The Effects of Providing Market Information on Farmers' Bargaining Power and Market Participation: Evidence from Small-Scale Coffee Producers in Ethiopia

Guenwoo Lee[*1], Aya Suzuki[2], and Yu Ri Kim[2]

[1] Institute of Economic Research, Hitotsubashi University

[2] Department of International Studies, Graduate School of Frontier Sciences, University of Tokyo

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Abstract

Information asymmetry between farmers and buyers is a classic source of market inefficiency and is more important in rural areas in developing countries due to high transportation costs, poor infrastructure, and limited number of buyers operating in rural areas. Using primary data collected from 466 smallholder coffee farmers in Ethiopia, this paper examines the effect of market information systems (MIS) on the coffee farmers' bargaining power and market participation. We found that: 1) while there is no difference in sales price per kilogram between MIS users and non-MIS users, there is a differences in sales volume, the ratio of sales volume, and coffee farm income; 2) the difference in coffee farm income between MIS users and non-MIS users is more attributed to an increase in sales volumes by MIS users rather than an increase in their selling prices. When we test for the presence of heterogeneous effects of MIS, we find that: 3) there is no systematic difference in the effects of MIS use on outcomes due to educational backgrounds; while 4) there is consistent regional heterogeneity in the impact of MIS across market structures. Such regional heterogeneity was likely observed due to different degrees of market competition in these areas, which may be determined both by demand and supply side conditions, namely the number of buyers accessible and the level of farmers' market participation in the area.

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* Corresponding author. Phone number: +81-42-580-8362. Address: A306, 2-1 Naka, Kunitachi, Tokyo 186-8603, Japan. Email: kunu_lee@ier.hit-u.ac.jp

1 Introduction

Information asymmetry between farmers and buyers is a classic source of market inefficiency (Stigler, 1961) and is more important in rural areas in developing countries due to high transportation costs, poor infrastructure, and limited number of buyers operating in rural areas (Fafchamps & Hill, 2008; Mérel et al., 2009; Osborne, 2005). As an effort to reduce this asymmetry, many Sub-Saharan African governments introduced the Market Information Systems (MISs), which publishes price information of various commodities at various markets, after the abolishment of marketing boards in the 1980s (Tollens, 2006; USAID, 2013). While this donor-funded first-generation MIS did not function effectively due to the operational difficulty, the development of ICT and penetration of mobile technologies in the 2000s led to the second-generation MIS (Courtois & Subervie, 2015; USAID, 2013). The new MIS was offered in a various forms, such as via FM radios, TV, short messaging services (SMS), and websites, and private MIS providers also emerged. Types of information was also expanded to include not only agricultural prices but also other various types of information, such as technical advices, input information, and weather forecast.

Following this rapid penetration of mobile phones in developing countries in the 2000s, the number of studies on the effects of mobile phones, which are considered to improve upon information asymmetry, on agricultural markets expanded (Aker & Mbiti, 2010; Nakasone et al., 2014). Earlier studies by Jensen (2007) and Aker & Mbiti (2010) showed that the introduction of mobile phones narrowed price dispersions across markets in India and in Niger, respectively. Thereafter, impacts of mobile phones on various agricultural outcomes have been analysed, including agricultural prices (Fafchamps & Minten, 2012; Shimamoto et al., 2015; Svensson & Yanagizawa, 2009), market participation (Aker & Ksoll, 2016; Muto & Yamano, 2009), farmers' income (Fafchamps & Minten, 2012; Muto & Yamano, 2009), techcnology adoption (Aker, 2011; Cole & Fernando, 2012), and crop diversification (Aker & Ksoll, 2016). While most find the introduction of mobile technology leads to a decline in price dispersion across markets and thus more market integrations, the impact on agricultural outcomes have been mixed and heterogenous (Nakasone et al., 2014). Positive effects on sales prices were found in Cambodia (Shimamoto et al., 2015) and on input use and agricultural productivity in Kenya (Ogutu et al., 2014) while no effects were found in many. Heterogeneous effects due to age, size of farmers, types of crops are also found (Fafchamps & Minten, 2012; Mitra et al., 2018; Muto & Yamano, 2009). These heterogeneity suggests the need for more studies in this area to clarify what drives the results. In addition, MIS analyzed in the existing studies are mostly privately managed MIS which charges fees, with a notable exception of Svensson & Yanagizawa (2009). As the public MIS has different features from the private MIS in terms of distribution and user fees for farmers, its effects on agricultural outcomes must be separately evaluated.

Given this background, we evaluate the effects of public MIS on farmers' agricultural outcomes, using primary data collected from 466 coffee farmers in Ethiopia in 2014. We collected data from two zones, which differ in the market structure, in order to examine the possible heterogeneity in the effects of MIS. We find that: 1) while there is no difference in sales price per kilogram between MIS users and non-MIS users, there is a differences in sales volume, the ratio of sales volume, and coffee farm income; 2) the difference in coffee farm income between MIS users and non-MIS users is more attributed to an increase in sales volumes by MIS users rather than an increase in their selling prices. As we expected the major benefit of having more information would be observed in a form of sales price increase, this was contrary to our expectation. However, when we test for the presence of heterogeneous effects of MIS, we find that: 3) there is no systematic difference in the effects of MIS use on outcomes due to educational backgrounds; while 4) there is consistent regional heterogeneity in the impact of MIS across market structures. Such regional heterogeneity was likely observed due to different degrees of market competition in these areas, which may be determined both by demand and supply side conditions, namely the number of buyers accessible and the level of farmers' market participation in the area. Indeed, we find that the MIS use was positively associated with price increase in Sidama, where the market competition was higher than the other zone Jimma. In Jimma, on the other hand, the price was unaffected by the MIS use. However, the MIS use was positively associated with higher sales volume, ratio of sales to production, and farm income in Jimma, which suggests that although farmers could not obtain higher prices, they were able to increase production and sales volume with the use of MIS. The results are robust to the different estimation methods employed, including quasi-experimental designs for evaluating causal treatment effect of MIS use.

Our paper contributes in two aspects on the emerging literature on the effect of ICT to improve on information asymmetry in agricultural markets in developing countries. First is that we evaluate the effects of using public MIS on farmers' farming outcomes while most of the existing studies analyze the impacts of privately managed MIS or the ownership (or use) of mobile phones. Public MIS is freely available to a large pool of farmers via radio, TV, SNS, or mobile phones, and it is important to understand whether the implementation of MIS has actually yielded positive results for farmers. Our findings confirmed that MIS use was positively related to the sales volume, market participation, and farming income. Second, we shed more light on the importance of heterogeneity of markets when we consider the impacts of MIS. We find that the effects of MIS in increasing the sales price was greater in more competitive markets where buyers have less barganing power relative to the other zone with lower competition. On the other hand, the MIS was positively associated with increasing sales, market participation, and farming income in the area with lower competition. These indicate the need to improve upon other market imperfections in addition to information asymmetry,

consistent with the findings in Aker & Ksoll (2016).

The rest of the paper is organized as follows. Section 2 reviews relevant extant literature on providing market information to farmers and explains our hypotheses to be tested. Section 3 describes Ethiopia's cofee industry and their market information system. In Section 4, we explain the data used herein and present summary statistics. Section 5 describes our empirical strategy, and the results are presented in Section 6. Finally, Section 7 concludes the study.

2 Hypotheses

With the rapid development of information and communication technology (ICT) letting farmers in developing countries to obtain market price information more easily, there has been a growing interest in the impact of providing market information on farmers' bargaining power and market participation. First, we focus on the relationship between market information and farmers' bargaining power. According to a study in India by Jensen (2007), the use of market information through mobile phones helped fishermen choose a fish market with the highest price. Courtois & Subervie (2015) evaluate the impact of an MIS-based program in Ghana on farmers' marketing performances. They find that MIS users sold maize at a price 10% higher than non-MIS users. Muto & Yamano (2009) describe how solving the problem of information asymmetry between farmers and traders increase farmers' bargaining power and sales prices. If traders know the market price of crops while farmers do not, the traders can maximize profits by offering prices slightly higher than the farmers' reservation prices. In this case, the gains the farmers get from the deal will be lower than the full potential gain. Meanwhile, farmers who know the market price can attempt to negotiate with traders to increase profits or seek other traders who offer a higher price. According to the findings from abovementioned studies, we assume that:

Hypothesis 1. *Providing market information to farmers increases farmers' bargaining power so that farmers can sell at a higher price.*

Next, we turn to the sales quantity side. There are several studies which examine the effect of farmers' use of market information on market participation. Muto & Yamano (2009) suggest that as the information flow increases, the cost of crop marketing decreases and this in particular increases farmer's market participation residing in remote areas. They interpret the result as farmers and traders bear the cost and risk of travelling if both parties are aware of the quantity and price of what they can trade in advance. Courtois & Subervie (2015) claim that asymmetric information about the market price may collapse negotiations between farmers and traders. In particular, when the market price

falls sharply due to external factors, uninformed farmers may refuse to sell their products to traders because the payoff by selling the products is lower than expected, even if traders offer prices that minimizes their gains. To deal with this problem, they propose the use of MIS by farmers, and expect that transaction success rates will be improved by farmers' MIS subscription even when the market price fluctuates largely due to unexpected external factors. According to a study regarding Mozambique's MIS by Mabota et al. (2003), farmers who use the MIS sell more cereals, beans, and peanuts to the market than non-users. The study suggests that the difference in sales volume between the MIS users and non-users has occurred because the MIS has a feature that enhances users' knowledge of the quantity available for sale.

Hypothesis 2. *Providing market price information to farmers increases farmers' market participation.*

In addition to looking at the impact of the ICT-based MIS on farmers' bargaining power and market participation, this paper extends its scope to examining two types of heterogeneity regarding the impact, namely farmers' individual ability and farmers' location. While many previous studies have revealed that the MIS is effective in changing the farmers' behavior, it remains unclear if the majority of smallholder farmers, especially less educated, will be able to benefit from using the new technologies. In other words, because an individual's ability to interpret information depends on the cognitive skills, the benefits of receiving information are expected to be larger for those with higher levels of education than those with lower levels of education. Thus,

Hypothesis 3. *The effects of providing market price information to farmers depend on the farmer's ability to interpret information.*

With respect to the farmers' location, we suspect that depending on the characteristics of each market, the impact of MIS may be different due to different elasticity of demand and supply. For instance, where the market structure is close to an oligopsony, it may be difficult for farmers to negotiate with traders. Even if the farmers are aware of the prevailing market price, they may not benefit from such information if they have no access to other buyers. Farmers only can choose from knowingly selling their products at lower price than the market price or not selling at all. In contrast, if there are many buyers in the market, farmers can search for other buyers who are willing to pay a price closer to the market price. In such market, it is expected that providing market information to farmers will induce farmers to sell more in the market.

Hypothesis 4. *The effects of providing market price information to farmers depend on the market*

structure.

We test these four hypotheses using the primary data of coffee farmers collected in Ethiopia to verify whether the MIS is a valid tool for enhancing farmers' bargaining power and market participation and how its effects depend on the individual's level of education and market structure.

3 Market Information System in Ethiopia

3.1 Coffee industry in Ethiopia

In Ethiopia, there are more than one million coffee-growing households and the livelihood of over 15 million people directly and indirectly depend on coffee industry (Labouisse et al., 2008; Lmc, 2000; Petit, 2007). Since liberalizing its agricultural market in 1990, the Ethiopian government has striven to improve the productivity, quality, and market efficiency of its domestic coffee crops (Petit, 2007). Consequently, in 2018, Ethiopia was ranked as the largest coffee exporter in Africa and tenth largest exporter in the world (ICO, 2020; Minten et al., 2019). Figure 1 marks Ethiopia's coffee exports volume and value between 1990 and 2018. During this period, Ethiopian coffee exports increased from 64 thousand tons to 215 thousand tons; in terms of U.S, dollar value, it rose from $129 million to $759 million. This represents a nearly 340% increase in volume and a nearly 590% increase in monetary value (FAO, 2020).

[Figure 1. Ethiopian Coffee Export Volume and Value]

In May 2008, with the aim of ensuring the development of an efficient modern trading system, the Ethiopian government established the ECX in Addis Ababa with $29 million in funding from international institutes and official development assistances and changed a hub of its coffee distribution from auction centers to the ECX (Gabre-Madhin, 2012). Currently, nine cash crops, including coffee, are traded on the exchange. In 2009, the year after its establishment, Ethiopia's coffee exports decreased by 60 thousand tons compared to 2008 but began to recover in 2010 and nearly doubled in 2018 as shown in Figure 1. This increasing trend may be partially due to the overall growing demand for coffee as coffee exports from coffee-producing countries around the world rose nearly 130% from 5.7 million tons to 7.4 million tons between 2009 and 2018 (FAO, 2020). At the same time, modernized trading system under the ECX has also contributed to the remarkable growth achieved by the Ethiopian coffee industry.

[Figure 2. Ethiopian Coffee Supply Chain after the Establishment of the ECX]

Figure 2 depicts the Ethiopian coffee supply chain after the ECX system was introduced in 2008. Currently, most of the coffee produced by smallholder farmers is traded at the ECX because the government revised laws on coffee trading for export or domestic distribution to ban coffee transactions outside the ECX (Gelaw et al., 2017). Since the Ethiopian government banned unauthorized collectors and brokers' business activities with the establishment of the ECX, most smallholder coffee farmers sell their products directly to cooperatives or licensed local suppliers, not to brokers (Minten et al., 2019). According to ECX (2020), coffee collected by cooperatives and suppliers is sent to the ECX's warehouses located throughout the country and graded by experts at the ECX. Coffee with grade 1 to 4 is exported overseas, while coffee with grade 5 or lower is distributed to domestic markets (Duguma & Van deer Meer, 2018; ECX, 2020; Tamirat, 2013).

3.2 Market information provided by the Ethiopian commodity exchange

Smallholder coffee farmers in Ethiopia produce about 95% of the country's total coffee output. Still, they have difficulty accessing information on wholesale prices since most smallholder coffee farmers are geographically isolated from central markets (Getnet et al., 2011; Labouisse et al., 2008). Most of them obtain market information from unofficial sources such as neighbors, friends, or traders and generally make marketing decisions such as selling prices and sales volume based on sometimes incorrect or outdated information (Getnet et al., 2011).

Such an environment, in which producers rely on unofficial market price information, causes information asymmetries between producers and traders who try to lower the selling prices. Since neighbors also obtain market information from traders or other unofficial sources, the information asymmetry problem persists even if there is an active exchange among producers (Osborne, 2005).

Since 2008, the ECX has adopted a MIS and disseminated price information on wholesale prices to all market actors, including smallholder farmers, via the website, electronic tickers in 250 rural markets, mobile phone short messaging services (SMS), interactive voice response (IVR) services, radio (three times a day), television (two times a day), newspapers, and newsletters (daily, monthly and half-yearly) (ECX, 2020). Given the Ethiopian coffee industry's supply chain structure which most coffee is traded at the ECX, the MIS is expected to provide more accurate price information than other channels.

To provide convincing evidence on the potential benefit of the Ethiopian MIS, Getnet et al. (2011) use a quasi-rational expectation formation and find that the MIS helps farmers make unbiased price forecasts. The positive impact of the MIS on farmers' price predictions may improve farmers' decision-making and market behavior related to coffee production and marketing; thus, the MIS can increase farmers' income. However, the paper does not estimate the MIS's effect on farmers' income

so that the emprical evidence for the positive effect of the MIS on farmers' income is still missing.

4 Data and Summary Statistics

To assess the impact of the MIS on coffee producers' bargaining power and market participation, we interviewed 466 smallholder coffee farmers living in 19 kebeles (wards) in Jimma zone and Sidama zone in 2014. We collected data related to coffee production and sales on 2012 and 2013 and restricted respondents to household head. The kebeles and the respondents were chosen randomly using the lists obtained from the Oromia Coffee Farmers Cooperative Union (OCFCU) and the Sidama Coffee Farmers Cooperative Union (SCFCU).[1] These two zones are chosen as they are the two largest coffee producers and exporters in Ethiopia. In 2013, Jimma zone exported about 20% of Ethiopia's total coffee exports, while Sidama zone exported about 40% of Ethiopia's total coffee exports (Minten et al., 2014). Another reason for choosing the two zones is to compare the effect of the MIS in different market structures. According to Minten et al. (2015), 80% of farmers in Sidama zone stated that they can choose whom to sell from multiple traders. On the other hand, only 63% of farmers in Jimma zone answered that they had choices in terms of trading partners. While only 2.2% of farmers in Sidama zone stated that they had no choice, 11.2% of farmers in Jimma zone answered they did not get to choose whom to trade. From these survey results, it can be presumed that there are more traders in Sidama zone than Jimma zone. The survey also found that 71% of farmers in Sidama zone have the option to sell to cooperatives, but only 41% of farmers in Jimma zone. Further, while farmers in Sidama zone sold 31.9% of their coffee to cooperatives, farmers in Jimma zone sold only 6.8%. Due to the differences in the market structure of the two zones, we expect the benefits of price information obtained from the MIS to be different in the two zones.

[Table 1. Number of sample households and MIS users in each kebele]

Table 1 presents the number of sample households and the number of MIS users in each kebele over two years. Between 2012 and 2013, the number of MIS users remains the same in all kebeles except for kebele K and O which show increases by two and one, respectively. Looking at the full sample, the share of MIS users increased only by 0.65% point from 29.61% in 2012 to 30.26% in 2013. This stagnant adoption trend may be attributed to low awareness of the system itself among the farmers. It is also possible that farmers are reluctant to use the MIS as the benefits of the new MIS which was less than five-years old at the time of the survey are not yet visible.

[1] The cooperatives have all smallholder coffee farmers in the Oromia region and in the SNNPR region including both members and non-members of cooperatives.

[Table 2. Types of price information sources]

Table 2 shows the types of information sources used by smallholder coffee farmers to obtain coffee price information in 2013. The respondents could select all applicable answers. 72% of all respondents answered that they obtained information from friends or neighbors, 43% from relatives, and 46% from cooperatives. Still, only 30%t of all respondents, or 141 smallholder coffee farmers among 466 respondents, used the MIS provided by the ECX. Overall, farmers in Jimma zone tend to rely on informal information such as family members, friends, and private traders, while most farmers in Sidama zone get price information through formal information sources such as cooperatives. Also, the MIS ranked the third most popular information source in Sidama after cooperative and friends and neighbors, marking the 41.18% of total sample. However, the user ratio of the MIS in Jimma zone is only half of Sidama's and the MIS was only fifth popular information source among ten types of sources surveyed.

[Table 3. Types of MIS channels]

Table 3 describes the types of MIS channels used by each coffee farmer in 2013. Again, all applicable answers were selected by the respondents. 99 percent of all respondents, 157 of 158 respondents who used the MIS, obtained information from radio. Although 85% of farmers in the sample owned mobile phones, the usage rate of Short Message Service (SMS) subscription and Interactive Voice Response (IVR) system was relatively low as the two services incurred costs. Instead, farmers used radio feature on mobile phones in addition to a radio receiver which was owned by 73% of the farmers, making radio the most popular MIS channel. Nobody accessed ECX website to check the price information. This is because first, the website targets foreign buyers rather than local coffee farmers; and second, most of the smallholder farmers do not have a device and network to view the website. Seven farmers in Sidama zone answered that they had obtained price information through electronic tickers whereas in Jimma, the number of users was zero. According to our field visit in 2014, we observed that there were several electronic tickers installed in our study areas. Nonetheless, most of them did not display any information due to shortage of electricity supply and network (Appendix 1). Therefore, infrastructure maintenance failure was the cause of low usage rate of electronic tickers in both zones. Similarly, the reason for the low usage rate for TV (10.64%) and newspaper (0.71%) seems to be due to lack of infrastructure. It is both difficult and costly for farmers living in remote areas to get newspapers every day and to purchase satellite TV receivers in addition to TVs. Furthermore, the low literacy rate (48%) and the average years of schooling (4years) in our

study areas are assumed to be factors that hinder the use of textual information channels such as SMS subscription, newspaper, and website.

[Table 4. Socio-economic characteristics of respondents]

Table 4 outlines the respondents' socio-economic characteristics from 2013 data. The MIS user group and non-MIS user group were divided according to the answer of the household head who participated in the interview. The grouping does not reflect the usage of other household members as we believe that household head holds the strongest bargaining power within the household. Thus, we only take account of household head characteristics in the following analysis. The average age of household head is 46 years old, and 98% are male. There is no significant difference between MIS and non-MIS users in these characteristics. The significant differences were found in the number of years of schooling, total assets, and the number of MIS informants, which were higher for MIS users than non-users. MIS informants refer to the number of people whom respondents mainly talk about market prices, but only those who use the MIS. The number of MIS informants was the only characteristics that is statistically different between the user and non-user groups in both Jimma and Sidama, as well as for the total sample. The MIS user groups in both zones had more informants who use the MIS around them compared to the non-user group.

[Table 5. Coffee production and sales performances of farmers]

Table 5 shows the figures related to coffee production, cost and sales in year 2013. The MIS user group has statistically higher harvest volume, sales volume, ratio of sales to production, total coffee cost, and labor cost than the non-MIS users. The difference in total coffee cost between the two groups is because the MIS group's labor cost is 926 birr (24.75 US$) higher than that of the non-MIS group. Since the MIS users can reduce market price uncertainty through the use of MIS, the MIS users in Sidama appear to have actively hired laborers as an investment strategy to increase their revenues. However, in Jimma, the difference in the labor cost between the groups is not statistically significant. Also, the MIS group harvested about 264 kilograms more and sold about 294 kilograms more than the non-MIS group despite statistically insignificant land size difference. Due to higher sales volume among the MIS users, they could earn 3,903 birr (104.29 US$) higher coffee income than the non-MIS users. Such higher income may not be the result of higher selling price as the price difference between the two groups is not statistically significant. We can infer that the effect of the MIS may be different in the two zones since difference between average prices between the users and non-users in Jimma indicates a negative sign while that of Sidama shows a positive sign. We also

observe that the sample farmers in Sidama harvested more, sold more, sold at a higher price, earned more, and invested more although they had smaller farmland compared to the farmers in Jimma.

5 Econometric Strategies

Using the unique data set of 466 farmers from the household survey mentioned in Section 4, we empirically examine the impact of the MIS on farmers' bargaining power and market participation. Although we collected two-year panel data from each farmer, the main analysis of the paper is cross-sectional because the number of the MIS users was almost the same between 2012 and 2013 as shown in Table 1. As an alternative, we employ a pooled regression model, a fixed effect model, a random effect model using the panel data as a robustness check. The following econometric model is estimated:

$$Y_{ik13} = \alpha + \beta_1 MIS_{ik13} + \beta_2 MIS\ informant_{ik13} + X_{ik13}\beta_k + \gamma Y_{ik12} + \delta_k + \varepsilon_{ik} \quad (1)$$

where Y_{ik13} is the outcome (logged sales price per kilogram, logged sales volume, the ratio of sales to total production, or logged coffee farm income) for farmer *i* in zone or woreda *k* in 2013; MIS_{ik13} is a dummy variable that indicates whether a farmer *i* is an MIS user or not in 2013; $MIS\ informant_{ik13}$ is the number of informants who use the MIS and exchange the price information with farmer *i* in 2013. This variable intends to control potential treatment spillover effects because as price information obtained from the MIS can easily spillover to other farmers who do not use the MIS. X_i contains a farmer *i*'s age, years of schooling, coffee farm size, total coffee cost, and types of coffee price information sources in 2013. δ_k captures unobserved heterogeneity across zones or woredas, and ε is an error term. To avoid collinearity problem, this study does not include zone or woreda dummies together in the regression model.

To test hypothesis 3, this study employs an interaction term between the MIS usage and years of schooling. This interaction term is a proxy for revealing the differences in the outcomes among MIS users, depending on their ability to interpret market price information. If the impact of MIS on the outcome variables is higher for more educated farmers, hypothesis 3 is supported. In other words, the effects of the MIS can be amplified when the price information is provided to individuals with better understanding and cognitive skills.

Another interaction effect between the MIS usage and residential area is estimated to test hypothesis 4. It is expected that the benefits of price information obtained from the MIS will differ in the two zones due to the differences in the market of the two zones as described in Section 4.

Because the farmers in our sample have chosen whether to use the MIS by their own will,

there may be self-selection bias in the analyses. Thus, as a quasi-experimental method, this study adopts inverse-probability-weighted regression adjustment (IPWRA) estimator and estimates the average treatment effects (ATE) to measure the differences in the average outcomes between the MIS user group and non-MIS user group. Since the estimator is a doubly robust estimator that combines a logistic model for treatment (IPW) and a linear model for outcome (RA) and, it serves asymptotically unbiased estimates even if one of the models is mis-specified (Bourguignon et al., 2007; Robins et al., 2007; Wooldridge, 2007).

$$\widehat{ATE_{IPWRA}} = \frac{1}{n}\sum_{i=1}^{n}\left[\frac{MIS_i Y_i}{\hat{\pi}(Z_i)} - \frac{(1-MIS_i)Y_i}{1-\hat{\pi}(Z_i)}\right] \quad (2)$$

where n is the number of individuals in our sample; $\hat{\pi}(Z_i)$ is the estimated propensity score, that is the estimated conditional probability of using the MIS given Z_i. The variables used to estimate the probability are shown in Appendices 2 to 4.

6 Estimated Results

6.1 Effects of MIS on farmers' bargaining power and market participation

We begin by analyzing the effect of the MIS on farmers' market participation and selling price using the full sample. In addition to ordinary least squares (OLS) which may be biased due to endogenous nature of MIS adoption, the results from the IPWRA are also presented. For matching, we use household head's age, years of schooling, number of adults in household, coffee farm size, total assets, information sources, and village dummies. The matching passed the covariate balance tests (Appendix 2) and overidentification tests (Table 6).

As shown in Table 6, the effects of the MIS are consistent under OLS and IPWRA specifications for all four dependent variables except for the ratio of sales to production variable. First, the MIS user dummy does not show the statistically significant effects on sales price per kilogram in both OLS and IPWRA, suggesting that the MIS did not increase farmers' bargain power (column i and ii). However, the MIS dummy shows positive and statistically significant effects on the user's sales volume, ratio of sale to production, and coffee farm income in both OLS and IPWRA columns, or either. In terms of magnitude, the sales volume of the MIS users is 10% higher (column iv) than that of non-MIS users. The ratio of sales to production is about 3% points higher for the MIS users, inferring that the MIS users increased their sales both in absolute and relative terms. Consequently, the MIS users also have statistically higher coffee farm income as presented in column (vii) and (viii).

In sum, farmers who used the MIS enjoyed higher income from coffee because of more active market participation, but not due to higher selling price and bargaining power.

[Table 6. Effects of of MIS on farmers' bargaining power and market participation]

Next, we examine whether the effect of the MIS is heterogenous depending on the user's education level using OLS. Table 7 shows that neither the MIS dummy nor the interaction term is statistically significant. Hence, the education level of the MIS users does not affect the users' performances. One possible reason for educational heterogeneity not being a statistically significant factor is that since the price information which farmers obtain from the MIS is simple enough so that even farmers with limited elementary education can understand and process the information without much difficulties. Since all models in this table fail the joint significance test, the models without interaction terms seem to be more appropriate for measuring the effects of the MIS.

[Table 7. Educational heterogeneity of MIS's effects: OLS]

6.2 Regional heterogeneity

In this section, we investigate the regional heterogeneity between Jimma and Sidama zones. Based on the differences observed in Table 4, we assume that farmers are situated differently in terms of both coffee production and marketing in the two zones. Table 8 captures the difference in the effect of MIS between Jimma and Sidama zone by including the Jimma dummy as well as the interaction term. While farmers in Jimma sold 5.12% points lower from their production and earned 19% less coffee farm income compared to the farmers in Sidama in average, the effects of using the MIS was much greater for the farmers in Jimma. If farmers in Jimma use the MIS, the ratio of sales to production and coffee farm income would increase by 0.8% points and 0.05% respectively more than the users in Sidama. Larger effects of the MIS among the MIS users in Jimma may be attributed to the lower sales volume, market participation and farm income compared to the farmers in Sidama. It seems that there is more room for the increased market participation as farmers in Jimma were less involved in the market. The effects of the MIS on the sales price remain insignificant even in Jimma where the sales price per kilogram was lower than Sidama.

[Table 8. Regional heterogeneity of MIS's effects: OLS]

To further dissect the difference between the effects of the MIS in Jimma and Sidama, we

divided the sample into two and ran regressions separately. The results are summarized in Table 9 using OLS and Table 10 using IPWRA. For matching, we use coffee farm size, total assets, and information sources. The matching passed all the covariate balance tests (Appendices 3 and 4) and overidentification tests (Table 10). We find that the significance level of the four dependent variables vary depending on the region under both OLS and IPWRA. The MIS variable shows positive and statistically significant effect on the sales price of farmers in Sidama, but effects on other three dependent variables are insignificant. The exact opposite case is true for Jimma zone. The coefficients of the MIS dummy are positive and statistically significant on the sales volume, ratio of sales, income of farmers but not on the sales price (Table 9). We suspect that such contradicting trend between the two zones is due to the difference in market structure. As explained above in Section 4, farmers in Sidama have relatively more choices in terms of whom to sell compared to farmers in Jimma so that additional access to the official price information via MIS could increase their price bargaining power. Nonetheless, higher selling price did not contribute to statistically significant increase in the farm income. In case of Jimma, due to narrower choices in sales channel, farmers did not enjoy higher selling price even though they obtained the MIS price information. Yet, the MIS encouraged farmers in Jimma to sell more coffee to the market so that it led to higher farm income.

[Table 9. The effects of MIS by region: OLS]

[Table 10. The effects of MIS by region: IPWRA]

6.3 Robustness check

As a robustness check, we ran fixed effect model, random effect model, and pooled model using the two-year panel data from 2012 and 2013. The results summarized in Table 11 are consistent with the results in tables shown earlier using OLS and IPWRA. The coefficients of the MIS dummy are insignificant for the sales price in all columns, but are statistically significant and positive for the sales volume, sales ratio, and income.

[Table 11. Robustness check]

7 Conclusion

This study aims to evaluate the impact of the MIS on smallholder farmers' bargaining power and market participation using our unique data collected from 446 coffee farmers in Ethiopia. Moreover, we examine whether the MIS's effect is heterogeneous, depending on the individual's level of education and the market structure.

Based on our results, we conclude that MIS users indeed obtain higher coffee farm income than non-MIS users on average. Such differences in coffee farm income between MIS users and non-MIS users may be more attributed to an increase in sales volumes by MIS users rather than an increase in their selling prices. Moreover, the ratio of sales to production is about 3% points higher for the MIS users, suggesting that the Ethiopian MIS may enhance farmers' market participation and is consistent with existing studies mentioned in Section 2 (Courtois & Subervie, 2015; Mabota et al., 2003; Muto & Yamano, 2009). However, unlike many previous studies (Courtois & Subervie, 2015; Jensen, 2007; Muto & Yamano, 2009), the MIS user dummy does not show the statistically significant effects on farmers' sales price per kilogram.

One reason for not having overall impact on the sales price is regional heterogeneity in our data. By region, the MIS dummy shows a positive and significant effect on farmers' sales price per kilogram in Sidama, but other dependent variables are statistically insignificant. On the other hand, the MIS dummy indicates positive and statistically significant effects on farmers' sales volume, the ratio of sales to production, and coffee farm income of farmers in Jimma except for sales price per kilogram. The difference seems to be related to the difference in market structure between Sidama and Jimma. According to Minten et al. (2015), coffee farmers in Sidama have more choice between traders and more options to sell to cooperatives than farmers in Jimma. We therefore claim that in a market dominated by a small number of traders, the MIS may not affect farmers' bargaining power. Also, we notice that in a market where farmers are less actively selling, the MIS may enhance farmers' market participation, as shown in Table 5.

In addition, we discover that there was no difference in the outcome among MIS users, depending on their years of schooling. There are two possible reasons. First, because the average education level is only four years and the variance are not too big across farmers, it seems that there was no big difference in the benefits of using MIS. Second, the type of information which the farmers can get from the MIS is only simple market price information. It does not require much education to process such simple information so that it did not lead to a statistically significant difference in how they use information for their decision-making process. Nonetheless, if the information provided by the MIS becomes more complex, the difference in MIS benefits will widen depending on the individual's ability to interpret.

While this paper contributes to the literature by looking at the impact of the MIS on both farmers' bargaining power and the market participation and by taking account into heterogeneity among farmers, we acknowledge several limitations. One limitation is that the data we used in this study was not obtained from a random assignment of the treatment. Although we adopt several specifications to assure the robustness of the estimations, we are not free from selection bias and cannot perfectly define the causal effects of MIS on the benefits of farmers. Second, we estimate heterogeneous effects across regions using data collected in only two zones. Moreover, because many regions in Ethiopia ban the sale of dried cherries to promote the sale of red cherries and the export of washed coffee (Minten et al., 2019), we do not take into account the farmer's strategy of storing crops to sell it next year.

Furthermore, it is beyond of our data scope to observe the effect of MIS on farmers' long-term decision-making to maximize their profits. Farmers may use the information from the MIS to decide the amount of inputs such as coffee farm size, the number of coffee trees, and fertilizers which may affect the performances of the next cropping year. If farmers use the MIS to obtain information on market trends, the MIS use may have a positive and significant effect on the users' profits in a longer-run. We therefore welcome a study that uses data obtained from a random assignment and from a longer time-span so that the findings presented in this study will further contribute to a better understanding of the effect of MIS on smallholder farmers' bargaining power and market participation.

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Table 1. Number of sample households and MIS users in each kebele

Zone	Woreda	Kebele	House holds	MIS Users			
				2012		2013	
			#	#	%	#	%
Jimma			245	50	20.41	50	20.41
	Gera	A	29	10	34.48	10	34.48
		B	19	2	10.53	2	10.53
		C	37	7	18.92	7	18.92
	Limu Seka	D	24	13	54.17	13	54.17
		E	23	1	4.35	1	4.35
		F	39	1	2.56	1	2.56
	Kersa	G	36	2	5.56	2	5.56
		H	26	7	26.92	7	26.92
		I	12	7	58.33	7	58.33
Sidama			221	88	39.82	91	41.18
	Dale	J	25	17	68.00	17	68.00
		K	34	28	82.35	30	88.24
		L	8	3	37.50	3	37.50
	Aleta Wendo	M	27	3	11.11	3	11.11
		N	27	18	66.67	18	66.67
		O	26	8	30.77	9	34.62
	Shebedino	P	29	4	13.79	4	13.79
		Q	23	5	21.74	5	21.74
		R	22	2	9.09	2	9.09
N			466	138	29.61	141	30.26

Notes: "MIS" is an abbreviation for market information system.
% of MIS users in each year = # of MIS users in each year / # of observations in each village

Source: Authors' survey (2014)

Table 2. Types of price information sources

(Multiple answers are allowed)

	Jimma (n=245)		Sidama (n=221)		Total (n=466)	
	#	%	#	%	#	%
From unofficial channels						
Family member	163	66.53	27	12.22	190	40.77
Friends and neighbors	226	92.24	109	49.32	335	71.89
Relative	187	76.33	15	6.79	202	43.35
From buyers						
Broker	24	9.80	2	0.90	26	5.58
Private trader	179	73.06	8	3.62	187	40.13
Collector	46	18.78	23	10.41	69	14.81
Exporter	38	15.51	1	0.45	39	8.37
From official channels						
Cooperative	21	8.57	193	87.33	214	45.92
Extension agent	25	10.20	5	2.26	30	6.44
MIS	50	20.41	91	41.18	141	30.26

Source: Authors' survey (2014)

Table 3. Types of MIS channels

(Multiple answers are allowed)

	Jimma (n=50)		Sidama (n=91)		Total (n=141)	
	#	%	#	%	#	%
Radio	49	98.00	91	100.00	140	99.29
SMS	9	18.00	14	15.38	23	16.31
TV	3	6.00	12	13.19	15	10.64
Electronic ticker	0	0.00	7	7.69	7	4.96
IVR	1	2.00	0	0.00	1	0.71
Newspaper	1	2.00	0	0.00	1	0.71
Website	0	0.00	0	0.00	0	0.00

Source: Authors' survey (2014)

Table 4. Socio-economic characteristics of respondents

Variables		Jimma MIS Mean	Jimma Non-MIS Mean	Jimma Dif.	Sidama MIS Mean	Sidama Non-MIS Mean	Sidama Dif.	Total MIS Mean	Total Non-MIS Mean	Total Dif.
HH's age	years	44.88	45.55	-0.67	47.31	46.72	0.58	46.45	46.02	0.43
		[12.81]	[11.53]	(1.87)	[9.18]	[11.21]	(1.43)	[10.63]	[11.40]	(1.13)
HH's gender	=1 male	0.98	0.97	0.01	0.98	1.00	-0.02*	0.98	0.98	-0.00
		[0.14]	[0.17]	(0.03)	[0.15]	[0.00]	(0.01)	[0.14]	[0.13]	(0.01)
HH's schooling	years	2.84	3.09	-0.25	5.38	4.78	0.61	4.48	3.77	0.72**
		[2.97]	[2.88]	(0.46)	[3.06]	[3.33]	(0.44)	[3.25]	[3.18]	(0.32)
Household size	#	5.68	5.96	-0.28	5.76	5.81	-0.05	5.73	5.90	-0.17
		[2.04]	[1.61]	(0.27)	[2.08]	[2.05]	(0.28)	[2.06]	[1.80]	(0.19)
Adults in the household	#	2.84	3.05	-0.21	4.29	4.13	0.15	3.77	3.48	0.29
		[1.18]	[1.22]	(0.19)	[2.11]	[2.17]	(0.29)	[1.96]	[1.74]	(0.18)
Total assets	birr	55373.72	31317.94	24055.78**	31276.02	31724.18	-448.16	39821.30	31480.44	8340.87*
		[76614.28]	[56204.60]	(9649.59)	[26948.34]	[28917.38]	(3844.10)	[51527.78]	[47164.09]	(4893.07)
MIS informants	#	0.48	0.02	0.46***	2.03	1.70	0.33*	1.48	0.69	0.79***
		[1.16]	[0.14]	(0.09)	[1.28]	[1.46]	(0.19)	[1.44]	[1.24]	(0.13)
N		50	195		91	130		141	325	

Notes: Standard deviations are in brackets. Standard errors are in parentheses. * p<0.05, ** p<0.01, *** p<0.001.
"HH" and "MIS" are abbreviations for the head of household and market information system, respectively.
Total assets = fixed assets + saving - loan

Table 5. Coffee production and sales performances of farmers

		Jimma			Sidama			Total		
Variables	Unit	MIS Mean	Non-MIS Mean	Dif.	MIS Mean	Non-MIS Mean	Dif.	MIS Mean	Non-MIS Mean	Dif.
Coffee farm size	Ha	0.83	0.94	-0.11	0.69	0.61	0.08	0.74	0.81	-0.07
		[0.57]	[0.63]	(0.10)	[0.39]	[0.36]	(0.05)	[0.46]	[0.56]	(0.05)
Harvest volume	kg	795.00	554.10	240.90***	1114.18	1011.15	103.02	1000.99	736.92	264.07***
		[470.37]	[404.12]	(66.31)	[544.83]	[665.58]	(84.58)	[540.14]	[569.61]	(56.56)
Sales volume	kg	725.00	434.74	290.26***	960.11	804.23	155.88**	876.74	582.54	294.20***
		[514.11]	[360.97]	(62.87)	[532.87]	[461.00]	(67.22)	[536.46]	[442.15]	(47.66)
Ratio of sales to production	%	86.81	74.72	12.09***	83.33	82.66	0.67	84.56	77.89	6.67***
		[17.43]	[18.11]	(2.85)	[12.49]	[17.72]	(2.16)	[14.47]	[18.35]	(1.74)
Sales price/kg	birr	10.39	12.80	-2.41***	14.71	13.10	1.61***	13.18	12.92	0.26
		[4.17]	[4.46]	(0.70)	[4.16]	[4.45]	(0.59)	[4.63]	[4.45]	(0.45)
Total coffee income	birr	6399.90	5307.80	1092.10	13848.90	10300.05	3548.85***	11207.41	7304.70	3902.71***
		[3639.65]	[4853.12]	(734.59)	[8071.70]	[6448.60]	(978.67)	[7701.29]	[6054.69]	(665.05)
Total coffee cost	birr	368.58	460.01	-91.43	2230.14	966.53	1263.61***	1570.01	662.62	907.40***
		[1476.41]	[1480.65]	(234.58)	[1979.71]	[2492.08]	(313.73)	[2020.20]	[1961.41]	(199.60)
Fertilizer	birr	22.58	41.44	-18.86	8.79	0.00	8.79***	13.68	24.86	-11.18
		[116.35]	[506.82]	(72.26)	[32.14]	[0.00]	(2.82)	[73.80]	[392.70]	(33.34)
Pesticide	birr	0.00	0.00	0.00	0.66	0.00	0.66	0.43	0.00	0.43
		[0.00]	[0.00]	(0.00)	[6.29]	[0.00]	(0.55)	[5.05]	[0.00]	(0.28)
Herbicide	birr	0.00	14.70	-14.70*	1.47	0.00	1.47**	0.95	8.82	-7.87**
		[0.00]	[56.59]	(8.01)	[8.25]	[0.00]	(0.72)	[6.65]	[44.38]	(3.76)
Labor	birr	346	403.87	-57.87	2219.22	966.53	1252.69***	1554.96	628.94	926.02***
		[1419.30]	[1393.43]	(221.72)	[1968.16]	[2492.08]	(313.18)	[2001.01]	[1926.53]	(196.57)
N		50	195	245	91	130	221	141	325	466

Notes: Standard deviations are in brackets. Standard errors are in parentheses. * p<0.05, ** p<0.01, *** p<0.001.
"MIS" is an abbreviation for market information system.
Total coffee income = sales volume × sales price/kg
Total coffee cost = fertilizer + pesticide + herbicide + labor

Table 6. Effects of of MIS on farmers' bargaining power and market participation

	ln(sales price/kg)		ln(sales volume)		Ratio of sales to production		ln(coffee farm income)	
	OLS	IPWRA	OLS	IPWRA	OLS	IPWRA	OLS	IPWRA
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
= 1 MIS user	0.002	0.01	0.08**	0.10***	2.17	3.44**	0.12***	0.16***
	(0.03)	(0.02)	(0.04)	(0.04)	(1.33)	(1.58)	(0.05)	(0.04)
= 1 info. from	-0.06	-0.10**	0.14*	0.09	1.12	-0.49	0.01	-0.12
unofficial channels	(0.04)	(0.05)	(0.07)	(0.08)	(2.15)	(2.12)	(0.09)	(0.08)
= 1 info. from	0.003	0.07	-0.03	-0.17	0.27	-6.00	-0.04	-0.23
buyers	(0.04)	(0.09)	(0.06)	(0.18)	(2.16)	(3.68)	(0.07)	(0.22)
= 1 info. from	-0.09**	-0.09*	0.19***	0.06	1.85	-4.21	0.17**	0.04
extension agents	(0.04)	(0.05)	(0.05)	(0.07)	(1.49)	(2.88)	(0.07)	(0.09)
= 1 info. from coop.	-0.0003	0.15**	-0.01	-0.10	-3.97**	-1.66	0.02	0.08
	(0.04)	(0.08)	(0.06)	(0.10)	(1.82)	(3.35)	(0.08)	(0.14)
# of MIS informants	-0.02*	-0.02	0.06**	0.04**	1.55**	-0.18	0.04	0.01
	(0.01)	(0.02)	(0.02)	(0.02)	(0.70)	(0.89)	(0.03)	(0.03)
Y_{t-1}	0.67***	0.63***	0.88***	0.93***	0.78***	0.79***	0.74***	0.75***
	(0.05)	(0.06)	(0.05)	(0.05)	(0.06)	(0.07)	(0.07)	(0.07)
HH's age	-0.01*	-0.02*	-0.002	0.01	-0.41	-0.29	-0.01	-0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.26)	(0.53)	(0.01)	(0.01)
HH's age^2	0.0001***	0.0002**	0.00002	-0.0001	0.003	0.003	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.003)	(0.005)	(0.0001)	(0.0001)
HH's schooling	0.01***	0.02**	-0.01*	0.003	-0.49***	-0.06	0.005	0.02
	(0.004)	(0.01)	(0.01)	(0.01)	(0.19)	(0.34)	(0.01)	(0.02)
Coffee farm size	-0.001	0.02	0.03	0.10	0.96	4.48	0.13	0.28***
	(0.03)	(0.03)	(0.06)	(0.07)	(1.65)	(3.55)	(0.08)	(0.08)
Jimma dummy	-0.03	-0.002	-0.07	0.19	-3.42	7.70*	-0.13	0.28
(=1 live in Jimma)	(0.06)	(0.13)	(0.07)	(0.19)	(2.40)	(4.63)	(0.10)	(0.21)
Constant	1.11***	1.36***	0.62*	0.09	29.96***	23.91	2.24***	1.99***
	(0.20)	(0.35)	(0.35)	(0.44)	(9.16)	(18.50)	(0.62)	(0.75)
Over. (Prob>F)		0.33		0.33		0.33		0.33
R^2	0.55		0.79		0.48		0.72	
N	466	466	466	466	466	466	466	466

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

Table 7. Educational heterogeneity of MIS's effects: OLS

	ln(sales price/kg)	ln(sales volume)	Ratio of sales to production	ln(coffee farm income)
	(i)	(ii)	(iii)	(iv)
= 1 MIS user	-0.01	0.08	2.05	0.12
	(0.04)	(0.06)	(2.24)	(0.08)
= 1 info. from unofficial channels	-0.06	0.14*	1.13	0.01
	(0.04)	(0.07)	(2.16)	(0.09)
= 1 info. from buyers	0.004	-0.03	0.27	-0.04
	(0.04)	(0.06)	(2.16)	(0.07)
= 1 info. from extension agents	-0.09**	0.19***	1.86	0.17**
	(0.04)	(0.05)	(1.53)	(0.07)
= 1 info. from coop.	-0.00004	-0.01	-3.97**	0.02
	(0.04)	(0.06)	(1.83)	(0.08)
# of MIS informants	-0.02*	0.06**	1.55**	0.04
	(0.01)	(0.03)	(0.71)	(0.03)
Y_{t-1}	0.67***	0.88***	0.78***	0.74***
	(0.05)	(0.05)	(0.06)	(0.07)
HH's age	-0.01*	-0.002	-0.41	-0.01
	(0.01)	(0.01)	(0.26)	(0.01)
HH's age^2	0.0001***	0.00002	0.003	0.0001
	(0.0001)	(0.0001)	(0.003)	(0.0001)
HH's schooling	0.01**	-0.01	-0.50**	0.005
	(0.01)	(0.01)	(0.24)	(0.01)
MIS × schooling	0.003	0.0001	0.03	0.0001
	(0.01)	(0.01)	(0.37)	(0.01)
Coffee farm size	-0.00	0.03	0.96	0.13
	(0.03)	(0.06)	(1.66)	(0.08)
Jimma dummy	-0.03	-0.07	-3.42	-0.13
(=1 live in Jimma)	(0.06)	(0.07)	(2.41)	(0.10)
Constant	1.11***	0.62*	29.99***	2.24***
	(0.20)	(0.35)	(9.16)	(0.62)
Joint. (Prob>F)	0.42	0.57	0.70	0.47
R^2	0.66	0.99	0.94	0.99
N	466	466	466	466

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

Table 8. Regional heterogeneity of MIS's effects: OLS

	ln(sales price/kg)	ln(sales volume)	Ratio of sales to production	ln(coffee farm income)
	(i)	(ii)	(iii)	(iv)
= 1 MIS user	0.02	-0.01	-0.40	0.01
	(0.04)	(0.05)	(1.38)	(0.06)
= 1 info. from unofficial channels	-0.06	0.16**	1.74	0.04
	(0.04)	(0.07)	(2.10)	(0.09)
= 1 info. from buyers	0.01	-0.04	-0.19	-0.06
	(0.04)	(0.06)	(2.16)	(0.07)
= 1 info. from extension agents	-0.08**	0.16***	1.03	0.13**
	(0.04)	(0.05)	(1.63)	(0.06)
= 1 info. from coop.	0.003	-0.01	-4.15**	0.01
	(0.04)	(0.06)	(1.79)	(0.08)
# of MIS informants	-0.02*	0.06**	1.61**	0.04
	(0.01)	(0.02)	(0.71)	(0.03)
Y_{t-1}	0.67***	0.87***	0.77***	0.75***
	(0.05)	(0.05)	(0.06)	(0.07)
HH's age	-0.01*	-0.0005	-0.38	-0.01
	(0.01)	(0.01)	(0.26)	(0.01)
HH's age^2	0.0001***	0.000004	0.003	0.0001
	(0.0001)	(0.0001)	(0.003)	(0.0001)
HH's schooling	0.01***	-0.01	-0.46**	0.01
	(0.004)	(0.01)	(0.19)	(0.01)
Coffee farm size	-0.003	0.04	1.21	0.14*
	(0.03)	(0.06)	(1.71)	(0.08)
Jimma dummy (=1 live in Jimma)	-0.02	-0.14*	-5.12**	-0.19*
	(0.06)	(0.08)	(2.55)	(0.10)
MIS × Jimma dummy	-0.04	0.22***	5.94**	0.24***
	(0.05)	(0.08)	(2.88)	(0.09)
Constant	1.12***	0.65	30.58***	2.20***
	(0.20)	(0.35)	(9.27)	(0.61)
Joint. (Prob>F)	0.38	0.004***	0.04**	0.007***
R^2	0.55	0.80	0.48	0.71
N	466	466	466	466

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

Table 9. The effects of MIS by region: OLS

	ln(sales price/kg)		ln(sales volume)		Ratio of sales to production		ln(coffee farm income)	
	Jimma	Sidama	Jimma	Sidama	Jimma	Sidama	Jimma	Sidama
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
= 1 MIS user	0.03	0.11***	0.22***	0.05	8.03***	0.07	0.29***	0.11
	(0.03)	(0.04)	(0.07)	(0.07)	(2.65)	(1.94)	(0.07)	(0.10)
= 1 info. from unofficial channels	0.002	-0.01	0.12	0.18*	-1.36	3.31	0.14	0.02
	(0.14)	(0.04)	(0.14)	(0.09)	(5.72)	(2.01)	(0.24)	(0.11)
= 1 info. from buyers	-0.04	0.06	-0.09	-0.10	0.20	-0.41	-0.11	-0.08
	(0.04)	(0.06)	(0.10)	(0.09)	(4.29)	(2.66)	(0.11)	(0.12)
= 1 info. from extension agents	-0.13***	0.14	0.17***	0.14	-0.36	4.88	0.10	0.27
	(0.03)	(0.17)	(0.05)	(0.15)	(2.06)	(4.66)	(0.06)	(0.27)
= 1 info. from coop.	-0.11*	0.03	-0.02	-0.12	-9.01***	-4.41	-0.02	-0.10
	(0.06)	(0.06)	(0.10)	(0.10)	(2.82)	(2.99)	(0.12)	(0.14)
# of MIS informants	-0.03	-0.05***	0.03	0.07**	-2.01	2.25***	-0.03	0.05
	(0.02)	(0.02)	(0.03)	(0.03)	(1.26)	(0.72)	(0.04)	(0.04)
Y_{t-1}	0.87***	0.42***	0.88***	0.85***	0.63***	0.90***	0.75***	0.74***
	(0.06)	(0.08)	(0.05)	(0.11)	(0.07)	(0.12)	(0.05)	(0.13)
HH's age	-0.02*	-0.0002	0.001	-0.003	-0.69*	0.02	-0.01	0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.42)	(0.29)	(0.01)	(0.01)
HH's age^2	0.0002**	0.00003	-0.00002	0.00003	0.01	-0.0003	0.0001	0.00003
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.004)	(0.002)	(0.0001)	(0.0001)
HH's schooling	0.02**	0.02**	-0.02**	0.003	-0.88***	-0.01	0.002	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.31)	(0.29)	(0.01)	(0.01)
Coffee farm size	-0.01	-0.04	0.07	-0.07	2.64	-2.70	0.16**	0.05
	(0.03)	(0.05)	(0.05)	(0.16)	(1.82)	(3.42)	(0.08)	(0.19)
Woreda dummies	Included	Included	Included	Included	Included	Included	Included	Included
Constant	0.78***	1.36***	0.57	0.77	51.12***	5.20	2.09***	1.81
	(0.27)	(0.35)	(0.38)	(0.65)	(12.90)	(9.98)	(0.48)	(1.20)
R^2	0.61	0.53	0.80	0.70	0.44	0.60	0.72	0.55
N	245	221	245	221	245	221	245	221

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

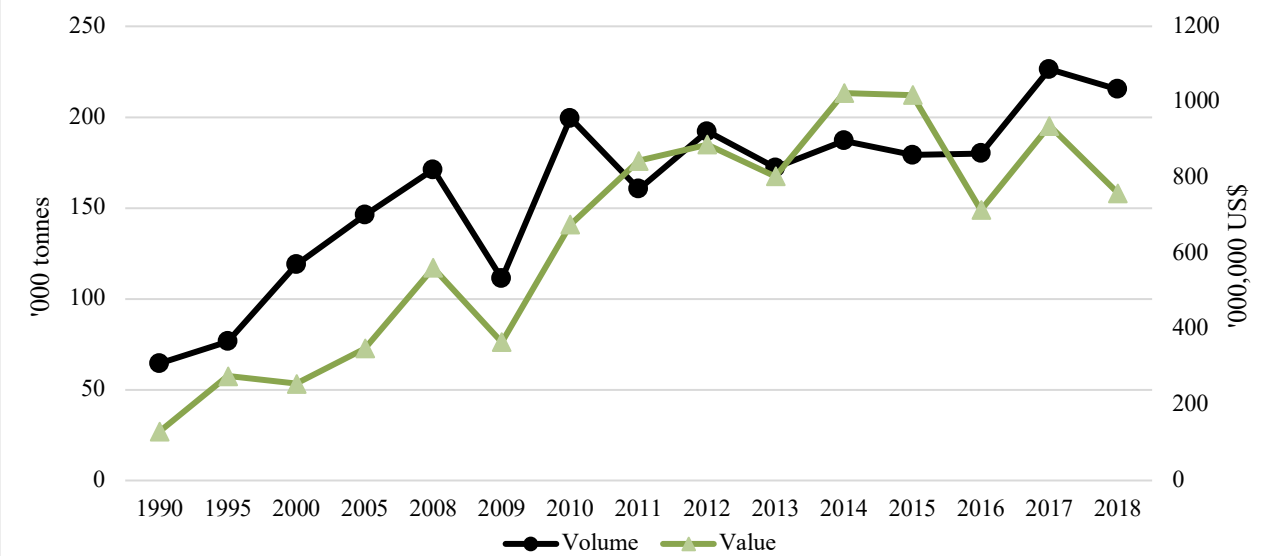
Table 10. The effects of MIS by region: IPWRA

	ln(sales price/kg)		ln(sales volume)		Ratio of sales to production		ln(coffee farm income)	
	Jimma	Sidama	Jimma	Sidama	Jimma	Sidama	Jimma	Sidama
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
= 1 MIS user	0.08*	0.10***	0.21***	0.03	8.20***	0.30	0.34***	0.10
	(0.04)	(0.04)	(0.07)	(0.07)	(2.73)	(1.71)	(0.08)	(0.08)
= 1 info. from unofficial channels	-0.23*	-0.08**	0.36	0.09	-6.39	2.03	0.12	-0.14
	(0.13)	(0.04)	(0.24)	(0.09)	(9.13)	(1.77)	(0.18)	(0.09)
= 1 info. from buyers	-0.37***	0.08	-0.33***	-0.18	4.40	-4.79*	-0.60***	-0.28
	(0.06)	(0.11)	(0.10)	(0.16)	(5.82)	(2.79)	(0.14)	(0.20)
= 1 info. from extension agents	-0.07	-0.06	0.06	-0.21**	-7.66*	-6.77*	0.10	-0.40**
	(0.05)	(0.08)	(0.08)	(0.10)	(4.43)	(3.85)	(0.10)	(0.20)
= 1 info. from coop.	0.17	0.06	-0.61**	0.11**	-9.80	4.19**	-0.37	0.22**
	(0.12)	(0.06)	(0.27)	(0.06)	(11.05)	(2.01)	(0.31)	(0.09)
# of MIS informants	-0.04	-0.05***	0.05	-0.0002	-2.49	0.01	-0.01	0.00
	(0.02)	(0.02)	(0.03)	(0.02)	(1.85)	(0.55)	(0.04)	(0.03)
Y_{t-1}	0.87***	0.40***	0.96***	0.93***	0.87***	0.87***	0.72***	0.71***
	(0.05)	(0.07)	(0.08)	(0.09)	(0.14)	(0.09)	(0.11)	(0.08)
HH's age	-0.02**	0.01	0.001	-0.02*	-0.39	-0.48*	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.65)	(0.26)	(0.01)	(0.02)
HH's age^2	0.0002*	-0.0001	-0.00002	0.0002*	0.003	0.01**	0.0001	0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.01)	(0.002)	(0.0001)	(0.0002)
HH's schooling	0.02	0.02**	-0.005	0.01	-1.24**	0.29	0.01	0.04**
	(0.01)	(0.01)	(0.02)	(0.01)	(0.57)	(0.29)	(0.02)	(0.02)
Coffee farm size	0.09***	0.07	0.12	0.16	1.19	6.84**	0.37***	0.53***
	(0.03)	(0.07)	(0.08)	(0.12)	(3.88)	(3.14)	(0.11)	(0.15)
Woreda dummies	Included	Included	Included	Included	Included	Included	Included	Included
Constant	1.47***	1.16**	0.20	0.77	37.76	10.97	2.99***	2.02**
	(0.34)	(0.49)	(0.34)	(0.51)	(26.73)	(10.15)	(0.67)	(0.90)
Over. (Prob>F)	0.24	0.82	0.24	0.82	0.24	0.82	0.24	0.82
N	245	221	245	221	245	221	245	221

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

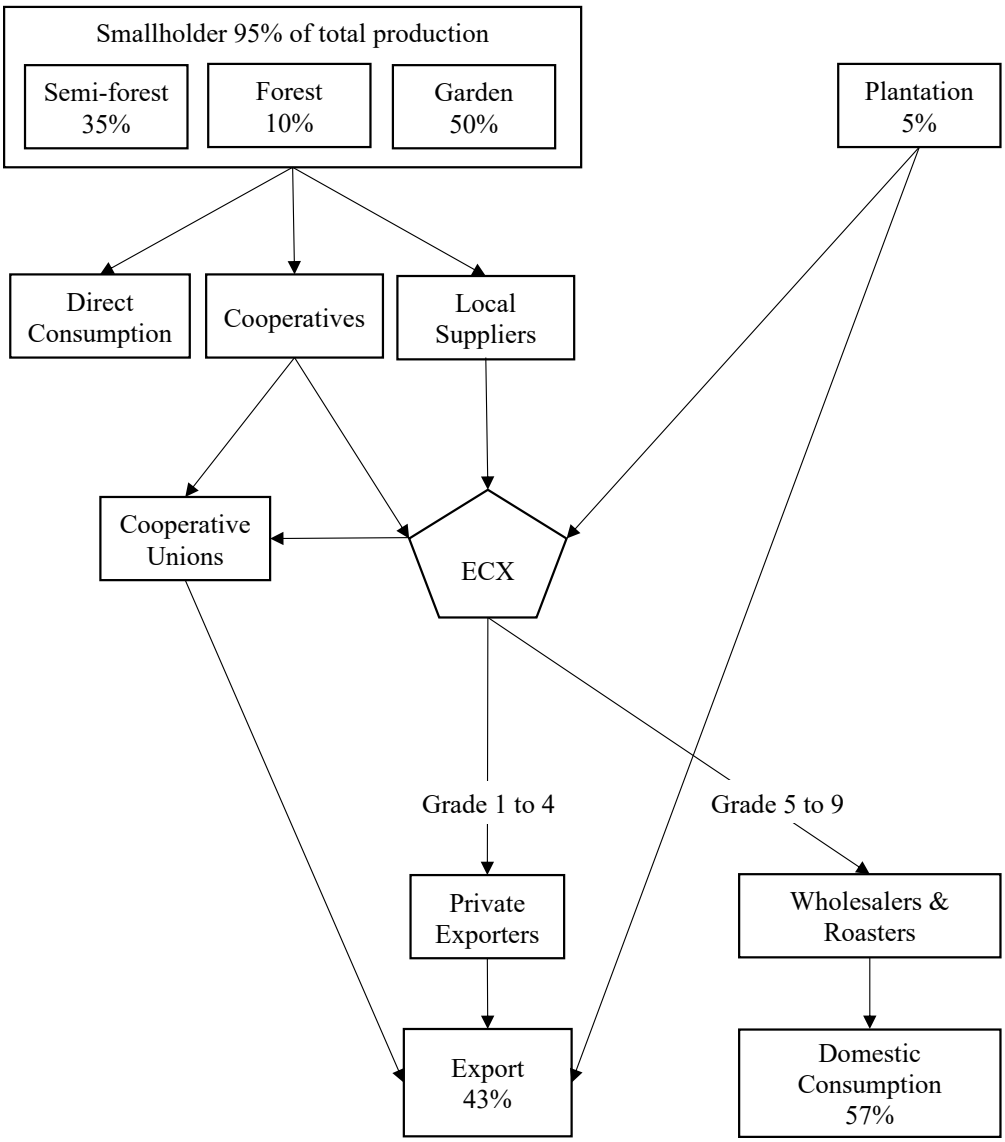
Table 11. Robustness check

	FE	RE	Pooled
	(i)	(ii)	(iii)
ln(sales price/kg)	0.01	0.03	0.03
	(0.05)	(0.03)	(0.03)
ln(sales volume)	0.16**	0.28***	0.29***
	(0.08)	(0.06)	(0.05)
Ratio of sales to production	2.31**	3.71***	3.76***
	(1.04)	(1.37)	(1.11)
ln(coffee farm income)	0.18***	0.30***	0.31***
	(0.05)	(0.06)	(0.05)
# of observations	932	932	932
# of groups	466	466	466



Source: FAO (2020)

Figure 1. Ethiopian Coffee Export Volume and Value



Source: Based on Tamirat (2013) and Duguma & Van deer Meer (2018)

Figure 2. Ethiopian Coffee Supply Chain after the Establishment of the ECX

Appendix 1. ECX's electronic tickers

Source: Authors' survey (2014)

Appendix 2. Covariate balance test: the full sample

	Standardized differences		Variance ratio	
	Raw	Weighted	Raw	Weighted
HH's age	0.04	-0.01	0.87	0.93
HH's schooling	0.22	-0.01	1.05	1.02
Adults in the household	0.16	-0.01	1.27	1.02
Coffee farm size	-0.13	-0.04	0.69	0.87
Total assets	0.26	0.02	0.98	1.01
Info. from traders	-0.38	0.01	1.01	1.00
Info. from extension agents	0.19	0.01	1.92	1.03
Village dummies	0.17	0.06	0.71	0.89

Appendix 3. Covariate balance test: Jimma

	Standardized differences		Variance ratio	
	Raw	Weighted	Raw	Weighted
Coffee farm size	-0.19	0.00	0.83	1.05
Total assets	0.37	0.01	1.58	1.22
Info. from unofficial channels	-0.05	0.03	1.31	0.87
Info. from traders	0.36	0.06	0.21	0.83
Info. from extension agents	0.49	0.01	2.98	1.03

Appendix 4. Covariate balance test: Sidama

	Standardized differences		Variance ratio	
	Raw	Weighted	Raw	Weighted
Coffee farm size	0.22	0.01	1.14	0.90
Total assets	0.07	0.01	0.70	0.75
Info. from unofficial channels	0.49	-0.01	0.92	1.00
Info. from traders	-0.19	0.04	0.66	1.08
Info. from extension agents	-0.01	0.00	0.96	0.99