Determinant of Sheno butter (cows’ butter) market chain: The case of Kimbibit District in North Shewa Zone of Oromia National Regional State, Ethiopia

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Received 23 October, 2015; Accepted 17 March, 2016

This study was carried out to assess the determinants of Sheno butter market participation decision and level of participation in Kimbibit District. The study took a random sample of 126 butter producer households by using multi-stage sampling procedure and employing a probability proportional to sample size sampling technique. The Heckman two-stage econometric estimation procedure is employed to identify factors that determine butter market participation decision and volume of participation. The result of descriptive statistics revealed that there were significant mean and proportional difference among participant (79%) and non-participant (21%) households in terms of livestock holding, total food crop yield, non-dairy farm income and edible oil and vegetable butter consumption. Likewise the result of the Heckman first stage (probit) showed that butter market entry decision was significantly affected by age, education level, distance to nearest butter market and access to market information of households. The second stage estimation result revealed that total butter output, total butter consumption, number of cross bred milking cows, edible oil and vegetables butter consumption and market information were found to be significantly affect the volume of marketed butter.

Key words: Market participation, determinants, Heckman’s procedure, Sheno butter, Kimbibit

INTRODUCTION

Ethiopia has one of the largest livestock inventories in Africa with a national herd estimated of 52.13 million cattle, 50.8 million sheep and goats, 9.92 million pack animals and 44.89 million poultry. All livestock currently support and sustain livelihoods for 80% of all rural poor. Of these resources, 20% of cattle and 25% of sheep are found in the lowland pastoral areas of the country. The estimated annual growth rates are 1.2% for cattle, 1% for sheep and 0.5% for goats. The percentage of total livestock population found in highlands of Ethiopia including per-urban and urban areas are 70-80% of the cattle, 48 - 75% of sheep and 27 - 55% of goats (CSA, 2012). Market-oriented development of smallholder dairying has a potential to spur economic growth and
alleviate poverty (Bennett et al., 2006).

The major species used for milk production in Ethiopia are cattle, camel and goats. Cattle produce 83% of the total milk and 97% of the cow milk comes from indigenous cattle breeds. The total population of animals used for milk production is 13,632,161 tropical livestock units (TLU). Although milk production is increasing by 1.2% per annum, the demand-supply variance for fresh milk is ever widening and the per capita consumption is diminishing (CSA, 2012). The key development issues in dairy are low milk production, complicated by widespread food insecurity, growing gap between supply and demand in urban areas, and low average milk productivity (MOARD, 2004).

Butter is an important source of food (cooking oil), cosmetics and common marketable form of dairy product for peri-urban and rural community. Butter produced from whole milk is estimated to have 65% fat and is the most widely consumed milk product in Ethiopia. Of the total milk produced, around 40% is allocated for butter while only 9% is for cheese (Ahmed et al, 2003). This study was, therefore, carried out to assess the determinants of Sheno butter market participation decision and level of participation.

Dairy production, among the sectors of livestock production system, is a crucial issue in Ethiopia where livestock and its products are important source of food and income. However dairies have not been fully exploited and promoted in the country. Despite its huge numbers, the livestock subsector in Ethiopia is low in production in general, and compared to its potential, the direct contribution it makes to the national economy is limited. A number of fundamental constraints underlie these outcomes, including traditional technologies, limited supply of inputs (feed, breeding stock, artificial insemination and water), poor or non-existent extension service, high disease prevalence, poor marketing infrastructure, lack of marketing support services and market information, limited credit services, absence of effective producers’ organizations at the grass roots levels, and natural resources degradation (Berhanu et al., 2007). Therefore, this study is basically aimed at identify determinants of market participation decision and level of participation and to identify major production and marketing constraints of butter in study area. Hence, the findings of this study would be useful to help policy makers in designing appropriate policies for private investment and nongovernmental organizations that are engaged in the development of livestock sub-sector.

**METHODOLOGY**

**Study area**

The research was conducted in Kembibit District, located in North Showa Zone, Oromia National Regional State at distance of 78 km from Addis Ababa on the way to Dessie. The total population living in the District is estimated to be 83,817 of which 41,729 male and 42,088 were female (Central Statistics Agency, 2011). The administrative center of this District is Sheno town. Kembibit District is familiar in production of organic Sheno butter/dairy butter. Butter produced in this area is named by the town name as Sheno butter. The District annual mean of butter marketed was about 864,000 kg. Because of its preferable accepted, vegetables butter producer named their product as “Sheno butter”.

**Sampling procedures and sample size**

Out of the 18 District found in North Showa Zone, Kembibit District was selected based on their Sheno butter production potential and high demand of the product. A multi-stage technique was used to draw an appropriate sample. In the first stage, among 29 rural kebele administrations (RKAs) found in the District 8 kebeles were selected based on their potential of Sheno butter production and market access. Finally by using simple random sampling technique 4 RKAs (Gara chatu, Golelcha, Tuka Abdolla and Moyona qumdingay) are selected. In the second stage, list of households involved in Sheno butter production was obtained from District Livestock Development and Livestock Health Office as well as RKAs. Thirdly, at survey time 2,315 households involved in Sheno butter production were identified from the list they belong in each RKAs. Finally, among several approaches to determine the sample size, Yamane (1967) is used and totals of 126 sample producers are selected for interview.

**Heckman’s two stage model specification**

The empirical specification of the probit model to be estimated by maximum likelihood estimation is defined as participation equation or binary probit equation:

\[ Y_i^* = \beta^t X_i + \epsilon_i \]  

Where \( Y_i^* \) = BMPRT, butter market participation decision  
\( X_i \) = vector of explanatory variables  
\( \beta = \) is the vector of parameter coefficients  
\( \epsilon_i = \) is the estimated butter market participation probability

The probit functional form compels the error term to be homoscedastic because the form of probability depends only on the difference between error terms associated with one particular choice and other (Amemiya, 1985). The marginal effects were estimated on the variable means. This calculation involved taking the partial derivatives that measures the change in the probability of participation per unit change in the independent variable. The second stage of Heckman’s two stage procedure for this study was specified as:

\[ TBS_j = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ..... + \beta_n X_n + \lambda \epsilon_i \]  

Where \( TBS_j \) = Total butter market supply by the \( j^{th} \) producer  
\( X_i \) = exogenous variables in the second stage  
\( \beta_i \) = parameter coefficients  
\( \lambda (X, \beta) = \) the Inverse Mill’s Ratio derived from the first stage  
\( \epsilon_i = \) error term in the second stage

The model parameters were estimated by Heckman selection model. As a result, employing OLS to estimate the model may introduce a sample selectivity bias and the parameter estimates may not be consistent and efficient. Therefore, to remove the selectivity bias,
the study used Heckman’s (1979) two step procedure. The first step of the procedure involves establishing the probability of participation in the butter market by estimating a probit model. The level or magnitude of sales or second stage was derived from first stage. Before running the Heckman selection model multicollinearity test was carried out. According to the results, significant problem of multicollinearity was not observed.

**Definition and measurement of the study variables and hypothesis**

In order to explain butter producer’s market participation, continuous and discrete variables were identified based on economic theories and the findings of different empirical studies. Accordingly, the following variables were included.

**Dependent variables**

- **Butter market participation decision (BMPRT):** Is a dummy variable that represents the probability of market participation of the household in the butter market that was regressed in the first stage of two stages estimation procedure. It takes a value of 1 for households who participated in the market and 0 otherwise.

- **Total butter market supplied (TBS):** It is continuous dependent variable in the second step of the Heckman selection equation. It is measured in kg and represents the volume of sold butter by households to the market which is selected for regression analysis that takes positive values.

**Independent variables**

Independent variables are assumed to influence butter market entry decision and level of market supply. The omission of one or more relevant variables or inclusion of one or more irrelevant variables may result in error of specification which may reduces the capability of the model in exploring the economic phenomena empirically. The following variables were identified to be included in the estimation equations.

- **Size of butter output (TOUT):** It is continuous variable measured in kilogram. The variable is expected to have a positive contribution to smallholder dairy market participation decision and level of butter market participation. A marginal increase in dairy production has obvious and significant effect in motivating market participation. As the number of dairy cow increases, production also increases and the percentage share of consumption declines and sales increases (Holloway and Ehui, 2002). Study conducted by Singh and Rai (1998) identified factors affecting marketed surplus of buffalo milk in Haryana. They observed that milk production significantly affected marketed surplus positively.

- **Distance to nearest dairy product market (DNM):** Is location of the dairy household from the nearest butter market and is measured in kilometer. The closer the dairy market to dairy households’ the lesser would be the transportation charges and better access to market information and facilities. A study conducted by Holloway and Ehui (2002) on expanding market participation among smallholder livestock producers in the Ethiopia high lands revealed that distance to milk market was negatively related to milk market participation decision of dairy households. Therefore, in this study, distance from nearest butter market will be hypothesized to be negatively related to market participation decision and marketable butter surplus.

- **Edible oil and vegetables butter consumption (OVC):** Is a dummy variable takes the values of one if the households consume edible oils and vegetables butter and zero otherwise. This is expected to have positive effect on participation and level of market participation, as the households uses edible oil, vegetables butter and cosmetics gel, market participation and volume of butter supply will be increases.

- **Number of milking cows/CB for cross breed, LB for local breed:** This variable is continuous and is measured in number of milking cow owned. The entry to butter market and marketed butter volume are assumed to be positively influenced by the number of milking cows owned. The study conducted by Holloway and Ehui (2002) in the Ethiopian high lands on expanding market participation among smallholder livestock producers indicated positive and significant relation between milking cow numbers and market participation and marketable milk volume.

- **Education Level of the Household Head (EDU):** It is continuous variable and is measured in years of formal schooling of the household head. Education plays an important role in the adoption of innovations/new technologies. Further, education is believed to improve the readiness of the household to accept new idea and innovations and get updated demand and supply price information which in turn enhances producers’ willingness to produce more and increase butter market entry decision and volume of sale. Study conducted by Rehima (2006) showed that formal education was positively related to household market participation and marketed volume.

- **Experience in butter production (EXP-B):** This variable is measured in terms of the number of years of butter producing of the household head. It is expected to have a positive effect on market participation and sale volume due to experienced household would more likely produce more.

- **Age of the household head (AGE):** It is a continuous variable and measured in years. Age is a proxy measure of farming experience of household and age of the household head was expected to have positive effects on market participation decision and level of supply. The positive and significant relationship between the two variables indicates that older dairy household head could have more milking cows which increases the probability of the households market entry decision (Birhanu, 2012).

- **Sex of the household head (SEX):** It is a dummy variable taking one for male and zero for female household head. In mixed farming system, both men and women take part in livestock management. Generally, women contribute more labor input in area of feeding, cleaning of barns, butter and cheese making and selling of dairy products. However, obstacles, such as lack of capital, access to institutional credit, access to extension service, may affect women’s participation and efficiency in livestock production (Tanga et al., 2002). Therefore, it is not possible to tell a priori about the likely sign of the coefficient of sex in market participation and sales volume.

- **Income from non-dairy/ non-farm sources (NDI):** Financial income from non-dairy/farm sources has positive effect on sale volume. The positive relation between the variables indicates that any additional financial income enables the dairy household to purchase more number of improved dairy cows which can contribute to increased milk production per household per day and then contribute to increased market participation decision by dairy households. Gizachew (2005) showed that financial capital from different sources has positive effect and indicating that such resources strengthen the ability of smallholder dairy producers’ for coping with different risks of production and consumption as well as enter to economic transactions.
Frequency of extension contact (FREXTCO): It is a continuous variable measured in numbers of days dairy experts contact with dairy producers per year. It is expected that extension service widens the household’s knowledge with regard to the use of improved dairy production technologies and has positive impact on butter market participation decision and sale volume. Number of extension visits improves the household’s intellectual capitals, which improves dairy production and divert dairy production resources. Different studies revealed that extension visit has direct relationship with market entry decision and marketable output. Gizachew (2005) and Embaye (2010) identified that extension visit was positively related to dairy market entry decision and marketed dairy volume. Therefore, number of extension visits will hypothesis to impact household butter market entry decision and marketed volume of butter positively.

Children below the age of five (CHIL5): It is a continuous variable measured in numbers of children belong to household head. Mostly milk is a major food for children and its importance in children growth is widely accepted and recognized both in rural and urban areas. Children have natural priority in consumption of milk in the household and increase in the number of children in this age category usually decreases the marketable surplus and reduces the ability of the smallholder in butter market participation.

Access to market information (MIFO): It is a dummy variable taking value of 1 if household access to market information, 0 otherwise. Farmers marketing decisions are based on market price information, and poorly integrated markets may convey inaccurate price information, leading to inefficient product movement. Therefore, it will be accepted that, market information is positively related to market participation and marketable surplus. Study conducted by Embaye (2010) on butter supply chain showed that better information significantly raises the probability of market participation for potential selling households.

Access to credit (CACE): Access to credit will be measured as a dummy variable, taking value of 1 if the farmer had access to credit and 0 otherwise. This variable is expected to influence the marketable supply of dairy product positively on the assumption that producers use the credit for production purpose (Gizachew, 2005).

Total butter consumption (TCONS): It is continuous variable measured in kilogram. The variable is expected to have inverse on butter market participation decision and level of butter market participation. As households butter consumption at home level increases the butter market participation and volume of supply will be decreases.

Other livestock in TLU: This is the number of live animals measured in tropical livestock unit, excluding lactating cows. This variable will have positive impact on both participation and level of participation.

RESULTS AND DISCUSSION

The results revealed that out of 126 sample households, about 100 households are market participants, while the rest 26 of them are non-participants.

Determinants of butter market participation decision

Table 1 presents the results of the probit estimation of factors that influenced the decision to sell butter. The model chi-square tests applying appropriate degrees of freedom indicated that the overall goodness of fit of the probit model was statistically significant at 1% probability level. This shows that jointly the independent variables included in the probit model regression explain the variations in the households’ probability of market participation decision. The probit model explained 72.89% of the variations in the likelihood of dairy farmers to butter market participation and predicted about 90.85% of the cases correctly.

The empirical results in Table 1 showed that the age of butter producer household head (AGE), education level of butter producer household head (EDU), distance to nearest butter market (DNM) and access to market information (MIFO), are significant variable that affect the probability of households butter market participation decision among responding households in study area. The age of butter producer household head have a positive and significant impact on butter market participation decision of the sample dairy producer at 1% probability level. The marginal effect also confirms that when the household head age increases by one year, the probability of participating in the butter market increases by 1.13%. This is in line with Woldemichael (2008) who illustrated that if dairy keepers get older, the milk market participation of household increases. Because, according to Ethiopian context, elders hold huge land size and younger ones hold less size of land; thus, it is quite challenging for youngest men to be raising number of livestock or land holding increases butter market participation of butter producer household. Education level of butter producer’s household also has positive effect on probability of butter market participation decision and is significant at 1% probability level. The marginal effect indicates that addition of one-year formal schooling leads to raise the probability of dairy households butter market participation by 1.81%. This is in line with Gizachew (2005) who found positive and significant relationship indicating that education improves the dairy household’s capacity to process production and market related information, which in turn improves bargaining position.

Access to information is also positively affected market participation at 1% significance level. The marginal effect of the variable also confirms that as household head has access to market information the probability of butter market participation increases by 18.45%. The implication is that obtaining and verifying information helps to participate more. Study conducted by Embaye (2010) on butter market supply chain analysis identified that better information significantly raises the probability of market participation. Distance to nearest butter market (DNM) had positive effect on butter market participation decision and found to be statistically significant at 5% significance level. The positive relationship indicates that the farther the household from the milk market, the more
Table 1. Probit results of butter market participation decision

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Robust Std. Err.</th>
<th>t-ratio</th>
<th>Marginal effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>0.011***</td>
<td>0.0031</td>
<td>3.6</td>
<td>0.0113</td>
</tr>
<tr>
<td>SEX</td>
<td>0.064</td>
<td>0.0414</td>
<td>1.54</td>
<td>0.0639</td>
</tr>
<tr>
<td>EDU</td>
<td>0.018***</td>
<td>0.0055</td>
<td>3.27</td>
<td>0.0181</td>
</tr>
<tr>
<td>TOUT</td>
<td>0.011</td>
<td>0.0094</td>
<td>1.16</td>
<td>0.0108</td>
</tr>
<tr>
<td>TLU</td>
<td>-0.001</td>
<td>0.0013</td>
<td>-0.80</td>
<td>-0.0010</td>
</tr>
<tr>
<td>TCONS</td>
<td>-0.048</td>
<td>0.0330</td>
<td>-1.45</td>
<td>-0.0478</td>
</tr>
<tr>
<td>CHIL5</td>
<td>0.047</td>
<td>0.0332</td>
<td>1.44</td>
<td>-0.0479</td>
</tr>
<tr>
<td>CB</td>
<td>0.001</td>
<td>0.0271</td>
<td>0.05</td>
<td>-0.0014</td>
</tr>
<tr>
<td>LB</td>
<td>0.023</td>
<td>0.0208</td>
<td>1.14</td>
<td>0.0238</td>
</tr>
<tr>
<td>MIFO</td>
<td>0.185***</td>
<td>0.0564</td>
<td>3.27</td>
<td>0.1845</td>
</tr>
<tr>
<td>FREXTCO</td>
<td>-0.001</td>
<td>0.0027</td>
<td>-0.25</td>
<td>0.0006</td>
</tr>
<tr>
<td>NDI</td>
<td>0.011</td>
<td>0.0442</td>
<td>0.25</td>
<td>0.0284</td>
</tr>
<tr>
<td>DNM</td>
<td>0.001**</td>
<td>0.0031</td>
<td>3.23</td>
<td>0.0099</td>
</tr>
<tr>
<td>OVC</td>
<td>0.128</td>
<td>0.0837</td>
<td>1.53</td>
<td>0.1283</td>
</tr>
<tr>
<td>EXP_B</td>
<td>-0.004</td>
<td>0.0037</td>
<td>-0.96</td>
<td>-0.0035</td>
</tr>
<tr>
<td>CACE</td>
<td>-0.036</td>
<td>0.0378</td>
<td>-0.94</td>
<td>-0.0357</td>
</tr>
</tbody>
</table>

\[
\text{chi}^2(1) = 8385.36^{***}
\]
Percentage of correctly predicted = 90.85%, n = 126
Log likelihood function = -28.78; Likelihood function = 72.89%

Sources: Own computation (2013).

Table 2 shows the determinants of volume of marketed butter. The R² explains about 94.25% of total variation in the determinants of volume of marketed butter, which is attributed to the specified independent variables in the model. The F statistic of 147.42 is statistically significant at 1% probability level; this means that the estimated R² is statistically significant. The empirical result showed that total butter output (TOUT), total butter consumption by producers (TCONS), the number of cross breed milking cows owned (CB), oil and vegetable butter consumption by cow butter producer (OVC) as well as access to butter market information (MIFO) are significantly determining the level of butter market participation (Table 2).

The total butter production is positively related with quantity supplied and significant at less than 1% probability level. The result showed that a one kg increase in the butter output causes a 0.707 kg increase in the amount of marketed supply per month. Total butter production influenced the amount of marketed supply of butter positively showing that farmers who produce more also sell more, which is consistent with the general expectation. Coefficient of butter consumption variable was negatively related with quantity supplied and significant at less than 1% probability level. The result indicated that a one kg increase in butter consumption causes a 1.32 kg decline in the amount of marketed supply of butter per month. Total butter consumption influenced the amount of marketed supply of butter negatively, showing that farmers who consume more sell less, which is consistent with the general expectation.

Number of cross breed milking cows (CB) was significant at 10% probability level and had positive effect on marketable butter volume. The model predicted that the addition of one crossbreed cow causes the marketable butter surplus of the dairy household to rise by 1.208 kg per month. This result suggests that marketable butter surplus of the households in the study area is more responsive to number of cross breed milking cows. Similarly, studies conducted by Holloway (2002), Gizachew (2005), Woldemicheal (2008) and Embaye (2010) found that household with larger number of dairy cows was positively associated with volume of sale of dairy products.

Oil and vegetables butter consumption (OVC), the consumption of butter substitute products is influenced butter marketed positively and significant at 10% probability level. When the households’ consumption of butter substitute products increases by one liter or kg, the
volume of butter sale is increases by 0.780kg per month. Access to market information (MIFO), Information access was also another factor, which positively affected level of participation at 5% significance level. Thus implies that having market information increases the quantity of marketed by 0.931 kg per month. The implication is that obtaining and verifying information helps to supply more. Finally, Lambda (Inverse Mills Ratio) or selectivity bias correction factor had negative coefficient, but statistically insignificant impact on marketable Sheno butter surplus.

**CONCLUSION AND RECOMMENDATIONS**

The econometric model result of Heckman’s first and second stage come up with significant coefficient of market information. The problems associated with market information seem lead to low awareness of butter transaction. Hence, market information is the important component for improving the whole marketing system. The availability of timely information to farmers can increase farmers’ bargaining capacity and participation. Therefore, market information service has to keep on aiming to provide information for all farmers involving in butter production and has to inform them how to reduce cost of production and marketing.

The study result revealed that consumption of butter is influenced level of participation negatively. The implication is that there was a consumption of edible oils and vegetables butter which in turn increases level of participation highly. Therefore, local government should introduce integrated edible oil and vegetable butter producers into the area as well as enhances quality and standard control for human health assurance. But butter fats were superior to vegetable butter because they contained vitamin A, which was not found in the vegetable butters. Therefore, this is recommended when removal of fat from milk and replacing it with an oil and vegetable butter. Overall, the study area is agro ecologically suitable for livestock rearing, specially milking cows. Therefore, by using this piece of insight information any interested private, local government, individual and non government organization can take part in Sheno butter production. Finally, future research should focus on chemical components and nutrient contents of Sheno butter and long term dairy development in kimbit district.

**CONFLICT OF INTERESTS**

The authors have not declared any conflict of interests.

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