LAND ECONOMY WORKING PAPER SERIES

Number: 77         Demand for dairy products in Malawi
Demand for dairy products in Malawi

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ABSTRACT

In this paper an almost ideal demand system with censoring was estimated to assess Malawians’ demand for six dairy products (i.e. fresh milk, powdered milk, margarine and butter, chambiko, yogurt and cheese). On the first stage of the estimation, it was found that the consumption of dairy products depend on whether the household is rural or urban, the region (North, Centre, South) and the household poverty status. The results also showed that the demand for fresh and powdered milk, butter and margarine, cheese and yogurt were price inelastic except chambiko, which was found price elastic. The cross-price elasticities showed that fresh milk, powdered milk were gross substitutes. The expenditure elasticities showed that the consumption of milk increases with household’s income.

KEY WORDS: dairy products, censored demand system, Malawi.

\[1\] This research is part of the DFID-ESRC project “Assessing the Contribution of Dairy Sector to Economic Growth and Food Security in Malawi” (ES/J009202/1).
1. Introduction

Milk and dairy products have been recognized as important foods for humans 3,000 B.C. when farm animals were first domesticated including cows (Rusoff, 1955). Their consumption has been scientifically proven to have several health benefits. For instance, dairy products are an important source of key nutrients including high quality protein, energy, and many essential minerals and vitamins. These nutrients have been found vital for building healthy bones and reducing risk of gum disease. Furthermore, several epidemiological studies found an inverse association between the intake of dairy products and hypertension, stroke and colorectal cancer (Alvarez-Leon et al, 2006). In response to these scientific evidences on the healthy value of milk and dairy products, dietary guidelines, such as World Health Organisation (WHO) guideline, have recommended daily intake of dairy products for the overall health of the population (e.g. 200 kg of milk/capita/year)

As a result of the importance of dairy products for health and the increase of the world population, the production and the demand for dairy products have significantly increased in the world. According to FAOSTAT, the global production of milk increased by 20 per cent between 1999 and 2009 (i.e. from 579.5 million tons to 696.5 million tons).

Regarding annual per capita consumption, FAOSTAT statistics show a quantity of 108 kg/capita/year in 2007. This number hides a huge variation among countries. For instance, Finland is at the top of the list with an average of 361kg/capita/year and the last position is occupied by Congo with consumption per capita per year of 1.28Kg.

Malawi, the focus of this study, is among the countries with the lowest production and consumption of milk and dairy product. In fact, the production of milk in Malawi did not vary between 1999 and 2009 and remained at the level of 35 thousand tonnes per year. Furthermore, the consumption of milk products in Malawi is very low, estimated at 4-6 kg/capita/year (Tebug, 2012). This quantity is lower than the
African average of 15 kg/capita/year, and significantly lower than the quantity of 200 kg/capita/year recommended by the WHO and FAO (Banda, 2008).

Due to the economic and nutritional importance of dairy products, the Government of Malawi and donor countries such as USA, Japan and Belgium are focusing part of their research effort on determining the causes of the low production and consumption of dairy products in Malawi and identifying the strategies they have to undertaken to improve the supply of dairy products and stimulate their consumption. The major part of the research effort has been focused on the supply side which, in part, explains the scarcity of publications on the demand for dairy products in Malawi with the exception of the work of Ecker and Qaim (2011) that was dedicated to analyzing the impact of nutritional food policies in Malawi.

Domestic pasteurised milk competes in Malawi with imported powdered milk. To counterbalance low import prices that harm domestic producers, the Government in response to the lobby of institutions, such as the Malawi Milk Producers Association and VSO increased the levy on imported milk in 2010 from 20 to 30 per cent (VSO, 2011). As the change in the levy most probably would increase the price of powdered milk, it would be important to be able to measure the impact on the demand for domestic pasteurised milk. Unfortunately, without detailed estimates of the demand for dairy products (and other price elasticities of demand) this is not possible.

The purpose of this paper is to fill this gap by estimating the demand for dairy products in Malawi using data from the third Integrated Household Survey (IHS3) that was conducted in Malawi between March 2010 and March 2011. Specifically, an almost ideal demand system with censoring was estimated to assess Malawians’ demand for six dairy products (i.e. fresh milk, powdered milk, margarine and butter, chambiko, yogurt and cheese). Own and cross-price elasticities as well as expenditure elasticities were computed to determine, among others, the sensitivity of demand for dairy products to variation of prices and income as well as to identify the nature of the relationship (substitution or complementarity) among the six dairy products considered in this study.
The structure of the paper is as follows: the next section, the empirical section, describes the data and the methodology used in data analysis. Next, the main findings are described and discussed, whilst the final section presents the conclusions.

2. Data

To estimate the demand for dairy product in Malawi, we used data from the Integrated Household Survey 3 (IHS3) conducted by the National Statistical Office of Malawi over the period of March 2010 to March 2011. The sample that comprises 12,271 households was statistically designed to be representative at national, district, urban and rural levels. The IHS3 consists of four questionnaire; the household questionnaire, the agriculture questionnaire, the fishery questionnaire and the community questionnaire (for more information on the IHS3 see the World Bank website, section “Data & Research”).

The data on household food consumption was collected as part of the household questionnaire. This questionnaire collected, among others, information on all food products consumed by the household in the seven days that preceded the administration of the questionnaire. As the data were based on household recollection, all the issues about accuracy mentioned in Ecker and Qaim (2011) apply.

The food products were classified according to their sources such as purchased, own production or food gifts and other sources. In the present study, we considered the data corresponding to six dairy products: fresh milk, powdered milk, margarine and butter, chambiko, cheese and yogurt. In addition to food consumption, household questionnaire also collected information on socio-demographic and economic characteristics of individuals living in the household such as gender, age, relationship to the household head, education, income, amongst others.
Table 1 provides the data descriptive statistics. It should be noted that the data have high dispersion, particularly as regards the consumption of fresh milk.

<table>
<thead>
<tr>
<th>Dairy products</th>
<th>Observations</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh milk</td>
<td>12271</td>
<td>0.619</td>
<td>14.415</td>
<td>0.32</td>
</tr>
<tr>
<td>Powdered milk</td>
<td>12271</td>
<td>0.123</td>
<td>5.507</td>
<td>0.38</td>
</tr>
<tr>
<td>Butter and Margarine</td>
<td>12271</td>
<td>0.105</td>
<td>5.332</td>
<td>0.22</td>
</tr>
<tr>
<td>Cheese</td>
<td>12271</td>
<td>0.009</td>
<td>0.936</td>
<td>0.01</td>
</tr>
<tr>
<td>Chambiko</td>
<td>12271</td>
<td>0.204</td>
<td>9.539</td>
<td>0.03</td>
</tr>
<tr>
<td>Yogurt</td>
<td>12271</td>
<td>0.161</td>
<td>7.560</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Source: Own elaboration, based on data from the IHS3, National Statistical Office of Malawii.

3. Almost Ideal Demand System and censoring

As regards the empirical methods in this paper, we estimated an Almost Ideal Demand System (AIDS, Deaton and Muellbauer, 1980) which is the most widely used demand model in the literature due to its ease of estimation and its flexibility to include parametric restrictions required for consistency with economic theory. Then, we computed the own and the cross-price elasticities as well as the expenditure elasticities for six dairy products: fresh milk, powdered milk, margarine and butter, chambiko, Cheese and yogurt.

In the AIDS model the budget share of good $i$, in time $t$, is given by:

$$ w_{it} = a_i + \sum_{j=1}^{n} y_{ij} \ln p_{jt} + \beta_i \ln \left( \frac{x_t}{p_t} \right) $$

where $p_{jt}$ is the price of commodity $j$, $x_t$ is total expenditure and $p_t$ is a price index defined by:

$$ \ln p_t = a_0 + \sum_{k=1}^{n} \alpha_k \ln p_k + \frac{1}{2} \sum_{j=1}^{n} \sum_{k=1}^{n} \gamma_{jk} \ln p_{jt} \ln p_{kt} $$
Adding up, homogeneity of degree zero in prices and total expenditure, and Slutsky symmetry imply the following restrictions on the parameters

\[
\sum \alpha_i = 1 \quad \sum \beta_i = 0 \quad \sum \gamma_{ij} = 0 \quad \text{(adding up)} \tag{3}
\]

\[
\sum_j \gamma_{ij} = 0 \quad \forall i \quad \text{(homogeneity)} \tag{4}
\]

\[
\gamma_{ij} = \gamma_{ji}, \quad \forall i, j \quad \text{(symmetry)} \tag{5}
\]

Using a price index such as in (2) may complicate the estimation of the AIDS system due to its non-linearity. To simplify this, Stone’s price index \((p^*)\) is often used instead of \(p\) where

\[
lnp^*_t = \sum_{k=1}^{n} w_{kt} ln p_{kt} \tag{6}
\]

The estimation of disaggregate demand for food products using household survey data such as IHS3 is often complicated by the existence of zero observations on expenditures of different types of food products. Expenditure is generally recorded as zero when the food product is not consumed during the recall period. There are, however, various ways to overcome the econometric problem created by the existence of zero observations. In this study, we used the approach proposed by Shonkwiler and Yen (1999). It consists in the estimation of a censored system in two steps.

In the first step, a probit model is estimated to determine the probability that a given household will consume the food product in question. To do so, the dependent variable for each one of the six dairy products is modelled as a dichotomous choice problem: the variable takes the value of 1 if the household reported consuming the product in the recalling period otherwise the dependent variable is given a value of zero. To estimate the probit model, the household’s socio-demographic characteristics were used as independent variables. Concretely, we used the following socio-demographic variables: the region (north, central or south region), the residential area (urban or rural) and the poverty level (poor or non-poor) as well as the prices corresponding to the six dairy products considered in our analysis. After
the estimation of the probit model, the normal probability density function \((\phi_{ih})\) and
the normal cumulative distribution function \((\Phi_{ih})\) are estimated for each household.

In the second stage, the probability density and the cumulative distribution function
are incorporated in the budget share equations and the AIDS model is estimated via
seemingly unrelated regression (SUR). Thus, the equation (1) is replaced by the
following equation:

\[
\sum \left[ \Phi_{ih} \left( a_t + \sum_{j=1}^{n} \gamma_{ij} \ln p_{jt} + \beta_{i} \ln \left( \frac{x_i}{p_i} \right) \right) \right] + \lambda_i \phi_{ih}
\]

(7)

After the incorporation of probability density and the cumulative distribution function,
the right-hand side of equation (7) do not add up to unity across all the budget share
equations and , hence, the common used procedure that consists in imposing the
adding up restriction on the system of equations and dropping one equation is not
anymore appropriate. According to Yen et al (2002) the censored demand system
can be estimated correctly considering all the budget share equations.

To calculate the price and expenditure elasticities, we followed the approach
suggested in Green and Alston (1990). The elasticities’ formulas are as follows:

The Expenditure elasticity:

\[
E_i = 1 + \phi_i \frac{\beta_i}{w_i}
\]

The Marshallian own-price elasticity:

\[
e_{ii} = \Phi_i \left( \frac{\gamma_{ij}}{w_i} - \beta_i \right) - 1
\]

The Marshallian cross-price elasticity:

\[
e_{it} = \Phi_i \left( \frac{\gamma_{ij} - \beta_i w_t}{w_i} \right)
\]

The Hicksian own-price elasticity:

\[
\tilde{e}_{ii} = e_{ii} + w_i E_i
\]
The Hicksian cross-price elasticity:
\[ \hat{e}_{ij} = e_{ij} + w_j E_i \]

4. Results and discussion

Before proceeding with the discussion of the unconditional elasticities for dairy products, it is useful to analyse the variation of dairy products consumption across households’ socio-demographic characteristics.

Table 1 presents the results from the estimation of Probit models that test the relation between the probability of consuming each one of the six dairy products and the following socio-demographic variables: (1) “Urban” that takes 1 if the household is located in an urban area and 0 if the household members are living in a rural area, (2) “North” takes 1 if the household is located in the north part of Malawi and 0 otherwise, (3) “Central” takes 1 if the household is located in the central part of Malawi and 0 otherwise, and finally (4) “South” takes 1 if the household is located in the southern part of Malawi and 0 otherwise, and (5) finally “Non-poor” is a binary variable that takes a value of 1 if the household is considered above the level of poverty and a value of 0 if the household is considered under the level of poverty. To avoid the problem of multicollinearity, the variable “Central” was dropped during the estimation of the six probit models.

Results, in Table 2, show that households residing in urban areas have a higher probability to consume fresh milk, powdered milk, butter and margarine, and yogurt than households living in rural areas. However, they are less likely to consume chambiko. In addition, it was found that Malawians living in the north have a higher probability to consume fresh milk and chambiko and lower probability to consume yogurt than Malawians living in the rest of the country. Furthermore, the results show that Malawians living in the south have a higher probability to consume yogurt but lower probability to consume fresh and powdered milk than the Malawians living in the north and the centre of the country.

Finally, it was found that non-poor households have a higher probability to consume fresh and powdered milk than poor households. However, the probability of
consuming butter/margarine, chambiko, Cheese and yoghurt is not significantly different between poor and non-poor households. To sum up, Malawians’ consumption of dairy product seems to vary in function of the region, the residential area and the level of poverty.

Regarding the unconditional elasticities for dairy products, Table 3 shows the computed Marshallian price and expenditure elasticities as well as their level of significance. The results show that all the own-price elasticities have the right sign and are significant. This implies that the six dairy products are normal goods implying that their consumption decreases when their prices increase. In addition, we found that the demand for fresh milk, powdered milk and butter and margarine, cheese and yoghurt is inelastic which implies that 1 per cent increase in the prices of these dairy products will lead to a decrease of the consumption with less than 1 per cent. However, we found that the demand for chambiko is inelastic. For instance, the results show that a 1 per cent increase of the chambiko price will lead to a decrease of the cheese consumption of 1.26 per cent.

Regarding the cross price elasticities, Table 3 shows that fresh and powdered milk are gross substitutes. Thus, an increase by 1 per cent in the price of powdered milk increases the consumption of fresh milk by 0.12; this an interesting result because it shows that: 1) cheap powdered milk can have some negative effect on the demand for domestic fresh milk (at least in urban areas, where consumption of powdered milk is more extended); and 2) the increase of the levy on imported powdered milk and its effect on consumer prices could have improve the competitiveness of the milk produced locally and increase the expenditure of those consuming powdered milk (i.e., those with an inelastic demand for powdered milk).

The expenditure elasticities show that the consumption of milk in Malawi increases with income. An increase by one per cent on the expenditure of food increase fresh milk demand by 1.456 and powdered milk demand by 1.120. Whilst these results appear very high and further work is required, it also may imply that policies that affect income of poor people also may have the effect of increasing their demand for dairy products.
### Table 2: Effect of some socio-demographic variables on the probability of buying dairy products

<table>
<thead>
<tr>
<th>Variables</th>
<th>Fresh milk</th>
<th>Powdered milk</th>
<th>Butter and Margarine</th>
<th>Cheese</th>
<th>Chambiko</th>
<th>Yogurt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>0.422 ***</td>
<td>0.325 ***</td>
<td>0.595 ***</td>
<td>6.490</td>
<td>-0.260 **</td>
<td>1.209 ***</td>
</tr>
<tr>
<td>North</td>
<td>0.530 ***</td>
<td>-0.102</td>
<td>-0.307</td>
<td>-0.811</td>
<td>1.554 ***</td>
<td>-0.458 ***</td>
</tr>
<tr>
<td>Central</td>
<td>-0.100 **</td>
<td>-0.211 **</td>
<td>0.001</td>
<td>4.210</td>
<td>0.106</td>
<td>0.253 ***</td>
</tr>
<tr>
<td>Non-poor</td>
<td>0.794 ***</td>
<td>0.663 ***</td>
<td>3.476</td>
<td>3.568</td>
<td>-0.090</td>
<td>1.420</td>
</tr>
</tbody>
</table>

Likelihood ratio test 2756.99  4875.79  4974.65  258  1000.67  474.53
P-value 0.00  0.00  0.00  0.00  0.00  0.00

Source: Own elaboration, based on data from the IHS3, National Statistical Office of Malawi.
Note: *** (**) Statistically significant at 1 per cent and 5 per cent level

### Table 3: Unconditional Marshallian elasticities

<table>
<thead>
<tr>
<th>Products</th>
<th>Fresh milk</th>
<th>Powdered Milk</th>
<th>Butter &amp; Margarine</th>
<th>Cheese</th>
<th>Chambiko</th>
<th>Yogurt</th>
<th>Expenditure elasticities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh milk</td>
<td>-0.848 ***</td>
<td>0.122 ***</td>
<td>0.075 ***</td>
<td>-0.018 ***</td>
<td>-0.053 ***</td>
<td>0.081 ***</td>
<td>1.456 ***</td>
</tr>
<tr>
<td>Powdered milk</td>
<td>0.058 ***</td>
<td>-0.786 ***</td>
<td>-0.013 ***</td>
<td>-0.031 ***</td>
<td>0.121 ***</td>
<td>-0.034 ***</td>
<td>1.120 ***</td>
</tr>
<tr>
<td>Butter &amp; Margarine</td>
<td>0.031 ***</td>
<td>-0.049 ***</td>
<td>-0.737 ***</td>
<td>-0.014 ***</td>
<td>0.068 ***</td>
<td>-0.006 ***</td>
<td>0.965 ***</td>
</tr>
<tr>
<td>Cheese</td>
<td>0.028 ***</td>
<td>0.029 ***</td>
<td>0.069 ***</td>
<td>-0.829 ***</td>
<td>0.148 ***</td>
<td>-0.117 ***</td>
<td>1.232 ***</td>
</tr>
<tr>
<td>Chambiko</td>
<td>-0.059 ***</td>
<td>0.253 ***</td>
<td>0.105 ***</td>
<td>0.072 ***</td>
<td>-1.266 ***</td>
<td>0.101 ***</td>
<td>0.328 ***</td>
</tr>
<tr>
<td>Yogurt</td>
<td>0.276 ***</td>
<td>0.223 ***</td>
<td>0.204 ***</td>
<td>-0.045 ***</td>
<td>0.151 ***</td>
<td>-0.838 ***</td>
<td>2.627 ***</td>
</tr>
</tbody>
</table>

Source: Own elaboration, based on data from the IHS3, National Statistical Office of Malawi.
Note: *** (**) Statistically significant at 1 per cent and 5 per cent level.
5. Conclusion

In this paper, the demand of Malawian household for six dairy products was analysed using data from the most recent integrated household survey conducted in Malawi.

The estimation of the almost ideal demand system with censoring and considering multiple stages, allowed us to compute unconditional own and cross-price elasticities as well as expenditure elasticities.

The results showed that all the dairy products are price inelastic except chambiko and the own-price elasticities show that dairy products are normal goods. Also, they showed that the consumption of milk in Malawi increases with income and, hence, showing policies that improve income of poor people may also have the positive effect of increasing their demand for dairy products. As regards the cross price elasticities, powdered milk (mostly imported) was found to be a gross substitute for fresh milk (domestically produced).

Although the results show that keeping the prices relatively low or subsidise consumers can expand the consumption of milk; however, a more sustainable way of securing lower prices could be by both expanding the domestic supply of milk and monitoring the marketing margins along the supply chain.

It should be noted that these results are preliminary as more work is being carried on to ensure that they are robust.
References


