THE RELATIONSHIP BETWEEN MARKET INFORMATION AND FARM-GATE PRICES RECEIVED BY SMALL-SCALE FARMERS IN THE MAGWAY REGION OF MYANMAR

By

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ABSTRACT

THE RELATIONSHIP BETWEEN MARKET INFORMATION AND FARM-GATE PRICES RECEIVED BY SMALL-SCALE FARMERS IN THE MAGWAY REGION OF MYANMAR

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This paper focuses on the relationship between market information and the level rice prices received by small-scale farmers in the Magway region of Myanmar. Using household-level data, we estimate this relationship based on a search cost model. The study extends previous literature by distinguishing between price information and other types of market information. The relationship between different information types and farm-gate prices received are estimated econometrically. We find a positive relationship between non-price information received from TV sources and the rice price received by farmers. However, other sources of information, including price information, show no statistically significant relationship with rice prices received by farmers. The results indicate there is a relationship between access to TV information and higher rice prices received, but we were not able to determine whether the information allows farmers to gain higher prices or farmers that get higher prices were able to access TV services better. (i.e., the direction of causality could not be determined).

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I. INTRODUCTION

Agriculture plays a vital economic role in most less developed countries and a large portion of agricultural output is produced by small-scale farmers. Indeed, over 60% of global agricultural output is being produced by small-scale farmers (Poole, 2017). Not only does small-scale agriculture contribute to economic output but it is also a major source of food consumption for developing countries, particularly in sub-Saharan Africa and Asia. Hence, small-scale agriculture is a vital source of income, sustenance, and a driving force for economic development in less developed countries.

Agriculture is a knowledge-intensive industry (Hall, 2011). Farming requires information on what inputs to use, how much of the inputs to apply, when and where to sell farm output, and so on. Above all, farmers make decisions for their farming activities based, at least in part, on the information they obtain. Hence, access to business and market information might have a close relationship with agricultural development.

Delivering useful information to small-scale farmers could promote agricultural and economic development as well as food security in less developed countries. Nevertheless, access to information is limited in many of these countries since a majority of the smallholders are illiterate, or not proficient in business transactions. Moreover, their lack of knowledge and information may sometimes be exploited by brokers and traders who are better informed about market conditions[1] (European Commission, 2012). In this situation, information asymmetry occurs as more informed agents bargain with less informed farmers (Magesa, Michael and Ko, 2014; Svensson and Yanagizawa, 2008).

[1] Small-scale farmers in developing countries are vulnerable in terms of bargaining for prices as they can hardly refuse price offered from their traders.

To narrow or eliminate the information gap between farmers and buyers, the Food and Agriculture Organization (FAO) and other organizations have been developing Market Information Systems (MIS) for many years. This movement was initiated at the time of market liberalization in many developing countries, especially those that had been undergoing structural transformation. It was believed that improved information would help farmers to plan their production based on market demand, make decisions on where and when to sell, and negotiate more equally with traders.

According to Elly and Silayo (2013), information might improve the bargaining position of farmers with traders, reduce transaction costs, and provide additional market opportunities for farmers and small traders, especially in those countries where markets are being liberalized. Eggleston, Jensen, and Zeckhauser (2002) stated that markets in developing countries, especially rural areas, are often inefficient because information flows sluggishly. As a result, farmers produce a different mixture of crops, or they use inefficient technologies, so consumers get products that do not meet their needs.

This paper investigates the relationship between access to information and the level of output prices received by smallholder farmers in developing countries. There has been previous research on this issue. For example, Salasya and Burger (2010) identified why there are large variations in the price offered at different market outlets for kale in Kenya, and used hedonic analysis to investigate what characteristics of kale influence the price. Results indicated that kale price variations were explained primarily by the location of production and distance to a local market. English (2008) examined the factors explaining farm gate prices received for cocoa among Liberian farmers using Ordinary Least Squares (OLS) regression. She found that the world price of cocoa, transport costs and distance, access to market information and resources were statistically

significant, while farmer characteristics were found to have little connection to the level of farmgate prices.

Svensson and Yanagizawa (2008) assessed the relationship between improved access to market information and farm-gate maize prices by comparing two regions with and without access to radio, as well as the districts affected and not affected by an MIS project in Uganda. They used the difference-in-difference approach. They found evidence that better-informed farmers managed to bargain for higher farm-gate prices for their products.

Lee and Bellemare (2013) focused on whether use of a mobile phone is connected to the level of onion prices received by farmers in the Philippines using two OLS regressions. First, they examined if mobile phone ownership at the household level is correlated with price levels. Second, they estimated the relationship between mobile phone ownership and prices after controlling for the intra-household distribution of mobile phones. It was observed that about 47% of the total households owned cell phones and the proportions of mobile phone ownership were 27.6% (farmer), 13.4% (spouse) and 11.2% (children) respectively. The results indicated that household ownership of a mobile phone does not correlate with onion price received. However, when the farmer or spouse owns a mobile phone, onion prices received are 5 to 8 per cent higher. This implies that the information obtained by mobile phones may not be shared within the household, especially when it comes to children's ownership of mobile phones.

Tadesse and Bahiigwa (2015) also investigated whether mobile phone use is associated with the level of barley and wheat prices received by farmers in rural Ethiopia. Results showed that mobile phone ownership generally has no statistically significant relationship with the price received. They mentioned three possibilities for the insignificant result: (1) farmers may not engage in spatial arbitrage; (2) farmers may not use their mobile phone for accessing market

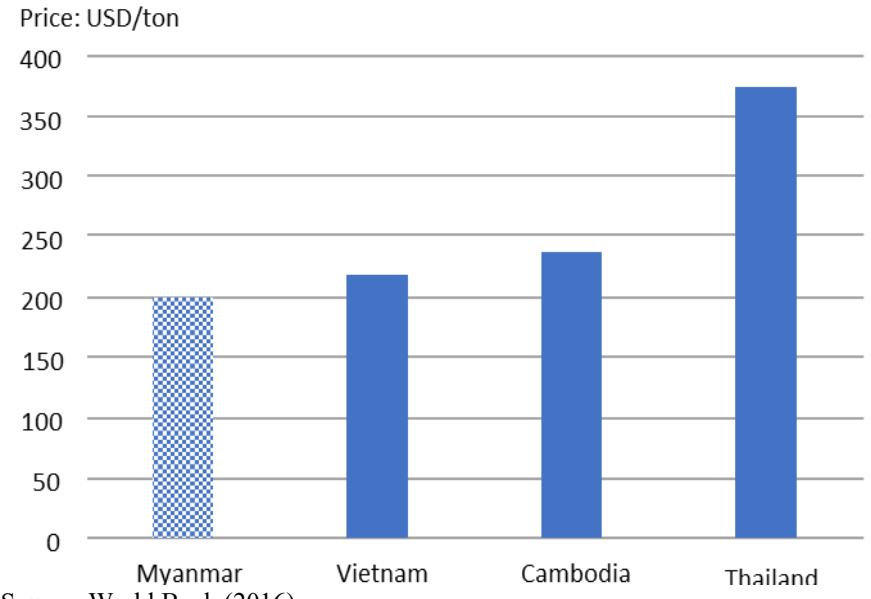
information; and/or (3) farmers may not obtain useful information through mobile phones.

Aker and Fafchamps (2010) also measured the impact of mobile phone coverage on millet and cowpea prices received by farmers in Niger, but using panel data. They used market pair fixed effects and found that price variation of cowpea has decreased by 6 percent with higher mobile phone coverage.

A common problem in much of the previous research (and the research reported in this paper) is distinguishing between correlation and causality (Singleton and Straits, 1999; Handy, Cao, and Mokhtarian, 2005). Although the current paper does not solve the causality issue, it does build on previous literature by studying multiple sources and types of market information in one study. Previous research has focused on one or at most two aggregate information types. Here we divide market information into price and other information but then each information type is further decomposed into its source (e.g. broker versus TV). This leads to a rich classification of information types that goes beyond most existing studies. Furthermore, we control for both household (farm) characteristics and product quality attributes in our analysis. While many previous studies have controlled for one or the other of these, we include both which may lead to more robust results.

In our empirical analysis we focus on the case of rice in Myanmar, which is one of the two lowest income countries in Asia and heavily dependent on agriculture. In Myanmar, rice is the most important agricultural product in terms of exports and domestic consumption and is produced primarily by smallholder farmers. As shown in Figure B.4, rice is produced in almost all regions in Myanmar with Ayeyarwady being the main rice-producing area.

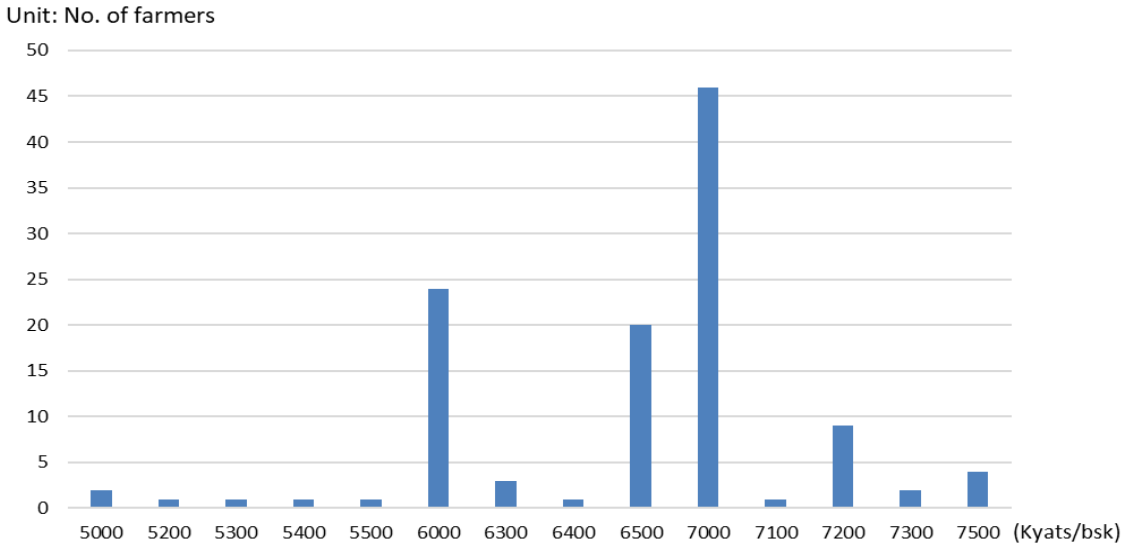
According to the World Bank (2016), Myanmar has the lowest farm-gate rice prices for monsoon rice among any of its neighbors (Figure 1). The large gap between Thai rice prices and most other countries is caused by Thailand's rice pledging scheme, a subsidy policy through which farmers sell rice to the government at a particular price, which is about 50% higher than the market price (Poapongsakorn and Pantakua, 2014). But Myanmar still has the lowest farm-gate prices in its area, which is typically explained by poor harvest quality, low volumes, high costs of milling, transport, and export, etc. (World Bank, 2016). As most rice farmers in Myanmar are small-scale farmers, marketable rice usually has high moisture content and many impurities, with multiple varieties used on a given farm. This makes it hard to get large volumes of uniform variety.



Source: World Bank (2016).

Figure 1. Comparison of the National Farm-Gate Monsoon Rice Prices (2013/14)

More importantly from the perspective of the current paper, there is also price variability across regions and across farms within regions in Myanmar. The World Bank (2016) indicated that the average monsoon rice price in Shan State was $340 per ton while the price in Ayeyarwady, which is the main rice-producing area, was $200 per ton. Farm-gate rice prices vary across the farmers within a region and even within a village. In a household survey conducted in Myothit Township of the Magway region, which is one of the rural areas in Myanmar, price variation from 5,000 Kyats/basket ($157/ton) to 7,500 Kyats/baskets ($236/ton)[2] is observed in monsoon rice farm data (Figure 2). The reasons for this farm-level price variation are not immediately clear. Spatial differences and transportation costs may explain some of the differences but the results in this paper show that there are many other factors at work also. It is important to know the sources of these price variations so that farmer actions and government policies can be recommended or designed to help lagging farms receive higher prices.



Note 1. Per basket = 20.68kg

2. 5000 Kyat = 3.25 USD as of the exchange rate on March 18, 2019.

Figure 2. Number of Farms by Price Variations of Monsoon Rice in the Household Survey

[2] In Myanmar, 1 basket equals to 20.68kg and Myanmar currency is calculated into USD as of the exchange rate on March 18, 2019. The number of cent digits was rounded.

The remainder of the paper is organized as follows. In the next section we give a brief explanation of the data used in this study. The third section outlines the empirical methods used to in the analysis. In the fourth section, we present the results and discuss the main findings of the paper. The last section states the major findings and policy implications.

II. DATA

A. The Study Area

This study is based on a rural household survey of small-scale rice farmers. The survey was carried out in in the Magway region[3] of Myanmar, in the central dry zone. The Magway region is located west of the capital city of Myanmar, Naypyidaw (Nay Pyi Taw) and consists of 25 townships within 5 districts. Among the townships, the survey was conducted in Myothit township, where a population of 157,544 (as of 2016) is located and most of the households are engaged in agriculture, mainly rice. Myanmar's new year begins in April and ends in March. The timing of rice cultivation depends on the location of the production area and whether irrigation facilities are used. In Myanmar, both monsoon rice, which is rain-fed, and summer rice, which uses irrigated water, are produced. In the survey area, most of the rice farmers are cultivating monsoon rice while only a few farmers grow summer rice. Thus, we focus on monsoon rice. In the Magway region, monsoon rice is cultivated from July to November, normally for 4 months, then summer rice is produced (USDA, 2018). After monsoon rice production, most farmers in this region plant peanut, corn, green gram, sunflower, sesame, etc.

Myothit township is located 37 miles away from Magway, the capital of Magway region where the area's major rice market is located. Brokers who obtain agricultural produce from farmers in Myothit township sell to the Magway market. In Myothit township, there are 47 village tracts and 169 villages. The annual temperature ranges from 56˚ F to 108˚ F and average annual rainfall is 812mm.

Most studies on rice production and marketing in Myanmar have focused on the

[3] Magway region is also called as Magwe.

Ayeyarwady region, which is the largest production area (Figure B.5). However, the current study investigates rice price variations in areas where rice production is less concentrated and price variation across households is likely to be higher.

B. Data and Data Collection

The survey was primarily conducted for a personal study on marketing activities of smallholder farmers in Myothit Township[4]. The survey contains household information, income, finance, production information, market participation, extension, market information, infrastructures and production constraints. It was collected by five enumerators from March to April in 2018. Among the 169 villages within Myothit Township, three villages (Ko Yan Taung, Pha Lan Tine, and Nyaung Kaing) were chosen for the survey. These three villages contain the most rice growers in Myothit Township. Summary data on the three villages is shown in Table 1. Among the three villages, Ko Yan Taung has the largest population and the most agricultural land. All three villages produce mainly rice but also cotton and sesame. Most marketed rice goes to Myothit Township market through various channels, including brokers and millers, and among the three villages Nyaung Kaing is closest to the Township market.

[4] This paper uses data collected and used for Kyaw, Ahn and Lee (2018). Thanks to them for kindly sharing their data.

	Unit	Ko Yan Taung	Pha Lan Tine	Nyaung Kaing
Total population	No. of people	977	769	364
Male	No. of people	478	380	184
Female	No. of people	499	389	180
Total agricultural land	Acre	2,740	446	1,271
Lowland	Acre	1,510	360	1,118
Upland	Acre	1,230	86	153
Paddy land	Acre	1,510	360	935
Agricultural crops		Paddy, Cotton, Sesame, Chickpea, Green gram	Paddy, Cotton, Sesame, Green gram, Chili, Tomato	Paddy, Cotton, Chickpea, Sesame, Groundnut
Area of village (farmer's house)	Square feet	2,526,480	3,136,320	114,022,656
Distance to township (market)	Kilometers	19.75	19.35	12.9

Source: provided by a government staff.

Table 1. Agricultural Overview of the Villages

One hundred and fifty small-scale farmers were randomly selected from the three villages and household interviews were conducted by five enumerators during March through April of 2018. In the sample, 46% of the farmers are from Ko Yan Taung village, 27% are from Pha Lan Tine, and 27% from Nyaung Kaing.

The survey questionnaires were mainly on rice production and sales after rice production in 2017.[5] Among the 150 households, 118 farmers were found to sell some of their rice and so could respond to the question about rice price received. Therefore we focus on the 118 farmers with price data. The household survey also contains household and farm characteristics, information on crop cultivation methods, availability of market, infrastructure, etc. Descriptive statistics on key survey questions are shown in Table 2. The average price received for monsoon rice sold during December 2017 to March 2018 varies from 5,000 kyats to 7,500 kyats per basket.[6,7] Farmer characteristics such as age, gender, education level, farming experience,

[5] As mentioned above, monsoon rice is cultivated during July to November, so the data are the average figures of December 2017 to March 2018.

[6] 5000 Kyat = 3.25 USD as of the exchange rate on March 18, 2019.

[7] 1 basket = 20.68 kg.

household size, and access to extension services could all potentially be related to the variation in prices received. Financial characteristics such as household income, landholdings, household consumption levels, and access credit may also be relevant factors.

Variable	Obs	Mean	Std. dev.	Min	Max	Explanation
Dependent variable						
Price	118	6,654.24	536.15	5,000	7,500	Average price of monsoon rice
lprice	118	8.80	0.08	8.52	8.92	Log (Price)
Explanatory variables						
Farmer Characteristics						
Age	118	51.82	10.39	25	74	Farmer's age in completed years
Gender	118	0.93	0.25	0	1	=1 if the farmer is male
Education	118	5.75	2.99	0	15	Farmer's education in completed years
Experience	118	28.38	10.73	5	55	Farming experience
HH_size	118	4.98	1.58	1	9	Number of individuals in the household
HH_income	118	4,793	5,611	294	54,100	Household income in 1,000 kyats
lincome	118	15.06	0.79	12.59	17.81	Log (HH_income)
Landhold	118	7.15	4.90	0	30	Household landholdings in acre
Consumption	118	90.37	56.44	0	300	Household consumption of rice
Credits	118	0.83	0.38	0	1	Access to credits
Extension	118	0.85	0.36	0	1	Access to extension services
Farm characteristics						
Cultivated	118	4.56	3.21	0	25	Cultivated area for monsoon rice
Variety_1	118	0.59	0.49	0	1	Ayeyarmin
Variety_2	118	0.25	0.44	0	1	Ayearpadathar
Variety_3	118	0.03	0.16	0	1	Manawhtikesa
Variety_4	118	0.03	0.16	0	1	Htikesa
Variety_5	118	0.01	0.09	0	1	Kayinma
Variety_6	118	0.01	0.09	0	1	Shwe Bo
Quality of rice						
Mill	118	0.08	0.27	0	1	Rice milled before selling
Store	118	0.42	0.50	0	1	Rice stored before selling
Plan	118	0.51	0.50	0	1	Plan to sell
Buyer						
Sell_consumer	118	0.02	0.13	0	1	Sold to consumer
Sell_broker	118	0.96	0.20	0	1	Sold to broker
Sell_miller	118	0.03	0.16	0	1	Sold to miller
Place of sale						
Place_farm	118	0.05	0.22	0	1	Sold at farm
Place_house	118	0.89	0.31	0	1	Sold at house
Place_town	118	0.02	0.13	0	1	Sold at town
Place_road	118	0.01	0.09	0	1	Sold at road
Place_other	118	0.02	0.13	0	1	Sold at other places

Table 2. Summary Statistics for Survey Questionnaire

Table 2 (cont'd)

Transport						
Road	118	0.91	0.29	0	1	Road condition
Village						
Village_1	118	0.47	0.50	0	1	Ko Yan Taun
Village_2	118	0.29	0.45	0	1	Pha Lan Tine
Village_3	118	0.25	0.43	0	1	Nyaung Kaing
Market information						
Info_price	118	0.93	0.25	0	1	Access to price information
Neighbor_price	118	0.29	0.45	0	1	Price information from neighbors
Broker_price	118	0.72	0.45	0	1	Price information from brokers
Miller_price	118	0.05	0.22	0	1	Price information from rice millers
DOA_price	118	0.01	0.09	0	1	Price information from governmental staff
Media_price	118	0.21	0.41	0	1	Price information from media
Info_nprice	118	0.81	0.40	0	1	Access to non-price information
Radio_nprice	118	0.15	0.36	0	1	Non-price information from radio
Mobile_nprice	118	0.22	0.42	0	1	Non-price information from mobile
TV_nprice	118	0.17	0.38	0	1	Non-price information from TV
Broker_nprice	118	0.53	0.50	0	1	Non-price information from broker

Most farmers in the sample are male and their mean age is around 52. The average years of education is about 6 indicating that most farmers are at an elementary school level. Their average years of farming experience is 28 and the mean household size is 5 members. Household income varies from 294,000 kyats to 54.1 million kyats[8] and the area of landholdings ranges from zero to 30 acres. The average household consumption of rice is around 90 baskets[9] per household and most farmers are using extension and loan services.

The mean cultivated area is 4.56 acres. Among the six rice varieties, Ayeyarmin and Ayearpadathar are the most cultivated and about 60% of farmers grew Ayeyarmin. The rice price may be influenced by quality, so it is important to account for whether the rice was milled or stored and sold later. The data show that most rice sold is not milled and, on average, 42% of production is stored for at least some time and 51% is planned for sale versus own consumption. Market-

[8] USD 177,870 to USD 32.7 million as of the exchange rate on March 18, 2019.
[9] 1 basket = 20.68 kg, 90 baskets = 1.86 tons

related variables such as the type of buyer, place of sale, and transport method are also potentially relevant. In this region, there are three types of buyers (consumers, brokers, and millers). Brokers (or middlemen) are small, village-based rice traders who own a small store or resell rice to a bigger market. Some farmers directly sell their rice to consumers, or to rice millers (processors) who polish and pack rice.

Among different buyer types, brokers are overwhelmingly the most common outlet (77% of respondents sell their rice to brokers). Other respondents sell to millers (2%) and directly to consumers (1%).

For place of sale, the farmer's house occurs 72% of the time, followed by farm, road, town and other places. In addition, most of the respondents indicated that road conditions in the area are good.

In this study our main interest is in the role of market information and we classify information as price and non-price. Price information relates to prices available in the market place. Non-price information includes who and where the buyers are, how they can be contacted, what their preferences for varieties, etc. Statistics show that about 93% of the farmers have access to price information. However, farmers obtain price information through different channels. The most frequent source of price information is brokers with 72% of the farmers obtaining price information this way. Some farmers (30% of the sample) indicated they get price information from multiple sources. Most farmers (98%) received some non-price information but the source varies. About 50% of farmers get information from brokers. The next most frequent source was mobile phone (22%) followed by TV (17%) and Radio (15%).

One possible problem in this study is that there can be measurement errors in our information variables. Measurement error is the difference between the value of characteristics

provided by respondent and the true values. A household survey is generally considered to have true values, assuming that the measured characteristics are accurately reported and obtained through appropriate procedures (Kasprzyk, 2005). However, there can be measurement errors in a household survey caused by questionnaire, data-collection method, interviewer, and respondent (Biemer et al., 2011). In particular, as the respondents have different experiences, knowledge and attitudes, it is possible that they interpret the meaning of questionnaire items differently. This is a problem faced by all primary data collection efforts.

III. EMPIRICAL METHODS

In this section, we develop a model of factors related to cross-sectional variation in farm-gate rice prices for smallholder farmers in developing countries. We use a search cost model. Search cost models are usually based in the notion of a consumer identifying a firm's product and prices or collecting information about alternative suppliers (Baye, Morgan and Scholten, 2006; Wilson, 2012). From a farmer's point of view, search costs can be defined as the cost of visiting or contacting different markets to collect information to determine where to sell his produce. Based on the information received and search costs, farmers would choose the market where they can maximize their profit. If search costs are too high, farmers would sell agricultural produce at low prices to any market instead of investigating alternative markets (Nakasone, Torero, and Minten, 2014).

For the farmer, search cost is travel, time, and other costs of collecting market information. Traditionally, farmers have gained market information from many sources including individual visits, radio, TV, etc. In more recent times, some researchers argue that farmers' search costs have been reduced with the introduction of modern Information Communication Technologies (ICTs) in the developing world. For instance, by using a mobile phone, a farmer could search for the price of his/her crops so there is no need to visit markets. Jensen (2007) applies the search cost model to estimate the relationship between information technologies and market performance and economic welfare of producers in the Indian fisheries sector. His experimental study is focused on how the introduction of mobile phones interacts with price dispersion, waste and economics welfare. Tadesse and Bahiigwa (2015) estimate the effect of mobile phone ownership on crop prices received by farmers using the search cost model. Aker and Fafchamps (2010) and Lee and Bellemare (2013) also apply the search cost framework to model to farmers searching information

through mobile phone use instead of visiting individual markets.

The basic search cost model for our application can be represented as:

$$lnP_i = \alpha + \boldsymbol{X_i}\boldsymbol{\beta} + \varepsilon_i \quad (1)$$

where lnP_i is the natural logarithm of the price of monsoon rice received by farmer i; $\boldsymbol{X_i}$ is a vector of search cost and other variables that affect the price received; $\boldsymbol{\beta}$ is the associated parameter vector; and ε_i is an error term assumed independently and identically distributed with zero mean. We define the variable vector $\boldsymbol{X_i}$ in more detail as:

$$lnP_i = \alpha + \theta\, MI_i + \boldsymbol{\gamma h_i} + \boldsymbol{\delta m_i} + \varepsilon_i \quad (2)$$

where MI_i is a dummy variable for access to market information (=1 if farmer i received market information; =0 otherwise); $\boldsymbol{h_i}$ is a vector of household and farm characteristics with associated parameter vector $\boldsymbol{\gamma}$; and $\boldsymbol{m_i}$ is a vector of market-related variables with associated parameter vector $\boldsymbol{\delta}$. To investigate the relationship between market information and the farm-gate prices in more detail, we divide market information into two types: price and non-price. We include separate dummy variables for each information type and source. We also investigate different information variable specifications to examine the robustness of results to including different information types and sources.

There are some potential problems with the estimation approach. First, the explanatory variables might have multicollinearity problems since household-related variables can be correlated with farm and market-related variables. For example, a highly educated farmer may choose a high quality rice variety. According to Dohoo et al. (1997), multicollinearity can be evaluated by computing a correlation matrix and Variation Inflation Factors (VIFs). They noted that when a correlation coefficient is 0.9 or higher multicollinearity may be a concern. We also like to see VIF values below 10. We computed the correlation matrix and VIFs for our explanatory

variables and results are shown in Tables A.1. and Table A.2. Hence, multicollinearity does not appear to be a problem in this study.

Another concern is potential endogeneity of explanatory variables. Better information may lead to higher prices but farmers with higher prices may have more resources to collect better market information. There also may be household unobservable factors that are related to both prices and access to information. If those who would benefit from better information are the ones who look for this type of information then estimates of information effects may be biased upward. Furthermore, there are unobservable factors (such as entrepreneurship, innate ability, technology, etc.) which can also influence price farmers receive. This may also bias the information effect on prices. The final endogeneity concern is spillover effects. Among 118 farmers who sell their rice, about 93% and 81% get price and non-price information respectively. Moreover, 85% of the farmers are engaged in agricultural extension programs. These figures imply that there might be potential spillover effects hat bias causal effects. According to Aker (2010), traditional agricultural extension programs generally have spillover effects within villages. Likewise, farmers with information may play important roles delivering information to other farmers within the village. She argued that potential spillover effects are much greater if ICT is being used.

Endogeneity problems are a concern for this study but data limitations preclude comprehensive identification of causal effects. However, we do investigate potential directions and magnitudes of endogeneity bias in estimated coefficients and caution the reader not to make direct causal interpretations for estimated coefficients on information variables.

IV. RESULTS

Table 3 is a summary that shows only the main results of interest. We would expect that access to price information should be positively correlated with rice prices received. However, the result (column 1) indicates no statistically significant relationship. Similarly, results (column 2) show no statistically significant relationship between non-price information and rice price levels. There are three possible explanations. First, it could be that alternative markets are very competitive and access to market information does not change the price received by farmers. Second, since almost all the farmers have received price information, it could be that it is just difficult to identify a price information effect with this data set. Third, it could be that each of the individual models (columns 1 and 2) are misspecified.

To investigate the third explanation, we estimated a model that includes both price and non-price information variables (column 3). For this model we find that access to non-price information is positively correlated with rice price received by farmers. To investigate this further we estimated models that differentiate non-price information by source and find that TV is the key information delivery source that is positively correlated with higher rice prices (columns 4 and 5). Results show that farmers with non-price information experience rice prices 2.7% higher on average than other farmers (column 3), and when the source of non-price information is TV[10] those farmers experience prices 5.0% higher on average (column 4). The comprehensive model which includes all information variables and their sources (column 5) indicate that farmers getting non-price information from TV receive 5.3% higher rice prices on average.

[10] According to our sample, 66.1% of the farmers own at least one TV.

Variable	(1)	(2)	(3)	(4)	(5)
Dependent variable: log of monsoon rice price					
Market information					
Access to price information	-0.020 (0.031)	-	-	-	-
From neighbor	-	0.004 (0.015)	-	-	-0.003 (0.015)
From broker	-	0.024 (0.018)	-	-	0.010 (0.018)
From rice miller	-	0.003 (0.026)	-	-	-0.013 (0.026)
From DOA (governmental staff)	-	0.026 (0.030)	-	-	0.056 (0.037)
From media	-	-0.010 (0.014)	-	-	-0.019 (0.016)
Access to non-price information	-	-	0.027* (0.016)	-	-
From radio	-	-	-	-0.013 (0.016)	-0.006 (0.017)
From mobile phone	-	-	-	0.003 (0.015)	0.003 (0.017)
From TV	-	-	-	0.050*** (0.013)	0.053*** (0.015)
From broker	-	-	-	0.016 (0.013)	0.015 (0.014)
Farmer characteristics					
Farmer age	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Farmer gender (male)	-0.023 (0.017)	-0.023 (0.021)	-0.028 (0.019)	-0.030 (0.021)	-0.029 (0.023)
Farmer education	0.004* (0.002)	0.004** (0.002)	0.004* (0.002)	0.004* (0.002)	0.004* (0.002)
Farming experience	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Household size	-0.002 (0.005)	-0.002 (0.005)	-0.001 (0.004)	-0.001 (0.004)	-0.002 (0.004)
Household landholdings	-0.001 (0.003)	-0.001 (0.003)	-0.002 (0.003)	-0.002 (0.003)	-0.002 (0.003)
Household consumption of rice	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Access to credits	0.008 (0.015)	0.005 (0.016)	0.009 (0.015)	0.001 (0.016)	0.001 (0.016)
Access to extension	0.016 (0.017)	0.012 (0.019)	0.005 (0.016)	0.007 (0.018)	0.008 (0.019)
Transport					
Road condition (good)	-0.046** (0.020)	-0.046** (0.019)	-0.042** (0.018)	-0.044*** (0.016)	-0.052*** (0.019)

Note 1. *, ** and *** indicate significance levels at 0.1, 0.05, and 0.01 respectively.

2. (1) the relationship between access to price information and monsoon rice price
   (2) the relationship between the sources of price information and monsoon rice price
   (3) the relationship between access to non-price information and monsoon rice price
   (4) the relationship between the source of non-price information and monsoon rice price
   (5) the relationship between all sources of both information and monsoon rice price
   (6) the relationship between all sources of both information and monsoon rice price (farmers with both information only)

Table 3. OLS Estimation Results for the Determinants of Monsoon Prices

Table 3 (cont'd)

Farm characteristics					
Household rice cultivated area	0.003	0.004	0.004	0.004	0.004
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Rice variety 1: Ayeyarmin	0.043*	0.029	0.043	0.053**	0.045
	(0.025)	(0.029)	(0.025)	(0.025)	(0.027)
Rice variety 2: Ayearpadaethar	0.040*	0.023	0.044**	0.041**	0.033
	(0.020)	(0.022)	(0.019)	(0.019)	(0.021)
Rice variety 3: Manawhtikesa	-0.158***	-0.166***	-0.157***	-0.165***	-0.174***
	(0.028)	(0.029)	(0.029)	(0.026)	(0.028)
Rice variety 4: Htikesa	-0.069	-0.072	-0.076	-0.084**	-0.084**
	(0.046)	(0.045)	(0.047)	(0.040)	(0.038)
Rice variety 6: Shwe Bo	0.022	-0.009	0.009	0.001	-0.010
	(0.032)	(0.034)	(0.026)	(0.029)	(0.035)
Quality of rice					
Mill	-0.002	0.007	-0.000	0.003	0.012
	(0.021)	(0.024)	(0.024)	(0.022)	(0.026)
Store	-0.019	-0.015	-0.014	-0.010	-0.011
	(0.017)	(0.019)	(0.015)	(0.015)	(0.016)
Plan	0.028	0.023	0.024	0.021	0.022
	(0.017)	(0.019)	(0.016)	(0.016)	(0.017)
Buyer					
Sell_consumer	0	0	0	0	0
	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Sell_broker	-0.072***	-0.069***	-0.065***	-0.065***	-0.064**
	(0.019)	(0.021)	(0.020)	(0.022)	(0.024)
Sell_rice miller	-0.047	-0.050	-0.047	-0.046	-0.050
	(0.035)	(0.038)	(0.035)	(0.033)	(0.037)
Place of sale					
Place_farm	-0.032	-0.013	-0.042	-0.037	-0.025
	(0.033)	(0.038)	(0.036)	(0.030)	(0.032)
Place_house	-0.007	-0.003	-0.011	-0.016	-0.015
	(0.032)	(0.033)	(0.034)	(0.027)	(0.027)
Place_town	-0.075	-0.077	-0.084	-0.072	-0.073
	(0.062)	(0.069)	(0.064)	(0.053)	(0.065)
Place_road	-0.058	-0.067	-0.062	-0.094*	-0.102*
	(0 .049)	(0.053)	(0.050)	(0.052)	(0.055)
Place_other	0.028	0.046	0.048	0.041	0.047
	(0.102)	(0.095)	(0.102)	(0.103)	(0.096)
Village					
Village 1: Ko Yan Taung	0	0	0	0	0
	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Village 2: Pha Lan Tine	0.069***	0.065***	0.063***	0.061***	0.062***
	(0.019)	(0.021)	(0.020)	(0.021)	(0.023)
Village 3: Nyaung Kaing	-0.046*	-0.039	-0.049*	-0.034	-0.035
	(0.026)	(0.027)	(0.027)	(0.028)	(0.028)
Constant	8.829	8.809	8.804	8.820	8.827
	(0.062)	(0.059)	(0.056)	(0.055)	(0.055)
Observations	118	118	118	118	118
R-squared	0.661	0.673	0.671	0.703	0.715

Note 1. *, ** and *** indicate significance levels at 0.1, 0.05, and 0.01 respectively.

2. (1) the relationship between access to price information and monsoon rice price
(2) the relationship between the sources of price information and monsoon rice price
(3) the relationship between access to non-price information and monsoon rice price
(4) the relationship between the source of non-price information and monsoon rice price
(5) the relationship between all sources of both information and monsoon rice price
(6) the relationship between all sources of both information and monsoon rice price (farmers with both information only)

TV can be a good source of information about agricultural production and often provides opinions or recommendations to farmers by quoting experts. Farmers can prepare for production and market sales based on the information obtained through TV programs. TV is better at delivering visual effects than other mediums. The ages of farmers who got information from the TV were between 41 and 66, and their average education level was about 7 years. According to Rahman, Lalon and Surya (2016), farmers prefer television as a source of information because of the "highly motivational and informative program telecast", "expert's opinion available with authenticity," and "latest and needed information available."

With the rapid development of ICT around the world, the number of mobile phone users has also increased in Myanmar. In 2017, the mobile phone usage rate in Myanmar was 110.43% of the population, which is an increase of 22% over 2016 (Mizzima, 2018). The internet usage rate has also skyrocketed since 2013. In the survey data used here 91.5% of households have at least one mobile phone. The data even suggests that households are more likely to have mobile phones than a TV. However, our results do not find a significant relationship between mobile phones as a source of market information and rice prices received. This result is consistent with some other research (Fafchamps and Minten, 2012; Lee and Bellemare, 2013).

Another possible outcome was that access to information from broker might have a connection with the prices since 96% are selling their rice to broker, getting price (72%) and non-price information (53%) from them but it was found that there was no relationship between them. About 35.6% of the farmers were counted as they obtained price and non-price information from brokers and sold rice to brokers. On the other hand, only 1.7% of the respondents received both information from the broker but did not sell it to the broker.

Among household characteristics, farmer education level was found to have a positive and

statistically significant relationship with rice prices received by farmers. More educated farmers may have more ability to negotiate based on their knowledge and training.

Among farm characteristics, some rice varieties received higher prices on average than others. Results suggest higher prices for Ayeyarmin (column 1 and 4), Ayearpadaethar (column 1, 3 and 4), and Shwe Bo (columns 1, 2 and 3). These results are generally consistent with price premiums for quality and uniformity. Higher prices for Shwe Bo appear counter intuitive but there is only one farmer who grew the variety in our survey data so this result is spurious. Ayeyarmin and Ayearpadaethar are high quality and more commonly planted.

Results for market-related variables indicate negative relationships between using brokers as a buyer and the level of farm-gate prices in all models. In addition, we found that as place of sale, road has a negative relationship with price in some models. This may be explained by the fact that farmers who sell their rice at the road may find it difficult to bargain for higher prices.

Village dummies are statistically significant showing that Nyaung Kaing is associated with lower farm prices for rice. As shown in Table 1, Pha Lan Tine has the highest proportion of rice cultivation. A large proportion of rice farmers may reduce farmer bargaining power.

Finally, results indicate that having a road in good condition is associated with lower farmer rice prices. This seems to be the result of selection bias since 91% of the farmers responded they have roads in good condition.

V. CONCLUSIONS

Agricultural output price dispersion in underdeveloped countries has always been a development challenge in smallholder agriculture. Considerable previous research has found a close relationship between output prices received by farmers and market information (Svensson and Yanagizawa, 2008; Salasya and Burger, 2010; Mather, Boughton and Jayne, 2011; Tadesse and Bahiigwa, 2015). In this paper, we extend this literature by differentiating market information into price and non-price types, and also focus on the sources of each information type. We apply our model to survey data on smallholder rice farmers in the Magway region of Myanmar.

Our main focus was the relationship between information variables and the level of rice prices received by farmers. We found that non-price information from TV was the only statistically significant information variable related to farm-gate rice prices. No source of price information was found to be statistically significantly related to rice prices received, although there is some evidence that selling to brokers is associated with a lower average rice price.

Mobile phone and TV use are widespread, even in rural Myanmar. In our survey data, 91.5% of households owned mobile phones and 66.1% owned a TV. Despite the prevalence of mobile phones, our empirical results suggest that farmers who received market information via mobile phone do not receive higher prices on average. However, we found that non-price information obtained via TV had a statistically significant positive relationship with rice prices received by farmers. This suggests that TV programming may be a good medium for delivering agricultural information to smallholders in rural areas.

We also found that farmers who sell to brokers received lower rice prices on average, suggesting that brokers may have an advantage in price negotiations with farmers.

Our empirical results have some limitations. The sample is relatively small with some

variables experiencing little variation across respondents. Also, the data is from a specific region of rural Myanmar so the external validity of the results is low. We are also unable to identify causal effects. These limitations need to be addressed in future research.

APPENDICES

APPENDIX A. TABLES

		Price information					Non-price information				Age	Gender	Education	Experience
		Neighbor	Broker	Miller	DOA	Media	Radio	Mobile	TV	Broker				
Price info	Neighbor	1.000												
	Broker	-0.479	1.000											
	Miller	0.023	0.144	1.000										
	DOA	-0.059	0.058	0.399	1.000									
	Media	-0.009	-0.139	-0.026	-0.048	1.000								
Non-price info	Radio	0.094	-0.156	0.009	-0.039	0.299	1.000							
	Mobile	-0.022	0.058	-0.030	0.174	0.225	0.002	1.000						
	TV	0.062	0.181	0.101	-0.042	0.208	0.123	0.141	1.000					
	Broker	0.118	-0.025	-0.012	-0.097	-0.089	-0.022	-0.191	-0.068	1.000				
Age		0.031	0.050	0.034	0.002	-0.039	-0.011	-0.011	-0.014	0.089	1.000			
Gender		0.097	-0.018	0.062	0.025	-0.025	0.114	-0.182	0.122	0.149	0.064	1.000		
Education		0.053	-0.089	-0.085	0.039	0.133	-0.084	0.195	0.121	-0.084	-0.210	0.080	1.000	
Experience		0.026	0.021	-0.044	0.083	-0.063	-0.022	0.067	0.007	0.112	0.743	0.079	-0.151	1.000
HH size		-0.172	0.161	-0.022	0.001	-0.087	-0.040	0.084	0.091	-0.032	0.091	0.040	-0.037	0.136
Landhold		0.139	-0.182	-0.027	0.016	0.065	-0.041	0.162	0.111	-0.025	-0.002	0.064	0.402	0.061
Cultivated land		0.114	-0.121	0.050	0.100	0.039	-0.089	0.089	0.147	-0.049	-0.039	0.079	0.404	0.052
Variety1		-0.159	0.214	0.113	0.077	0.007	-0.033	0.232	0.052	-0.372	0.053	-0.086	0.111	0.043
Variety2		0.058	0.017	-0.047	-0.054	-0.065	-0.085	-0.217	-0.108	0.204	-0.099	0.080	-0.056	-0.152
Variety3		0.016	-0.019	-0.037	-0.015	-0.084	-0.069	-0.086	-0.073	0.154	-0.044	0.044	-0.240	-0.046
Variety4		-0.103	-0.019	-0.037	-0.015	0.180	0.231	0.044	0.071	0.046	0.133	0.044	-0.113	0.075
Variety5		-0.059	0.058	-0.021	-0.009	-0.048	-0.039	-0.049	-0.042	0.088	-0.034	0.025	-0.117	0.031
Variety6		-0.059	0.058	-0.021	-0.009	0.178	-0.039	-0.049	0.205	-0.097	0.091	0.025	0.070	0.075
Consumption		0.077	0.008	-0.067	0.016	-0.061	-0.099	-0.029	0.152	0.045	0.110	-0.022	0.235	0.225
Credits		0.038	0.021	0.105	0.042	0.013	0.003	0.131	0.144	-0.113	-0.058	0.148	0.092	0.020
Extension		-0.094	0.261	0.098	0.039	0.047	-0.082	0.226	0.129	-0.073	0.029	0.073	0.115	0.101
Village1		-0.069	0.090	0.093	0.099	-0.027	-0.066	0.200	0.076	-0.439	0.031	-0.086	0.185	0.056
Village2		0.008	0.146	0.023	-0.059	0.037	-0.010	-0.022	0.012	0.267	-0.110	0.023	-0.017	-0.063
Village3		0.072	-0.258	-0.132	-0.053	-0.007	0.086	-0.209	-0.101	0.227	0.080	0.076	-0.197	0.002
Sell_consumer		-0.084	0.082	-0.030	-0.012	0.093	0.127	0.089	0.116	0.125	0.047	0.035	-0.055	0.057
Sell_broker		0.134	-0.131	0.049	0.019	-0.097	-0.145	-0.091	-0.129	0.053	0.110	-0.057	-0.032	0.074
Sell_miller		-0.103	0.101	-0.037	-0.015	0.048	0.081	0.044	0.071	-0.170	-0.179	0.044	0.086	-0.142
Place_farm		0.194	-0.200	0.122	-0.021	-0.026	0.009	-0.030	-0.002	0.143	-0.097	-0.091	-0.046	-0.034
Place_house		-0.015	0.082	-0.288	0.033	-0.083	-0.152	0.056	0.015	-0.009	0.057	0.013	0.135	0.111
Place_town		-0.084	0.082	0.269	-0.012	0.093	0.127	-0.070	-0.059	-0.007	-0.125	0.035	-0.011	-0.103
Place_road		-0.059	0.058	-0.021	-0.009	0.178	0.218	0.174	0.205	0.088	-0.052	0.025	0.039	-0.021
Place_other		-0.084	-0.065	-0.030	-0.012	0.093	-0.056	-0.070	-0.059	-0.138	0.098	0.035	-0.099	-0.042
Mill		-0.112	-0.034	0.079	-0.027	0.242	0.056	0.078	-0.045	0.017	-0.245	-0.050	0.088	-0.157
Store		-0.015	-0.039	-0.120	-0.079	0.143	0.066	0.041	-0.067	0.025	-0.048	-0.042	0.249	0.079
Plan		-0.086	0.105	-0.081	-0.094	0.136	0.040	-0.009	-0.008	0.118	-0.050	0.005	0.277	0.076
Road		-0.054	-0.005	-0.059	0.030	-0.262	-0.107	0.100	0.067	-0.071	0.011	0.030	0.111	-0.005

Note 1. Variety 1-6 are the rice varieties; Ayeyarmin, Ayearpadaethar, Manawhtikesa, Htikesa, Kayinma, Shwe Bo in the order.
2. The village names are Ko Yan Taung, Pha Lan Tine, Nyaung Kaing in the order.

Table A.1. Correlation Matrix of Independent Variables

Table A.1 (cont'd)

	HH size	Landhold	Cultivated land	Variety1	Variety2	Variety3	Variety4	Variety5	Variety6	Consump-tion	Credits	Exten-sion	Village1	Village2	Village3
HH size	1.000														
Landhold	0.252	1.000													
Cultivated land	0.173	0.790	1.000												
Variety1	0.200	0.195	0.183	1.000											
Variety2	-0.142	-0.183	-0.166	-0.705	1.000										
Variety3	0.070	-0.038	-0.113	-0.195	0.029	1.000									
Variety4	-0.067	0.100	-0.011	-0.085	0.029	-0.026	1.000								
Variety5	-0.234	-0.107	-0.103	-0.112	-0.054	-0.015	-0.015	1.000							
Variety6	-0.058	-0.098	-0.074	-0.112	-0.054	-0.015	-0.015	-0.009	1.000						
Consumption	0.399	0.436	0.480	0.166	-0.180	-0.087	-0.020	-0.116	-0.116	1.000					
Credits	0.096	0.125	0.118	0.224	-0.255	-0.071	-0.071	0.042	0.042	0.105	1.000				
Extension	0.250	-0.054	0.001	0.320	-0.077	0.069	-0.231	-0.218	0.039	0.124	0.123	1.000			
Village1	0.205	0.205	0.092	0.739	-0.546	-0.151	-0.151	-0.086	-0.086	0.146	0.286	0.349	1.000		
Village2	-0.065	-0.201	0.047	-0.197	0.273	-0.103	-0.103	-0.059	-0.059	-0.010	-0.311	0.010	-0.594	1.000	
Village3	-0.169	-0.026	-0.155	-0.649	0.345	0.283	0.283	0.162	0.162	-0.158	-0.004	-0.415	-0.533	-0.363	1.000

Note 1. Variety 1-6 are the rice varieties; Ayeyarmin, Ayearpadaethar, Manawhtikesa, Htikesa, Kayinma, Shwe Bo in the order.
2. The village names are Ko Yan Taung, Pha Lan Tine, Nyaung Kaing in the order

Table A.1 (cont'd)

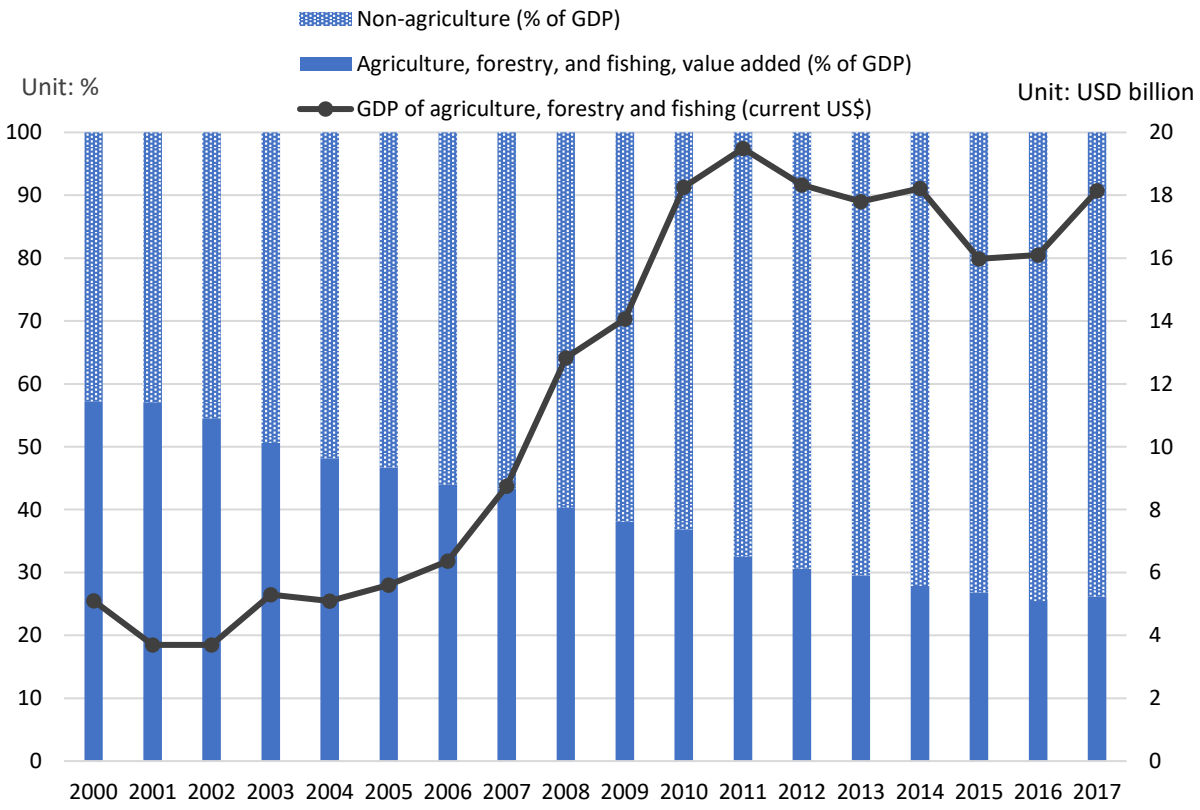
	Sell_ consumer	Sell_ broker	Sell_ miller	Place_ farm	Place_ house	Place_ town	Place_ road	Place_ other	Mill	Store	Plan	Road
Sell_consumer	1.000											
Sell_broker	-0.624	1.000										
Sell_miller	-0.021	-0.768	1.000									
Place_farm	-0.030	0.049	-0.037	1.000								
Place_house	-0.164	0.195	-0.115	-0.535	1.000							
Place_town	-0.017	-0.298	0.396	-0.030	-0.373	1.000						
Place_road	0.704	-0.440	-0.015	-0.021	-0.263	-0.012	1.000					
Place_other	-0.017	0.028	-0.021	-0.030	-0.373	-0.017	-0.012	1.000				
Mill	0.210	-0.257	0.156	-0.067	-0.205	0.457	0.322	-0.038	1.000			
Store	0.020	-0.075	0.079	-0.199	0.028	0.153	0.108	0.020	0.271	1.000		
Plan	-0.002	-0.039	0.051	-0.158	0.087	0.129	0.091	-0.002	0.219	0.603	1.000	
Road	0.042	-0.067	0.052	0.074	0.073	-0.184	0.030	0.042	-0.237	-0.315	-0.199	1.000

Note 1. Variety 1-6 are the rice varieties; Ayeyarmin, Ayearpadaethar, Manawhtikesa, Htikesa, Kayinma, Shwe Bo in the order.
2. The village names are Ko Yan Taung, Pha Lan Tine, Nyaung Kaing in the order.

Variable	VIF	1/VIF	Variable	VIF	1/VIF
Variety_1	6.21	0.16	Education	2.09	0.48
Landhold	5.49	0.18	Mill	2.05	0.49
Sell_broker	5.41	0.18	Extension	2.01	0.50
Village_3	5.11	0.20	Broker_nonprice	1.87	0.53
Sell_miller	4.73	0.21	Miller_price	1.84	0.54
Cultivated	4.72	0.21	HH_size	1.79	0.56
Place_house	4.42	0.23	Road	1.75	0.57
Variety_2	3.64	0.27	Mobile_nonprice	1.74	0.58
Village_2	3.25	0.31	Variety_3	1.73	0.58
Experience	3.21	0.31	Neighbor_price	1.72	0.58
Age	3.14	0.32	Media_price	1.69	0.59
Place_road	3.14	0.32	DOA_price	1.52	0.66
Place_farm	2.99	0.33	Radio_nonprice	1.49	0.67
Place_town	2.6	0.39	Variety_6	1.48	0.67
Store	2.31	0.43	TV_nonprice	1.46	0.68
Plan	2.26	0.44	Credits	1.42	0.71
Broker_price	2.26	0.44	Variety_4	1.41	0.71
Place_other	2.16	0.46	Gender	1.33	0.75
Consumption	2.13	0.47	Variety_5	1.29	0.78
Mean VIF	2.65				

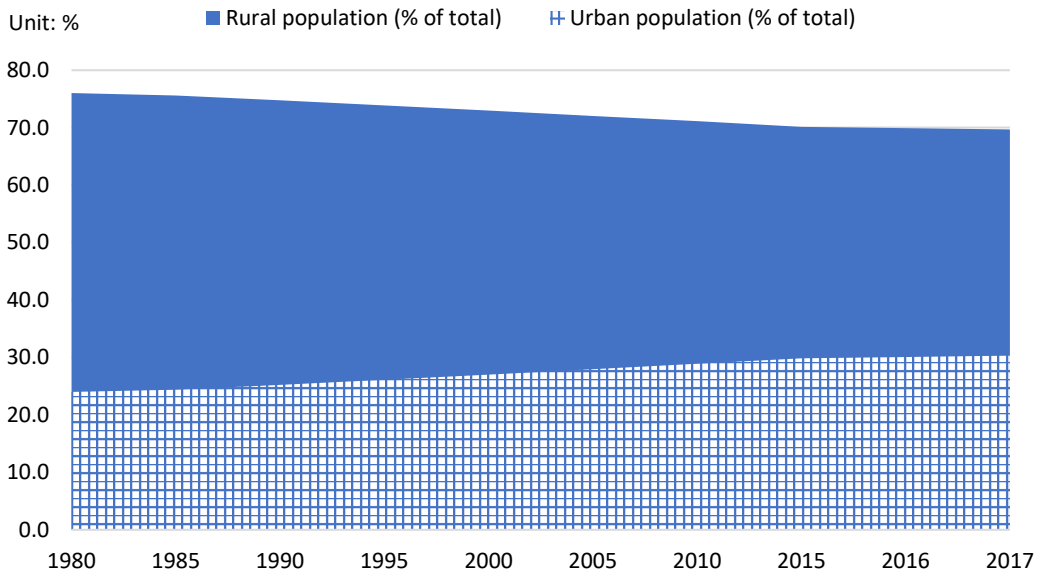
Table A.2. Variation Inflation Factors (VIF) for All Independent Variables

APPENDIX B: FIGURES



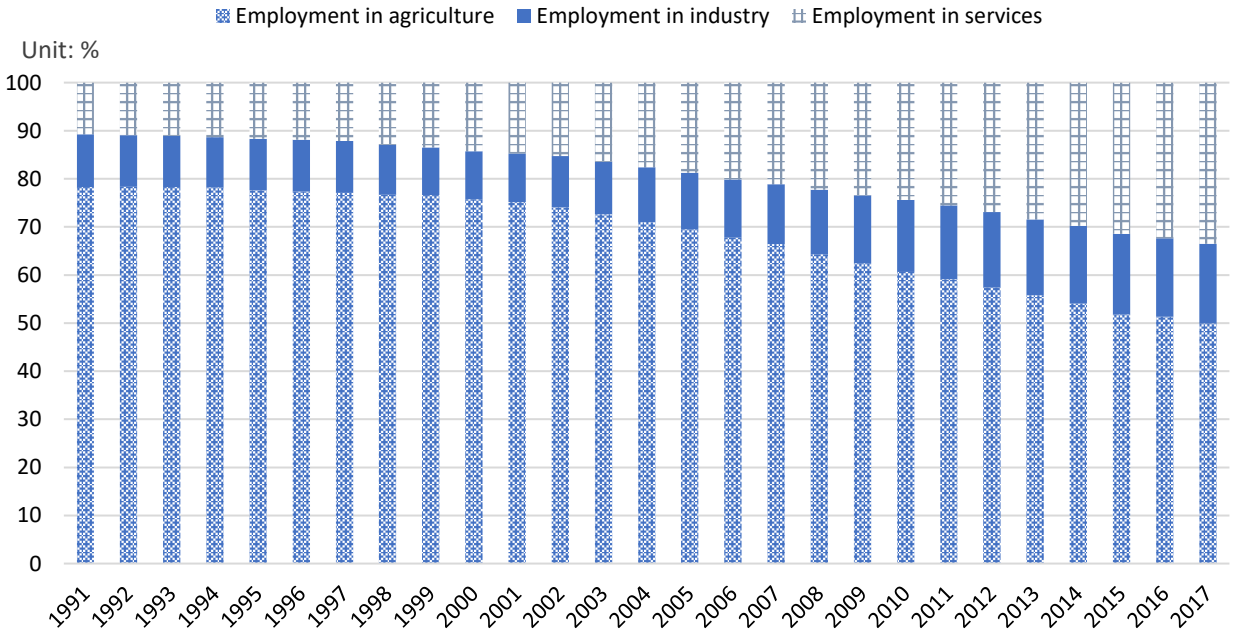
Source: World Bank (2018).

Figure B.1. GDP Shares of Agricultural and Non-agricultural Sector



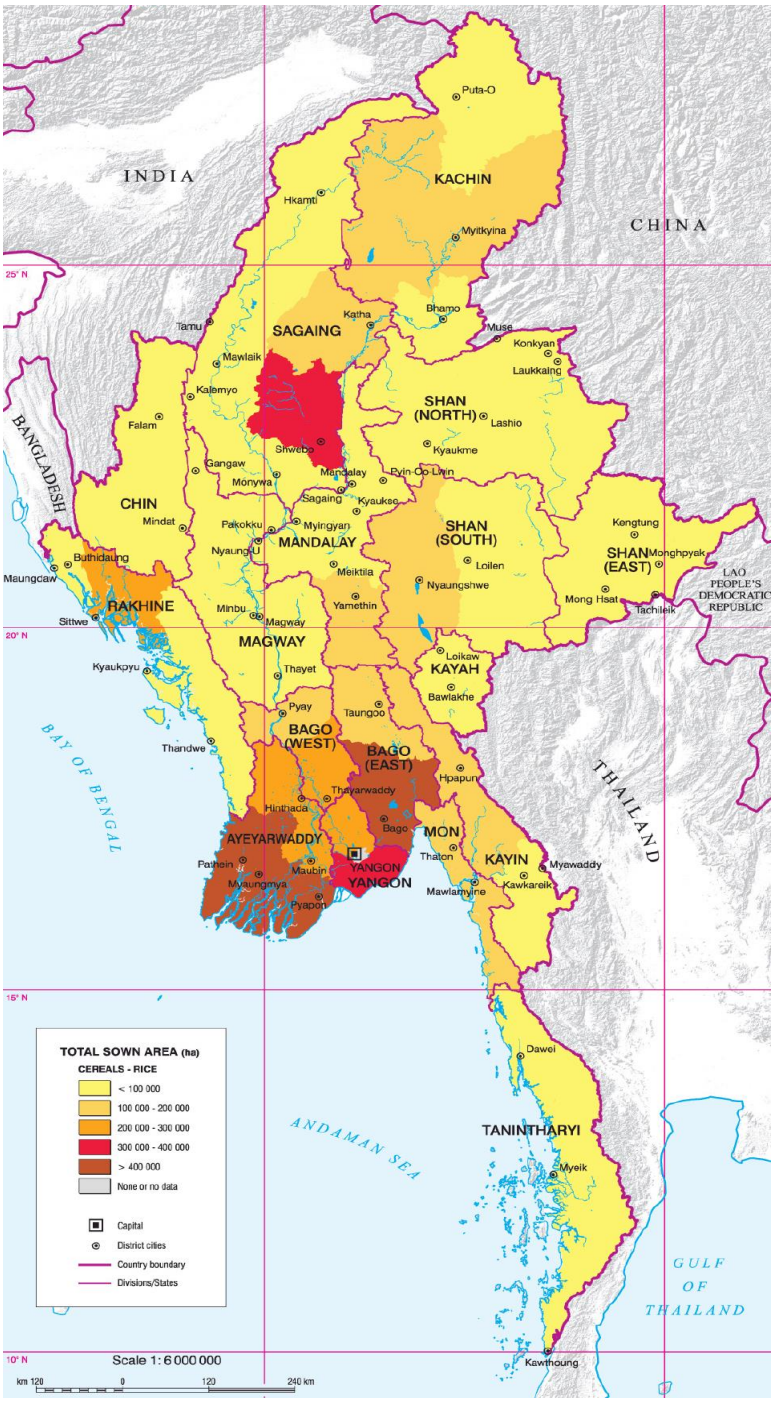
Source: World Bank (2018).

Figure B.2. Population Ratio Between Rural and Urban Areas



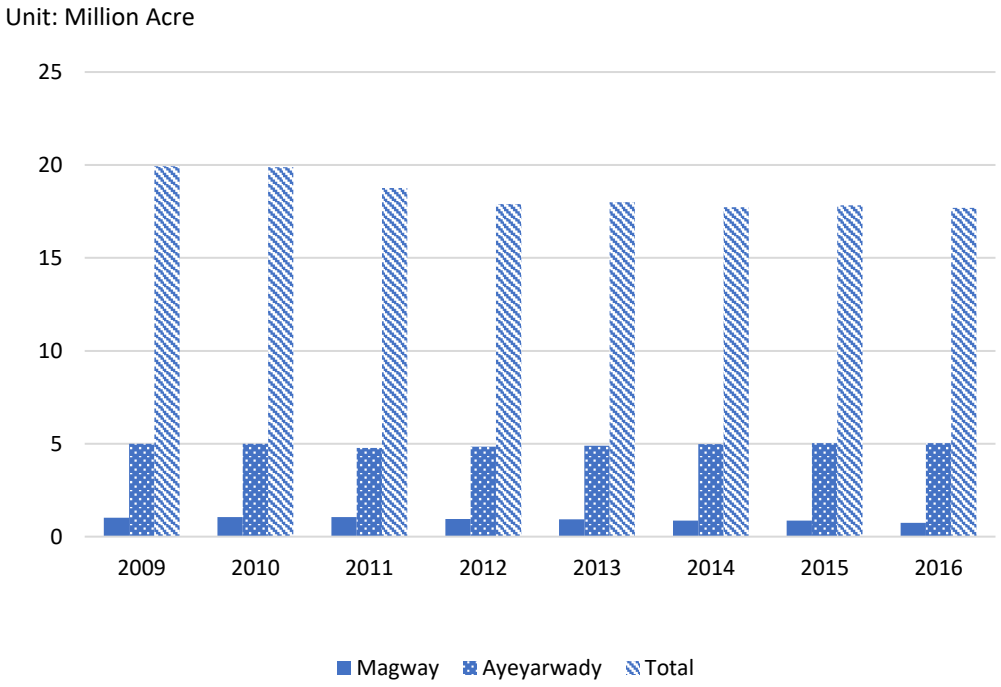
Source: World Bank (2018).

Figure B.3. Employment Rate of Total Employment



Source: FAO.

Figure B.4. Rice Map of Myanmar (Total Sown Area)



Source: CSO (2019).

Figure B.5. Sown Acreage of Rice Cultivation Area in Myanmar

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