Analysis of Factors That Dictate Farmers to Sell Their Produces Early: Implication for Seasonal Price Fluctuation

Bedaso Taye[1]

Abstract

In Ethiopia, agricultural markets are characterized by seasonal price fluctuations as price seasonality is a fact of life in any agrarian production system. Prices of agricultural crops typically fall immediately after harvest and rise gradually thereafter until the next harvest. This study was conducted to analyze the factors that dictate farmers to sell their produces immediately after harvest and thereby create price fluctuations. The study used household survey data to estimate Tobit model for the propensity and intensity to sell crops immediately after harvest. The econometric result indicates that education of head of household, number of markets, input cost, labor cost, and credit are found to affect quantity and intensity of early sale positively while family size and technology use affect intensity and propensity to sell early negatively.

JEL Code: Q12, Q13
Key Words: Price Fluctuation, Tobit Model, Crop markets, Early Selling

[1] Monitoring, Learning and Evaluation Specialist, Freelance Consultant
bedho250@gmail.com
O: +251 929 107 937
M: +251 911 941 508

1. Introduction

Agriculture in Ethiopia is practiced mainly by farmers that rely on small scale production. Crop production and marketing are the means of livelihood for millions of households in the country. It is the single largest sub-sector within Ethiopia's agriculture, far exceeding all others in terms of its share in rural employment, agricultural land use, calorie provision, and contribution to national income. For example crop production contributed 68.3% to agricultural GDP and 26.1% to total GDP of the country in 2013/14 (MoFED, 2014)). This indicates that a shock in this sub sector affects the economy significantly.

There are several factors that affect the productivity of the sector, dependence on rainfall and limited adoption of improved technologies being the major ones. Apart from these problems, failure to secure sustainable and profitable grain markets constrain the development of the sector and prevent farmers from benefiting adequately from their harvests.

The majority of farmers use local or town markets to sell their produce. A recent survey by Sasakawa Global 2000 on smallholder farmers' market access indicates that more than 90 percent of farmers in Ethiopia use local and town markets that are not large enough to accommodate all surplus production (SG 2000, 2012)). Due to such narrow and undiversified markets, farmers are vulnerable to acute price falls during peak harvest times. The problem gets worse in areas where perishable and non-storable crops are produced in bulk.

In theory price fluctuations should benefit the producer, but in practice the result might be different if risk awareness is not considered. For developing countries it might be even more important to reduce the risk of price fluctuations due to the relative importance of agricultural food products (Bäckman and Sumelius, 2009). Therefore, it is worthwhile to understand the causes of price fluctuations and take appropriate policy measures to curb them.

The major reasons behind price fluctuations are related to demand, supply and market institutions (Bäckman and Sumelius, 2009). While it is plain to argue that prices change with changes in demand, it is also fair to argue that demand factors are stable and gradual unlike supply factors. Changes in supply are usually unpredictable and large enough to create huge price fluctuations. Higher market supplies will push prices down if there is no corresponding change in demand particularly during peak harvest times of agricultural products. Some of the reasons why households sell their produce too early are to pay for household events inputs in addition to the fact that their produce and farm labor costs might be perishable (SG 2000, 2012). Moreover, household cash demand dictates farmers to sell their produce immediately after harvest. Due to these reasons farmers tend to bring their produce to market places immediately after harvest which increases supply temporarily and push prices down. This prevents farmers from adequately benefiting from their harvests.

The grain marketing system and the spatial movements of Ethiopian grain prices have been widely studied (Getnet, 2007; Getnet *et al*., 2005; Negassa, 1998; Negassa *et al*., 2004; Tadesse, Shively, 2009, Shahidur *et. al*., 2010/11 and Getaw *et al*., 2010). However, they hardly assessed the factors that lead farmers to sell their harvests too early, which cause abnormal seasonality of prices. Most of them are based on analysis of factors that influence commercialization, outlet choice, and price trends and marketing margins over times and storage decisions. Particularly Getaw *et al*., 2010, analyzed the behavior of commodity prices and economics of storage using time series data but without analyzing quantity sold and temporal selling decisions. Therefore, there is a missing link in these studies to explain why farmers sell their produces too early and create temporary market gluts that reduce significantly the price that farmers receive. Based on this fact this study tries to identify and explain factors that dictate farmers to sell their production too early. The specific objectives of the study are to:

1. estimate the quantity of crop outputs sold immediately after harvests, and

2. identify and explain factors that dictate farmers to sell their produce too early and intensity of early sales.

2. Nature of Crop Markets in Ethiopia

Assessment of market performance requires analyses of prices (over time and space) and the process that influences price formation. This follows from the simple fact that the price of a commodity is the outcome of an exchange process, which we call the market. In the absence of public interventions, three important determinants of an efficient exchange process (market fundamentals) are infrastructure, institutions, and information (Rashid and Asfaw, 2011). If there is inadequacies/incompleteness in these fundamentals, it will be reflected in the prices. For instance, if the markets are not connected with adequate infrastructure and efficient information flow, price shocks in one market location may not get transmitted to the other, which can be detected through spatial integration of market locations (*ibid*, pp 17). Similarly, if farmers do not have access to credit or risk-mitigating institutions, they are compelled to sell immediately after harvest when prices are low. The presence of such institutional incompleteness can be detected though analysis of price seasonality and its causes.

Seasonality is a fact of life in any agrarian production system. Prices of agricultural crops typically fall immediately after harvest and rise gradually thereafter until the next harvest. This is a natural price pattern, unless prices fall too low after the harvest or rise too high during the lean season. In a competitive market, the difference between harvest time and lean season prices should reflect the costs of storage, which consist of opportunity costs of holding stocks (interest charges), storage losses, the costs of labor and capital, and a normal profit (Timmer *et.al*., 1983). While concluding whether seasonality is consistent with competitive markets is difficult, any changes in price seasonality should indicate an improvement (or deterioration) of market performance. An improvement in access to credit can alleviate farmers' liquidity constraints and hence reduce distress sale and market supply, resulting in an overall increase in postharvest prices. Similarly,

improved storage and access to credit can lower the cost of storage and hence result in lower lean season prices.

Furthermore, contrary to the common perception that the seasonality of grain markets are changing, seasonal variations in prices tend to follow the country's production cycles (Rashid and Asfaw, 2011). This indicates that prices of agricultural products fall during peak harvest seasons and rise in lean seasons.

Shahidur and Moron, 2010 analyzed the cause of price instability in Ethiopia with a focus on staple food crops. They mentioned three factors as the main source of price instability. These are agro-climatic factors, information and infrastructure, and incomplete markets: insurance and credit, and other factors (like world food prices and high safety net interventions). It seems that due to over dependence on rainfall, agricultural production in Ethiopia is seasonal which involves a huge supply in times of harvest and little in off seasons. Even though infrastructure and access to information are recently being improved, a vast majority of Ethiopian farmers live in conditions of limited infrastructure and access to information. Therefore, this has an adverse effect on price information in the country.

The undeveloped and incomplete credit and insurance markets in Ethiopia are the other factors that create price volatility in the country (Shahidur and Moron, 2010). In developing countries, these institutions are largely incomplete or non-functional, and thus inadequate to address the credit and insurance needs of a vast majority of households (Shahidur and Moron, 2010). This indirectly contributes to agricultural risks and price instability. For instance, if the credit market is well-functioning, households can borrow to maintain a certain level of consumption, or to avoid distress sales in the face of negative income shocks. It is often the case in many developing countries where farmers have to sell a portion of their crops immediately after harvest to pay loans, wages, school fees, or to meet other social obligations.

3. Seasonal Fluctuation of Price of Major Crops in Ethiopia

In Ethiopia seasonal price fluctuations are not studied widely. Most studies focus on the 2007/08 price hike and related developments. For example, Shahidur (2010) explained the reasons behind price trend puzzles in Ethiopia. He emphasized three key factors behind unusual food prices in Ethiopia. The first factor was that the growth in money supply far exceeded the overall economic growth in the country. This clearly implies strong inflationary pressure. Indeed, a 2007 World Bank study argued that, during 2004-2006, the money supply increased by 108 percent, and real GDP increased by 48 percent. That is, growth of the money supply was 40 percent faster than the GDP growth. This helps explain the growth in nominal food prices over this period. The real price of most cereals, except *Teff*, actually declined during that time (World Bank, 2007 as cited in Shahidur, 2010).

Another most important factor behind this puzzling price trend appears to be an over-estimation of cereal production. The price trend in 2007-2008 was indeed puzzling because prices were going up despite a reported growth of about 15 percent in cereal production. Compare this with 2002- 03, when a reported bumper harvest of 9 million tons of grain resulted in market collapse—so much so that some farmers did not find it worthwhile harvesting their maize (Shahidur, 2010). The International Food Policy Research Institute and the Joint Research Centre of the European Union conducted a comprehensive study in order to better understand the puzzling trends. The study involved a representative household survey, a market survey, a cross border trade survey, as well analyses of a large amount of time series data. One of the key findings of the study was that production estimates of cereals from the IFPRI survey were roughly 30 percent lower than the official estimates (Minot, 2008 cited in Shahidur, 2010).

When we look at monthly (seasonal price variation), for most crops prices during the months of December, January and February are lower than other months. For example average wholesale price of maize in 2011/12 for these months was 10percent lower than average whole sale prices of other months.

Similarly, average whole sale prices of wheat and *Teff* was lower during the peak harvest seasons than the lean seasons. Look at the graphs below to see the behavior of prices over months in 2011/12 and 2012/13.

Figure 1: Monthly average wholesale price of *Tiff* in Amhara and Oromiya regions 2011/12-2012/13

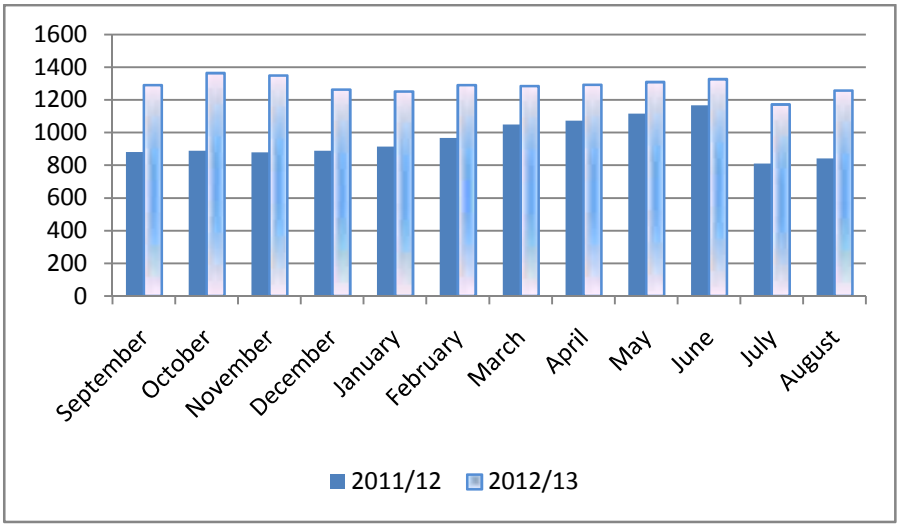
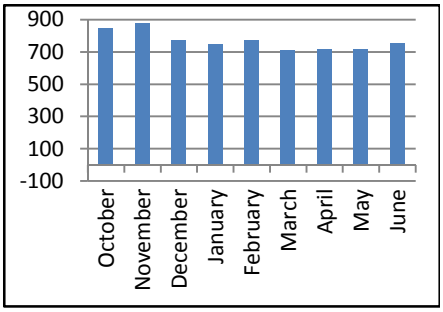
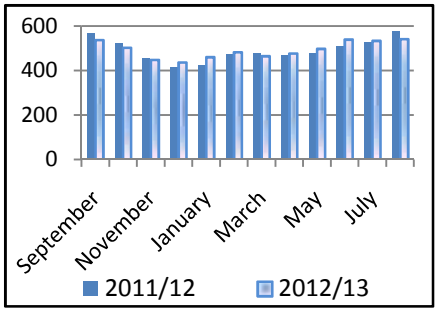


Figure 2: Monthly average wholesale price of maize in Amhara and Oromiya regions 2011/12-2012/13



Monthly average wholesale price of wheat in Amhara region



Monthly average wholesale price of maize in Oromia

Source: Computed from EGTE data (2011/12)

4. Methodology of the Study

The study is based on a household survey conducted using structured instruments to collect data from randomly selected 845 agricultural households in 14[2] Woredas of Oromia, Amhara and SNNP regions in December 2011. 35-40 households per Keble were randomly selected based on systematic sampling methods using a list of household names at Kebeles as a sampling frame. The Woredas are mostly mid-highland and highland known for surplus production in the country. They include Adana, Arsis Robe, Tale, Chewbacca, Gules, Beret in Oromia region; Deben, Arable, Dangle, LiboKemkem and DawaCheffa in Amhara region and, Cheha, Lemmo and Silti in SNNP region. The data consists of household characteristics, agricultural production, post-harvest activities and post-harvest losses, market access, technology and extension service use, credit access and marketing infrastructure and problems. In order to assess and triangulate the general agricultural activities of the communities including community level technology adoption and the institutional environment the survey was also conducted at Woreda and Kebele levels.

The data is analyzed using descriptive statistics and an econometric framework to identify the factors that affect intensity and propensity to sell crop outputs immediately after harvest. The quantity sold too early and its effect on price is analyzed descriptively.

4.1 Specification of the Model

In this study the major focus is to see the factors that affect farmers to sell their products too early and the amount they sell early. The econometric model applied for analyzing factors influencing participation and intensity of participation in certain activities is the Tobit model shown in equation (1). This model is chosen because it has an advantage over other models (LPM, Logistic, and Probit) in that it reveals both the probability of participation of

[2] 2 kebeles per Woreda were selected for Woredas where control group are included and only one kebele per Woreda where control group is not included.

farmers in early sale and intensity of their sale. Following Maddala (1992), Amemiya (1985) and Johnston and Dinardo (1997), the Tobit model can be defined as;

$$Yi^* = \beta Xi + \varepsilon_i \quad i = 1, 2 \ldots n \qquad \textbf{(1)}$$

$Yi = Yi^*$ *if* $Yi^* > 0$

$= 0$ *if* $Yi^* < 0$

Where,

Yi = the observed dependent variable, in our case the quantity of output sold within four weeks after harvest. Y_i^* = the latent variable which is not observable. Xi is vector of factors affecting farmers' decision to sell within four weeks after harvest and β is vector of unknown parameters to be estimated while ε_i is residual that is independently and normally distributed with mean zero and a common variance δ^2. Note that the threshold value in the above model is zero. This is not a very restrictive assumption, because the threshold value can be set to zero or assumed to be any known or unknown value (Amemiya, 1985). The Tobit model shown above is also called a censored regression model because it is possible to view the problem as one where observations of Y* at or below zero are censored (Johnston and Dinardo, 1997). The model parameters are estimated by maximizing the Tobit likelihood function of the following form (Maddala, 1997 and Amemiya, 1985).

$$L = \prod_{yi^*>0} \frac{1}{\sigma} f\left(\frac{Y_i - \beta i Xi}{\sigma}\right) \qquad \textbf{(2)}$$

Where L and F are respectively, the density function and cumulative distribution function of $\prod_{yi^*}$ means the product over those i for which Yi*>0, and $\prod_{Yi^*}$ means the product over those i for which Y>0.

It may not be sensible to interpret the coefficients of a Tobit in the same way as one interprets coefficients in an uncensored linear model (Johnston and Dinardo, 1997). Hence, one has to compute the derivatives of the estimated

Tobit model to predict the effects of changes in the exogenous variables. As cited in Maddala (1997), Johnston and Dinardo (1997), McDonald and Moffit proposed the following techniques to decompose the effects of explanatory variables into participation and intensity effects. Thus, a change in Xi (explanatory variables) has two effects. It affects the conditional mean of Yi in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. A similar approach is used in this study. The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\frac{\partial E(Yi/Yi^{*}>0)}{\partial Xi} = \beta i\left[1 - Z\frac{f(Z)}{F(Z)} - \left(\frac{f(z)}{F(Z)}\right)^{2}\right] \qquad \textbf{(3)}$$

Where, (2) is denoted by z, following Maddala, (1997). The Change in the probability of selling crop outputs as independent variable Xi changes is:

$$\frac{\partial E(Y_i)}{\partial X_i} = F(Z)\beta i \qquad \textbf{(4)}$$

The change in intensity of participation with respect to a change in an explanatory variable among participants is:

$$\frac{\partial E(Y_i/Yi*>0)}{\partial X_i} = F(Z)\beta i \qquad \textbf{(5)}$$

Where, F (z) is the cumulative normal distribution of Z, f(z) is the value of the derivative of the normal curve at a given point (i.e., unit normal density), Z is the z-score for the area under normal curve, βis a vector of Tobit maximum likelihood estimates.

4.1.1 Description of Explanatory Variables

A. Dependent variable

Quantity of output sold within four weeks after harvest (Q_S): It is a partially continuous variable of quantity of crop output sold within four

weeks after harvest. It takes positive the value Qs if the household sold crop output within four weeks after harvest and takes the value of zero otherwise. So it is left censored variable at 0. Since most perishable crops like vegetables are sold immediately after harvest the study only included grain crops (cereals, pulses and oil crops).

B. Independent variables

1. **Sex:** a dummy variable representing sex of household head; 1 if male, 0 if female. Since male headed households are better off in both production and asset endowment, it is expected to have a negative relationship with quantity sold early.
2. **Education:** A continuous variable indicating educational level of household head. It is assumed that more educated household heads have a lower tendency to sell their products too early.
3. **Asset value:** A continuous variable representing the estimated asset value of the households. Since it represents the asset endowment of the household it is expected to reduce quantity of output sold early after harvest.
4. **Family size:** A continuous variable representing the size of the family of the household. This may have either a negative or positive sign depending on whether the household members are earners of income or dependent. To capture age, factor adult equivalent family size is used in this study.
5. **Labor cost:** This is a continuous variable indicating the estimated labor cost incurred by the household in the production of crops. Since it reduces the effect of heteroscedasticity, log of labor cost is considered in the estimation.
6. **Cost of inputs:** The higher the cost of inputs incurred by households in the last production season the higher the demand for cash after harvest and hence the probability to sell early is higher. Log of input cost is considered in the estimation for this variable too.
7. **Storage method:** A dummy variable of the type of storage materials for crop outputs. Households with improved storage

facilities are expected to sell outputs later when prices are higher and stable; hence storage dummy is hypothesized to affect quantity sold within four weeks after harvest negatively.

8. **Non-farm income:** A dummy variable to see whether the household has a non-farm income source. If households have alternative income sources they can defer sale of crop output to a time of good prices.
9. **Market information:** This is A dummy variable which takes T HEvalue of 1 if the household received market information or received training on output marketing and 0 if not. Farmers who have information and training on output marketing are expected to make prudent decisions and hence the expected sign for market information variable is negative.
10. **Credit/Debt:** This is a dummy variable for a household that took loans (credit) the previous year. If households are expected to repay loans after harvest, they are forced to sell their products after harvest immediately.
11. **Extension:** A dummy variable that takes 1 if the household has received extension service in the production year or 0 otherwise. Since extension is expected to deliver both production and marketing information this variable is expected to reduce early sale.
12. **Technology:** A dummy variable that takes 1 if a household used improved technology (seed, full rate of fertilizer etc.) or 0 otherwise. Since farmers that use improved technologies are supposed to be informed farmers this variable is expected to reduce early sale.

5. Findings and Discussion

5.1 Household Characteristics

The data used covered 3 regions, 14 Woredas and 21 Kebeles and 805 households. About 71percent of the households are male headed and 29 percent female headed. Average family size is 5.84 and dependency ratio is 1.37 persons per adult. 69.8percent of the heads are married and

monogamous, and 19.8 percent are widowers. About 93percent of the households rely on agriculture and a smaller proportion of households is engaged in non-farm activities like casual labor (14.7percent) beverage sale (5percent) and farm product trading (22percent). It was also found that 45percent of the household heads cannot read and write while 15percent of them have attended only informal education. 33.8percent of the heads have completed primary education and only 5.8percent of them have completed post primary education.

All households have about three building structures in their homestead on average. However, the building materials are mostly traditional. For example 45percent of the roofs of their living houses are made of thatch and straw and 55 percent corrugated iron tin. 91.7 percent of the walls of living houses are constructed out of mud while 98.2 percent of the floors are made of earth or mud. About 40percent of the households have separate bed rooms, and 59.5percent and 58.8percent of the households have kitchens and toilets, respectively. On average each household has an estimated asset value of 2291 ETB. Households in Oromia have higher estimated asset value than the other two regions. Land is another important asset held by farming households. In this survey each household has 1.62 hectares of land and each operates on 1.92 hectares of land. The main means of access to land include; allocation by government (50.6percent), renting (10.5percent) and inheritance (25.8percent).

Almost all (97percent) households are engaged in crop production as their primary livelihood source. Livestock production is a secondary source serving 72percent of the households. Trading crop and livestock products and petty trade are tertiary sources of income for 17.6percent and 10.4percent of the households, respectively. Female headed households participate more in nonfarm activities like off farm labor (4.3percent) and petty trade (3.9percent). The most common off farm income sources are alcohol trading absorbing 15.7percent of the households, and off farm labor, handicraft and trading grains which, in this order, engage 15percent, 12.6percent and 12.2percent of the households. In 2010, households received

1533 ETB average income from all off-farm activities with households in SNNP receiving 2296 ETB average annual income. Those households engaged in wage earning employment and alcohol trading received more income than in other activities. On the other hand, 13percent of the households had bank accounts in 2010 and the proportion of households that received credit in the same year was 44.3 percent. The main sources of credit in Oromia are Saving and Credit Cooperatives (SACCOs) and Microfinance Institutions (MFIs) while it is service cooperatives and MFIs in Amhara and government and relatives in SNNP Region.

5.2 Quantity produced and sold by households

Teff, maize and wheat are cultivated by 71%, 61% and 46%, respectively, of the households covered by the study. All crops covered 1387 hectares of cultivated land out of which *Teff*, maize, wheat, sorghum and chick pea took 100.81ha (72.29percent. *Teff*, maize, wheat, chickpea, sorghum, finger millet, vetch (grass pea), rice, barley and faba bean are the top ten crops grown. In the 2010/11 production season, sample households harvested 16,471 quintals (1647.1 tons) of crops of which *Teff*, wheat and maize constituted 65percent. Therefore, *Teff*, maize and wheat are the top three crops in terms of area, production and number of cultivating households.

With regard to yield, on average 10.91 quintals of *Teff* were harvested from a hectare while maize and wheat yields were 21.62 Qt/ha and 15.51 Qt/ha, respectively. Yields of *Teff* and maize are the highest in Oromia with (12.49Qt/ha and 22.61Qt/ha, respectively) and the lowest in the SNNP with (9.71 Qt/ha and 19.12Qt/ha) in that order. In 2011 most of the harvest was used for consumption. As the data indicates 43percent of the total harvest was consumed and 29 percent was sold while the remaining was used as seed, animal feed and giveaway.

Table 1: Quantity harvested, total quantity sold and sold within 4 weeks of harvest

Region	Total quantity harvested (Qt)	Total quantity sold (Qt)	Quantity sold within 4 weeks (Qt)	Percent of total quantity sold	Percent Quantity sold within 4 weeks	Percent of Total quantity sold within 4 weeks of harvest
Oromia	11,358.4	3,776.5	524.1	33.2%	13.9%	4.6%
Amhara	7,297.5	1,833.0	314.9	25.1%	17.2%	4.3%
SNNP	1,302.8	169.6	45.9	13.0%	27.1%	3.5%
Total	**19,958.6**	**5,779.1**	**885.0**	**29.0%**	**15.3%**	**4.4%**

Source: baseline survey of SG 2000 – Ethiopia, December 2011

As the table above reveals, out of the total quantity produced 29 percent was sold by households in the year and 15.3percent of the total quantity sold was sold immediately after harvest. Of the total harvest the quantity sold within four weeks constitutes about 4.4percent. A simple analysis indicates that if households delayed the sale for at least eight weeks they would get an additional 439 Birr income. This is because after two months of harvest, the average price of grains increase by 7.6 percent. Price fluctuation is the main marketing problem reported by 67.8percent of the households surveyed. Lack of transportation and long distance to the market places are the other market access problems each reported by 22.8percent of the households. The main reason behind price fluctuation and low prices during harvest is lack of enough market centers in the Regions and seasonality in the supply of products. There is a small number of buyers and the marketing options are limited so that prices go down during peak harvest time. About 44 percent of the households sold at least one of their products within four weeks of harvest due to various reasons.

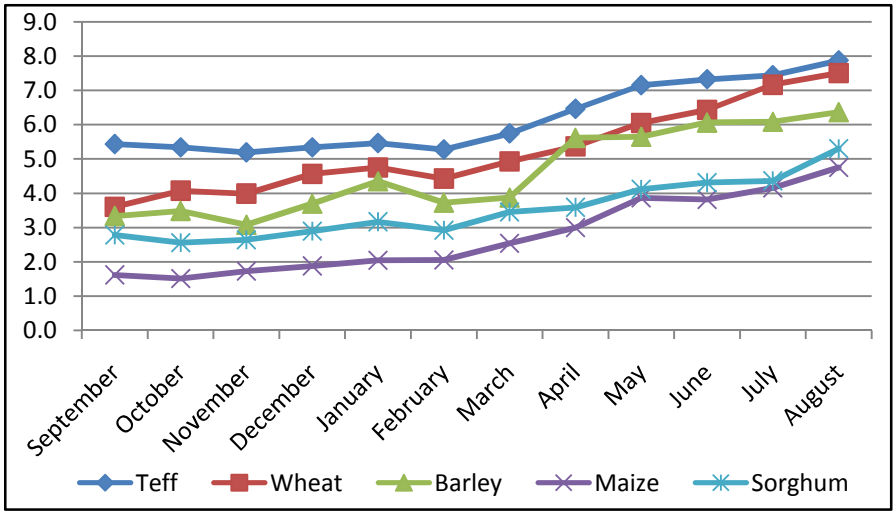
The main reasons why households sell their crops within four weeks of harvest are: to pay for household functions, like wedding, *mahiber* etc. which was reported by 53.6percent of the households; due to perishable nature of the products reported by 26.5percent; and to pay for farm labor cost, reported by 18.4percent of the households. In the SNNP Region

households that reported "perishable nature of the products" as their main reason constitute the highest category (66.2percent), while in Oromia it is farm labor cost which accounts for 34.5percent and household functions in Amhara accounting for 74.5percent.

5.3 Price Variations of Major Crops

Price for food grain is more volatile than non-food items (FAO, 2008). This is because of the non-elastic demand for food items and the variation of supply across time. CSA data shows that prices of major food crops is higher in the months of June-November after which they show a steady decline until they start to rise again after May. These months (November to May) correspond with the major harvest season of the country. The average producer price of *Teff* from September to November in 2005 E.C was 11.78 Birr per kg, which fell to 10.92 Birr per kg in the subsequent three months (December to February).

Figure 3: Price of major food crops



Source: CSA producer price survey, 2003 E.C

5.4 Econometric Results

The study applied the Tobit model to estimate factors that dictate farmers to sell their outputs immediately after harvest. During the survey 508 households did not sell their harvest within 4 weeks and hence they were left censored. The likelihood ratio chi-square of 99.35 (*df*=17) with a p-value of 0.0000 tells us that the model as a whole fits significantly better than an empty model (i.e., a model with no predictors). Model estimates show that the model is robust as the overall p-value is 0. The log likelihood and pseudo $R^2$are found to be -1073.5958 and 0.0442, respectively.

In general the estimation exercise indicates that technology use, education level, number of markets, input cost, labor cost, credit, family size and regional dummies are found to significantly affect quantity sold within 4 weeks of harvest.

In addition to determinants of quantity sold within four weeks, the model estimates determinants of early sale. According to H. Joseph Newton (2000) for the Tobit model, there are four forms of marginal effects that are of great interest. They are (1) the β coefficients themselves are the changes in the mean of the latent dependent variable, (2) the changes in the unconditional expected value of the observed dependent variable, (3) the changes in the conditional expected value of the dependent variable, (4) the changes in the probability of being uncensored. The above estimates are the β coefficients that affect the change in mean of the dependent variable, i.e. quantity sold within four weeks of harvest. In this study the 4^{th} marginal effect is one of our interests. That is the probability of being censored or probability of selling within four weeks. In what follows we discuss the conditional marginal effects and probability of being censored. In other words we discuss the marginal effect of the independent variables given that the quantity sold early is greater than zero and the variables that affect the probability of selling too early.

Table 2: Tobit estimates of determinants of quantity sold within four weeks

Variables	Coef.	Std. Err.	t-value	P>t	[95% Conf. Interval]	
Technology	-1.864	0.8968	-2.08	0.038	-3.625	-0.104
Extension	0.370	0.8140	0.45	0.650	-1.228	1.968
Education	-0.259	0.1205	-2.15	0.032	-0.496	-0.023
Number of markets	0.592	0.3387	1.75	0.081	-0.073	1.257
Market info	-0.348	0.7780	-0.45	0.655	-1.875	1.179
Lnassets	0.197	0.3460	0.57	0.568	-0.482	0.877
Lninputc	1.416	0.3801	3.73	0.000	0.670	2.163
Lnlaborc	0.221	0.1246	1.77	0.077	-0.024	0.466
Oromia_dummy	4.592	1.2319	3.73	0.000	2.174	7.010
Amhara_dummy	5.256	1.2471	4.21	0.000	2.808	7.704
Storage method	0.482	0.4248	1.14	0.256	-0.351	1.316
Improved seed	0.000	0.0044	0.06	0.956	-0.008	0.009
Land size	0.314	0.3457	0.91	0.364	-0.365	0.993
Sex of head	0.853	0.8351	1.02	0.307	-0.786	2.493
Credit received	1.310	0.6851	1.91	0.056	-0.035	2.655
Adult Equivalent	-0.311	0.1825	-1.7	0.089	-0.669	0.047
Non-farm income	-0.202	0.6859	-0.29	0.769	-1.548	1.145
_cons	-22.194	3.2021	-6.93	0.000	-28.480	-15.907
/sigma	***7.09493***	***0.33982***			***6.428***	***7.762***

Obs. summary: 508 left-censored observations at Quantity sold in 4wks<=0
254 uncensored observations
0 right-censored observations

Table 3 below gives the conditional marginal effects of the variables on quantity sold within four weeks of harvest. For example farmers that used improved technologies sold 0.54 quintals less of their output within four weeks. This can be because farmers that use improved technologies have better access to information and make profitable marketing decisions. Similarly as farmers' level of education increases by 1 year quantity sold within four weeks decreases by 0.26 quintals.

One of the variables that affect the level of output sold is access to markets. In this study, number of markets in the area, market information and distance to markets are used as indicators of market access. From these variables the number of market places (sales outlets) is found to positively and significantly affect quantity sold within four weeks of harvest. Additional number of market places in the Woreda increases quantity sold within four weeks of harvest by 0.17 quintals.

In rural Ethiopia the most common factors that dictate farmers to sell their products too early are demand to pay loans, family expenditure, labor costs, non-availability of assets or income and perishability lack of/storage facility. To see the impacts of these variables the study included input cost, labor cost, assets value, availability of improved storage facilities and credit. All these variables, except asset value and storage facilities are found to significantly affect quantity sold too early. For example, one unit increase in cost of inputs increases quantity sold by 0.4 percent, other things remaining constant. In addition to this a unit increase in cost of labor increases quantity sold too early by 0.06 percent. This is because farmers that incur higher cost of inputs and labor face higher demand for cash earlier than others. Moreover, it is good to be cautious in using this result because farmers that spent higher cost of inputs may be market oriented/commercial farmers that produced outputs for selling purpose only. In this study adult equivalent is included to capture labor size of households. As highlighted in the methodological section this variable can have either a negative or positive effect. The estimation shows that as family size increases by one unit quantity sold too early is reduced by 0.09 quintal. The reason can be that adult equivalent, unlike family size, captures number of economically active household members who can contribute to household income. The higher the number of adult equivalent in a household the less the demand for hired labor which eases pressure to sell outputs too early for cash.

One of the key factors that dictate farmers to sell their output too early is indebtedness. Therefore, the study included information on whether or not the farmers have received credit in that production season. Accordingly, the

result indicates that farmers that received credit (owe money to others) sold 0.38 quintals more output than farmers who did not receive credits. This justifies that Ethiopian farmers sell a significant amount of their outputs at lower prices during peak harvest time to pay for credits. Therefore, credit interventions should take into account this effect when deciding the appropriate time for loan repayment by farmers.

Table 3: Conditional marginal effects of variables

Variables	dy/dx	Std. Err.	z-value	P>z	[95% Conf. Interval]	
Technology	-0.544	0.263	-2.07	0.038	-1.059	-0.030
Extension	0.108	0.238	0.45	0.650	-0.358	0.574
Education	-0.076	0.035	-2.14	0.032	-0.145	-0.007
Number of markets	0.173	0.099	1.74	0.081	-0.022	0.367
Market info	-0.102	0.227	-0.45	0.655	-0.547	0.344
Lnassets	0.058	0.101	0.57	0.569	-0.141	0.256
Lninputc	0.413	0.113	3.68	0.000	0.193	0.634
Lnlaborc	0.064	0.036	1.77	0.077	-0.007	0.136
Oromia_dummy	1.341	0.365	3.68	0.000	0.626	2.055
Amhara_dummy	1.534	0.370	4.15	0.000	0.810	2.259
Storage method	0.141	0.124	1.13	0.257	-0.102	0.384
Improved seed	0.000	0.001	0.06	0.956	-0.002	0.003
Land size	0.092	0.101	0.91	0.363	-0.106	0.289
Sex of head	0.249	0.244	1.02	0.308	-0.230	0.728
Credit received	0.382	0.200	1.91	0.056	-0.010	0.775
Adult Equivalent	-0.091	0.053	-1.70	0.089	-0.196	0.014
Non-farm income	-0.059	0.200	-0.29	0.769	-0.451	0.334

Another important point is that the two regional dummies have been found to affect quantity sold within four weeks significantly. This means farmers in Oromia and Amhara regions sell more outputs too early than farmers in SNNP region. The reason for this might be that farmers in SNNP have more non-farm income to take care of immediate expenses. The quantity of output produced and sold in the year is also lower than in the other regions. It also

worth noting that important variables like using extension service, head of household were found to be insignificant determinants of early sale.

In addition to estimates of marginal effects of variables, estimates of the probability to sell outputs too early are given in Table 3. The same variables that affect the conditions for expected value of output sold too early affect the probability of early sale. Therefore, farmers that use improved technologies have eight percent less probability to sell outputs too early. Similarly, as years of education of head of household increases by one year the probability to sell outputs too early decreases by 1.1 percent which is significant at the level of 5 percent.

Table 4: Marginal effects of probability of selling outputs too early

Variables	dy/dx	Std. Err.	z-value	P>z	[95% Conf. Interval]	
Technology	-0.081	0.039	-2.1	0.036	-0.157	-0.005
Extension	0.016	0.036	0.45	0.650	-0.053	0.086
Education	-0.011	0.005	-2.17	0.030	-0.022	-0.001
Number of markets	0.026	0.015	1.76	0.079	-0.003	0.055
Market info	-0.015	0.034	-0.45	0.655	-0.082	0.051
Lnassets	0.009	0.015	0.57	0.569	-0.021	0.038
Lninputc	0.062	0.016	3.83	0.000	0.030	0.093
Lnlaborc	0.010	0.005	1.78	0.075	-0.001	0.020
Oromia_dummy	0.200	0.052	3.83	0.000	0.098	0.303
Amhara_dummy	0.229	0.052	4.38	0.000	0.127	0.332
Storage method	0.021	0.018	1.14	0.255	-0.015	0.057
Improved seed	0.000	0.000	0.06	0.956	0.000	0.000
Land size	0.014	0.015	0.91	0.362	-0.016	0.043
Sex of head	0.037	0.036	1.02	0.307	-0.034	0.109
Credit received	0.057	0.030	1.93	0.054	-0.001	0.115
Adult Equivalent	-0.014	0.008	-1.71	0.087	-0.029	0.002
Non-farm income	-0.009	0.030	-0.29	0.769	-0.067	0.050

Other things remaining constant, number of markets in a particular area increases the probability to sell outputs too early. The data shows that as

number of market centers increases by one the probability to sell outputs too early increases by 2.5 percent which is statistically significant at the level of 10 percent. Moreover, cost of inputs and labor also increase the probability of selling outputs early. As cost of labor and inputs increases by one unit, the probability to sell output early increases by 6.2 percent and 1 percent, respectively.

The other variables that affect the probability to sell early are credit and adult equivalent family size. Those farmers who received credit had a 5.7 percent higher probability to sell their crops too early. A unit increase in adult equivalent family size reduces the probability to sell crops early by 1.4percent and the estimate is significant at 10percent significance level.

6. Conclusion and Policy Implication

The study analyzed factors that dictate farmers to sell their crops too early. It is done using the Tobit model that enable us to identify both the factors that affect probability to sell early and intensity of sale. It is observed in the study that there is a significant amount of output that sold too early (within 4 weeks after harvest) which is up to 5 percent of total harvest. This pushes the local price down and farmers sell their output at lower prices to only buy it back at times of higher prices. Due to limited local market size and huge simultaneous supply there is a strong downward effect on price of agricultural products. For example the price of agricultural output is reduced by up to 10percent during a harvesting season, despite an upward trend of price over time. After the peak time of harvest prices gradually increase. If farmers delayed sale of their outputs for three months after harvest in 2012, their sales revenue would have increased by about 439 Birr because price of output increased by 7.6percent at that time in 2003 E.C.

Some of the factors that identified to affect the propensity and intensity to sell output too early are use of improved technology, educational level of head, of household adult equivalent family size, credit, number of local markets, cost of labor and inputs and regional dummies. However, access to

extension services, market information, land size and asset holding are found to be non-significant factors in determining selling crops too early. Therefore, there is a need to improve farmers' access to technology and improve credit management system, particularly repayment time. Previous studies indicated that access to credit is important to avoid early sale of outputs. However, in this study the farmers who received credit are found to sell too early than others. This is because credit is given for production not for marketing. A credit facility for crop marketing is one of the intervention areas to avoid sale of hard earned outputs at lower prices.

Moreover, crop price insurance can be one of the solutions to avoid too early sale of crops at lower prices. Farm households face different types of compulsory expenditures immediately after harvest. Some of the compulsory expenditures are loan repayment, school fees and wages for hired labor which are unavoidable. In order to effect these payments without selling outputs at lower prices, marketing insurance can be an important scheme for farmers.

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Annex

Table 5: Description of dependent and independent variables

Variable name	Description of the variable	N	Mean	Standard division	Minimum	Maximum
Q_sold4wks	Quantity of output sold within 4 weeks after harvest in quintals	790	1.14	3.82	0	70.5
Age	Age of household head in years	790	45.43	13.65	20	99
Sex	Sex of head, 1=male, 0= female	790	0.71	0.45	0	1
Land size	Land owned in ha	787	1.50	1.34	0.0075	15.25
Improved seed	Quantity of improved seed used	790	27.57	79.84	0	1700
Storage method	Dummy, 1= if improved storage, 0 otherwise	787	1.18	0.90	0	2
Credit	Dummy, 1= if the household received credit in the previous 12 months, 0 otherwise	788	0.45	0.50	0	1
Oromia	Regional dummy, 1=Oromia, 0 otherwise	790	0.43	0.50	0	1
Amhara	Regional dummy, 1=Amhara, 0 otherwise	790	0.38	0.49	0	1
Labor cost	labor cost incurred in Birr	789	597.10	1560.06	0	20190
lnassets	logarithm of asset value owned by the household	790	6.98	1.31	0.6931472	10.71175
Total input	total input cost in Birr	790	3202.21	4909.38	0	76858
Market info	dummy, 1= if the household accessed market info, 0 otherwise	790	0.27	0.45	0	1
Number of markets	Number of market centers in the area	790	2.82	1.02	1	5
Education	years of education of head	790	2.39	3.25	0	18
Extension	Dummy, 1=if the household accessed	789	0.56	0.50	0	1

	extension, 0 otherwise					
Technology	Dummy, 1=if the household used improved practices, 0 otherwise	789	0.26	0.44	0	1
lnlaborc	logarithm of labor cost	789	3.15	3.29	0	9.912943
lninputc	logarithm of input cost	790	7.31	1.57	0	11.24971
Adult Equivalent	family size in adult equivalent scale	805	4.90	2.12	0.74	15.88
Non-farm income	Dummy, 1=if the household has non-farm income, 0 otherwise	804	0.50	0.50	0	1
Family size	number of household members	805	5.84	2.46	1	18

Table 6: Average Marginal effect after Tobit: conditional on being uncensored

Variable name	**dy/dx**	**Std. Err.**	**z**	**P>z**	**[95% Conf. Interval]**	
Technology	-0.487	0.235	-2.08	0.038	-0.947	-0.028
Extension	0.097	0.213	0.45	0.65	-0.321	0.514
Education	-0.068	0.032	-2.15	0.032	-0.130	-0.006
Number of markets	0.155	0.089	1.75	0.081	-0.019	0.329
Market info	-0.091	0.204	-0.45	0.655	-0.490	0.308
Lnassets	0.052	0.091	0.57	0.569	-0.126	0.229
Lninputc	0.370	0.099	3.73	0	0.175	0.565
Lnlaborc	0.058	0.033	1.77	0.077	-0.006	0.122
Oromia_dummy	1.201	0.323	3.72	0	0.568	1.833
Amhara_dummy	1.374	0.326	4.21	0	0.735	2.014
Storage method	0.126	0.111	1.14	0.256	-0.092	0.344
Improved seed	0.000	0.001	0.06	0.956	-0.002	0.002
Land size	0.082	0.090	0.91	0.364	-0.095	0.259
Sex of head	0.223	0.219	1.02	0.307	-0.205	0.651
Credit received	*0.343*	*0.179*	*1.91*	*0.056*	*-0.009*	*0.694*
Adult Equivalent	-0.081	0.048	-1.7	0.089	-0.175	0.012
Non-farm income	-0.053	0.179	-0.29	0.769	-0.404	0.299