quantity Price (in 2005)?		Birr	Birr	Birr	Birr	Birr
5.Which were important to you in terms of income in 2005? (Ranking)						
6.Name of crop (in 2005)?	Coffee					
7.Farm size (in 2005)?		ha	ha	ha	ha	ha
8.Quantity Sold (in 2006)?		queantal	queantal	queantal	queantal	queantal
9.Quantity Price (in 2006)?		Birr		Birr	Birr	Birr
10.Which are important to you in terms of income in 2006?(Ranking)						