

Effects of Household Characteristics on Expenditure for Dairy Products in Vietnam

Nguyen Van Phuong

Lecturer and Researcher; Department of Marketing
Vietnam National University of Agriculture Vietnam
phuonglangvan@gmail.com

Tran Huu Cuong

Associate Professor; Department of Marketing
Vietnam National University of Agriculture
Vietnam
Trancuong@hua.edu.vn

Marcus Mergenthaler

Professor; Department of Agriculture
South Westphalia University of Applied
Sciences, Germany
mergenthaler.marcus@fh-swf.de

Abstract: *In this study, Vietnamese households' expenditure on dairy products for home consumption is analyzed using the latest Vietnamese Household Living Standard Survey datasets from 2010. A double-hurdle model is utilized to analyze the effects of socio-economic and demographic variables on Vietnamese households' decision to purchase dairy products and how much to spend per capita on these items. Our results suggest that several socio-economic and demographic variables affect household expenditure on dairy products. In particular, young and old household members increase dairy expenditures. The results may help policy makers to implement policies related to the dairy industry, to nutrition for children and older people, to health and food security.*

Keywords: *Dairy products, double-hurdle model, household expenditure, VHLSS.*

1. INTRODUCTION

Dairy production and trade is on the rise on a global scale (Beghin, 2006; More, 2009; Ray et al., 2012). Similar to many Asian countries, Vietnam's economic situation has improved and thereby the living standard of its population has increased. For this reason Vietnamese have shifted from staples and nowadays pay more attention to health aspects in their food choices – particularly in urban areas. As a consequence, demand for high protein and energy dense food has increased, especially dairy products such as milk, cheese, and yogurt (Jaccar, 2009; Pingali, 2007; Dong, 2006). In recent years, the Vietnamese dairy industry has become one of the fastest growing in the food industry of the country (Khoi, 2013). However, most of Vietnam's domestic milk production comes from small-scale farms. Currently, the Vietnamese dairy market is dominated by few, large companies that import high amounts of powdered milk to meet local demand (Saenger et al., 2013a).

Vietnamese dairy demand has increased rapidly over the last years (Saenger et al., 2013a; BMI, 2011; Cuong and Nga, 2011). According to a report of the Business Monitor International (2011), Vietnamese milk demand has been driven by increasing domestic consumption due to rising incomes (BMI, 2011), by increasing welfare levels, and by urbanization (Saenger et al., 2013a). In fact, milk consumption per capita in Vietnam has doubled in the period from 2000-2009 to 12 kg/year and to 15 kg per/year in 2011 (USDA, 2011; Saenger et al., 2013b). Vietnam's milk products' market is potential and strong. The young population continues to create a stable demand for consuming dairy products, whilst awareness of consumers about health benefits related to milk products is increasing, especially with the older generation (Euromonitor, 2014). However, compared with regional countries, Vietnamese per capita consumption is still relatively low (Anh et al. 2010).

The price of foreign milk in Vietnam has been one of the highest in the world (Tuan et al., 2013; BMI, 2011). The price of imported milk has also been higher than in other developing countries in the region such as Thailand, Malaysia or Indonesia (Tuan et al., 2013). Vietnam mainly depends on imports to meet domestic demand for dairy products. The country is the 20th most important importer of dairy products in the world and it is foreseeable that demand continues to rise. Vietnam's milk

production is able to provide only 22% of the domestic demand (Cuong and Nga, 2011). Most of imported dairy products are UHT (Ultra High Temperature) milk, yogurt, condensed milk, and formula (GSO, 2014). This implies that Vietnam's dairy products' market has a high potential for future growth, both through increased domestic production and imports (Dong, 2006; Cuong and Nga, 2011; Euromonitor, 2014). High demand for milk and milk products in Vietnam creates incentives for different private actors to take advantage of the emerging opportunities. Yet, it is not clear which factors and the level of the individual household effect on expenditure behavior of dairy products.

Several studies used household data to examine socio-economic and demographic factors affecting food consumption and household expenditure on food products. Su and Yen (1996) utilized the data of the 1987-88 US Nationwide Food consumption survey to investigate households' pork consumption in the United States. The results have had an important policy implication for US' pork industry. Bittencourt et al. (2007) found affects of household characteristics on food consumption in Japan over life-cycle periods by using data from Japanese household survey in 1997. While Shiptsova et al. (2004) examined the impacts of household demographic factors on the expenditures for potatoes, bread, flour, rice and pasta. Schröck (2012) analyzed demand for organic and conventional milk by using household panel dataset of 20,000 German households. Wu et al. (2014) used data included 8188 households distributed in 15 cities and prefectures of Guangdong province to explore the determinants of urban at-home consumption demand for powdered milk. Results show the effect of socio-economic and demographic factors on food consumption behavior. These findings are useful to policy makers in developing products for national markets, ensuring food security, and improving nutritional and health policies.

In addition, several studies in Vietnam using data from household surveys, have analyzed food consumption patterns. Minot and Goletti (2000) estimated household food demand in Vietnam based on data of the Vietnam Living Standard Survey 1998. Le (2008) used data of VHLSS 2004 to investigate food consumption in Vietnam that focused on three categories of food: rice food, non-rice food and meat/fish. Meat consumption patterns in Vietnam have been analyzed by Phuong et al. a (2014) by using VHLSS 2010 data. However, no specific study is found that has paid attention on household's expenditure on dairy products in Vietnam. On the background of Vietnam's dynamic dairy market this is rather surprising and thus the paper can contribute to narrow this research gap. Therefore, the major objective of this study is to identify and examine factors that affect Vietnamese households' consumption behavior for dairy products and to derive policy implications to guide the development of the dairy sector in Vietnam.

Specific objectives considered in this study are:

- To examine the factors affecting the decision to consume dairy products.
- To determine the drivers of expenditure on milk products.
- To derive policy recommendations to develop the Vietnamese dairy sector in line with demand patterns.

1.1. Dairy Production in Vietnam over Time

Income growth, urbanization, globalization and changing lifestyles have been associated with transformations in food consumption pattern of developing countries (e.g. Mergenthaler et al., 2009; Pingali, 2007). The westernization of diets in Asian countries implies that consumers use less calorie intake from cereal and more from meat, dairy products, vegetables and fruits (Phuong et al., 2014a; Pingali, 2007). This has led to a rapid development of the dairy industry of Vietnam in production and consumption over the last years.

For Vietnamese farmers, dairy cattle are not traditional animals and rather new in their farms. Almost all dairy cattle are kept by smallholders in Vietnam. Smallholders have dominated the dairy industry, contributing about 90 percent of total domestic milk yield (Hostiou et al. 2012; Lam, 2011; Huyen et al., 2006). Small-scale dairy farms have low outputs per animal and produce poor quality milk (Lam, 2011; Falvey and Chantalakhana, 2001). Furthermore, animal-keeping smallholders are associated to the increasing production costs and spread of animal diseases (Phuong et al. b, 2014). Still, dairy production in Vietnam has grown significantly over the last years (Lam, 2011). From 2001 to 2012, Vietnam's milk production grew rapidly by approximately 10 percent annually, from 64.7 thousand tons in 2001 to 382 thousand tons in 2012 (see details in table 2.1). This growth has been the result of

Effects of Household Characteristics on Expenditure for Dairy Products in Vietnam

increased milk demand and government's policies to promote efforts developing domestic dairy industry (Garcia et al., 2006).

Table2.1. Population and domestic milk production in Vietnam, period 2001-2012

Year	Population (million people)	Milk production (.000 tons)	Domestic milk production/capita (kg/capita/year)
2001	78.6	64.7	0.8
2002	79.5	78.5	1.0
2003	80.5	126.7	1.6
2004	81.4	151.3	1.9
2005	82.4	197.7	2.4
2006	83.3	216.0	2.6
2007	84.2	234.4	2.8
2008	85.1	262.2	3.1
2009	86.0	278.2	3.2
2010	86.9	306.7	3.5
2011	87.8	345.4	3.9
2012	88.8	382.0	4.3

Source: GSO, 2014

Figure 2.1 compares average dairy products supply quantities in Vietnam, South Eastern Asia and the world average from 1990 to 2009. Compared to worldwide milk consumption per capita, dairy consumption in Vietnam and other countries in South Eastern Asia are comparatively low. In 2009 milk products supply quantities per capita of the world was 87.3 kg, whilst these numbers are 15.3 and 11.5 in South Eastern Asia and Vietnam, respectively. However, starting at low level, milk products consumption per person in Vietnam has increased from 1.4 kg in 1990 to 11.5kg in 2009 (increased 8.22 times compared with 1990) over the last two decades. This number is still lower than in other countries in South Eastern Asia indicating further potential for sustained growth.

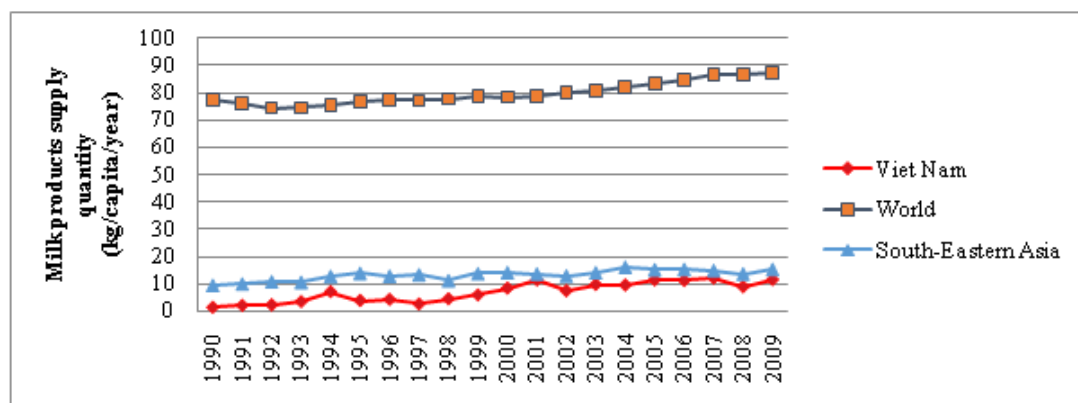


Figure2.1. Annual per capita milk products supply quantity of Vietnam, the world and countries in South Eastern Asia, 1990-2009

Source: FAOSTAT, 2014

2. METHODOLOGY, DATA AND VARIABLES

2.1. The Model

In this paper, a double-hurdle model is used to analyze household expenditure patterns on dairy products. One of the important sources of data to analyze consumption behavior is household survey data. The great issue with cross-sectional survey data is the significant proportion of households that report zero expenditure. Tobit and infrequency of purchase models must also be considered. However, these models are considered very restrictive. Many previous studies on food expenditure and consumption found that the double hurdle model outperformed the tobit model (Keelan, 2009; Dong and Gould, 2000; Yen et al, 1996; Cragg, 1971) This paper continues with this methodological

approach. We assume that households make two decisions with regards to buying an item. Firstly, a Probit model is employed to determine participation and the decision of whether households consume milk products or not. Secondly, a regression model is used to determine how much households spend on milk products. The double hurdle model was proposed by Cragg (1971), which allows separate stochastic variables dealing with both participation and expenditure decisions. The same variables are used in both estimations. The double hurdle model can be written as (Su and Yen, 1996):

- (1) $Z_i^* = W_i' \alpha + v_i$ participation decision
- (2) $Y_i^* = X_i' \beta + u_i$ expenditure decision
- (3) $Y_i = X_i' \beta + u_i$ if $Z_i^* > 0$ and $Y_i^* > 0$
- (4) $Y_i = 0$ otherwise

Where:

Z_i^* and Y_i^* are latent variables that describe the household's decision to participate in consuming milk products and household per capita expenditure on milk products. Y_i is the observed dependent variable. W_i and X_i are vectors of variables explaining the participation decision and the expenditure decision, respectively. α and β are coefficients estimated. v_i and u_i are the respective error terms assumed to be independent and normally distributed such as $v_i \sim N(0,1)$ and $u_i \sim N(0, \sigma^2)$.

The double hurdle model is estimated based on assumptions of the normality of the error terms v_i and u_i . However, the usual ML estimates which assume normality are inconsistent when normality assumption is violated (Arabmazar and Schmidt 1982). One way to allow for nonnormal errors, one way is to transform the dependent and latent variables to accommodate the nonnormal error structure. The latent expenditure equation can be written as:

$$(5) \quad T_{(Y_i^*)} = X_i' \beta + u_i$$

Where $T_{(Y_i^*)}$ is form of transformation such that:

$$(6) \quad T_{(Y_i)} = T_{(Y_i^*)} \quad \text{if } Z_i^* > 0 \text{ and } Y_i^* > 0$$

$$(7) \quad T_{(Y_i)} = T_{(0)} \quad \text{otherwise}$$

Yen (1993) estimated the double hurdle model based on the Box-Cox transformation and his findings suggest nonnormal errors. However, there are some problems with the Box-Cox transformation. Such as, normality assumption is violated and the transformation can not be used on random variables that can take on zero or negative value (Jensen and Yen, 1996, Su and Yen, 1996). To overcome these problems, the inverse hyperbolic sine (IHS) transformation is considered and the IHS transformation of random variable is defined as following equation (Jensen and Yen, 1996; Su and Yen, 1996; Burbidge et al. 1988).

$$(8) \quad T_{(v)} = \frac{\log \left[\theta v + (\theta^2 v^2 + 1)^{\frac{1}{2}} \right]}{\theta} = \frac{\sinh^{-1}(\theta v)}{\theta}$$

Where θ is an unknown parameter. The transformation is linear when θ approaches zero and behaves logarithmically for large values of v over a wide range of θ (Burbidge et al. 1988). More importantly, this transformation can be performed on random variables that can take any values (Su and Yen, 1996).

The likelihood function for the double hurdle model can be written as (Su and Yen, 1996):

$$(9) \quad L = \prod_{Y_i=0} \left\{ 1 - \Phi(W_i' \alpha) \Phi \left(\frac{X_i' \beta}{\sigma_i} \right) \right\} \prod_{Y_i>0} \left\{ \Phi(W_i' \alpha) \frac{1}{\sigma_i} \phi \left[\frac{T_{(Y_i)} - X_i' \beta}{\sigma_i} \right] \frac{1}{(1 + \theta^2 Y_i^2)^{\frac{1}{2}}} \right\}$$

Where $\phi(\dots)$ is standard normal density function, $\Phi(\dots)$ is cumulative distribution function.

The elasticity of expenditure probability, conditional level and unconditional level are calculated by referencing to Yen and Huang (1996); Su and Yen (1996) formula. For the double hurdle model, the probability of positive observation is:

$$(10) P(Y_i > 0) = \phi(W_i' \alpha)$$

The conditional mean of dependent variable that measures the average of dairy products expenditure given that $P(Y_i > 0)$ is computed as following formula:

$$(11) E(Y_i/Y_i > 0) = \left[\phi \left(\frac{X_i' \beta}{\sigma_i} \right) \right]^{-1} \int_0^\infty Y_i \frac{1}{\sigma_i} \phi \left[\frac{T(Y_i) - X_i' \beta}{\sigma_i} \right] \frac{1}{(1 + \theta^2 Y_i^2)} dY_i$$

The unconditional mean of dependent variable that measures the average household expenditure on milk products is formulated as:

$$(12) E(Y_i) = E(Y_i/Y_i > 0)P(Y_i > 0)$$

The elasticity of probability, conditional and unconditional level is computed with continuous variables, but with dummy variables, the elasticity is interpreted as change in probability or level of expenditure when the value of the dummy variables change from 0 to 1. To check for multicollinearity, we used the variance inflation factor (VIF).

2.2. Data

In this study, we utilized data from the Vietnamese Household Living Standard Survey (VHLSS), which was conducted by the Vietnam General Statistical Office (GSO) in 2010. The VHLSS 2010 was conducted nation-wide with a sample size of 69,360 households (22,365 households for income survey, 37,596 households for income and other and 9,399 households for income, expenditure and other survey) in 3,133 communes/wards. The surveys were representative for the whole country, 6 regions of the country, urban and rural areas and provincial levels. Surveys collected information during 4 periods in 2010-2011 through face-to-face interviews conducted by interviewers with household heads and key commune officials (VHLSS 2010). VHLSS 2010 records the household expenditure for certain products and product groups, e.g. daily consumption of foods and drinks.

2.3. Variables

Previous findings on food demand showed that food consumption is influenced by household’s characteristics and structure (Verbeke et al., 2000; Mihalopoulos and Demoussis, 2001; Thiele and Weiss, 2003; Reynolds-Zayak, 2004; Zhang and Goddard, 2010; Moon et al, 2010, Phuong et al., 2014). Income, household size, characteristics of household head and resident household has a significant impact on food consumption. Furthermore, households with children and older people are expected to have an influence on milk expenditure (Mergenthaler et al. 2013). Ates and Ceylan (2010) examined the effects of socio-economic factors on the consumption of milk, yoghurt, and cheese using their household survey in Turkey. While Davis et al. (2011) utilized purchase data from Nielsen 2007 Homescan (ACNielsen, New York, NY) data to determine the effects of changes in demographic variables, retail prices, and total dairy expenditure on at-home consumption of dairy products (cf. Davis et al., 2011).

In our empirical model, the dependent variable of the participant equation is a dummy variable for dairy products’ expenditures. The dependent variable of expenditure equation is the natural logarithm of the expenditure per capita of households on dairy products (thousand VND per year). The socio-economic variables of households are hypothesized to impact on dairy products expenditure in Vietnamese families.

Table 2.2. Descriptive Statistics

Variables	Definition	Mean	S.D.
Y	Expenditure on milk products (thousand VND/capita/year)	43.236	103.650
Ln(Y)	Natural logarithm of expenditure on milk products	1.744	2.130
Income	Per capita annual income of household (‘million VND)	18.253	35.862
Income2	Income squared	1619.072	86040.71
HHsize	Number of household’s members (persons)	3.937	1.566
Urban	Household in urban area (1/0)	0.282	
Female	Household with female head (1/0)	0.248	
Ethnic	Household belonging to Kinh (Vietnamese) ethnicity (1/0)	0.821	
Age	Age of household head (years)	48.345	14.245
Edu	Schooling of household head (years)	7.142	3.732

Child 1	Household with children below 7 (1/0)	0.220	
Child 2	Household with children age 7-18 (1/0)	0.520	
Older	Household with members older than 55 years (1/0)	0.383	
Geographic location of households			
REG1	Red river delta area (base category)	0.212	
REG2	Northern midland and mountain area (1/0)	0.177	
REG3	North Central area and Central coastal area (1/0)	0.220	
REG4	Central highlands (1/0)	0.069	
REG5	South east (1/0)	0.119	
REG6	Mekong river delta (1/0)	0.203	

Source: Based on VHLSS 2010 (GSO)

Price is one important factor in demand analysis. Other studies using cross-section household data assumed that prices are constant (Prais and Houthakker, 1955; George and King, 1971; cited in Cox and Wohlgenant, 1986). Many behavioral factors apart from price may result in zero observations (Yen, 2005). Furthermore, neither price information nor purchased quantities for all dairy products were collected in the VHLSS. Therefore, we hypothesize that all of households face the same price and we do not include price in the models. We estimate the following expenditure equation:

$$Y = f(\text{income, household size, urban area, household head gender, household head education, age of household head, ethnic, presence of children below 7 years old, presence of children from 7 to 18 years old, presence of old people over 55 years old, region})$$

The variables used in this study are listed and described in table 2.2.

2.4. Bivariate Analysis

Based on the result of VHLSS in 2010, an independent-samples T-test was conducted to find differences between rural and urban households. The result of the T-test shows that the difference in the two groups' means is statistically significant with P-value at 1%. The household size in urban areas is smaller than in rural areas. The percentage of female household heads in urban areas is higher than in rural areas. Rural household heads' age is lower than in urban household and rural household heads' education is lower than in urban areas. In particular, more ethnic minority families live in rural areas and there are more children in rural families. These findings are not surprising because in general, rural areas are poorer and generally less developed. The wedding age is also lower in rural than urban areas (Phuong et al. a, 2014). Furthermore, income per capita is nearly twice as high in urban areas as compared to rural areas. On average, annual urban household income per person is 27.09 million VND per year, while this figure for households in rural areas is 14.79 million VND per year. There is no significant difference between rural and urban families that have children below 7 years old, but the percentage of households with children aged between 7 and 18 in rural areas is higher than in urban areas. On the contrary, the percentage of households with people older than 55 years is higher in urban areas than rural areas (see details in table 2.3).

Table 2.3. Households' socio-economic and demographic factors in rural and urban Vietnam

Characteristic	Units	Urban		Rural		T-test	Sig.
		mean	SD	Mean	SD		
Income	Million VND	27.09	26.12	14.79	38.48	17.82	.000
Household size	Person	3.82	1.46	3.98	1.60	-4.71	.000
Female	0-1	0.35	0.48	0.21	0.4	13.23	.000
Age	Years	49.73	14.07	47.8	14.28	5.93	.000
Education	Years	8.59	3.61	6.57	3.63	24.36	.000
Ethnic	0-1	0.92	0.27	0.78	0.41	19.83	.000
Household composition:							
Child 1(0-7)	0-1	0.22	0.41	0.23	0.418	-0.71	.476
Child 2 (7-18)	0-1	0.48	0.50	0.53	0.50	-4.80	.000
Older (older 55)	0-1	0.41	0.49	0.37	0.48	3.30	.001

Source: Based on VHLSS 2010 (GSO)

Table 2.4 indicates the share of families consuming dairy products in the survey of the VHLSS 2010. It can be seen that, the percentage of households consuming milk products is rather low. In general, there are more than 50% of households that did not consume milk products. While nearly 80% of

Effects of Household Characteristics on Expenditure for Dairy Products in Vietnam

households confirmed that they did not drink fresh milk, approximately 75 % of households said that they did not spend money on powdered milk or other dairy products. This finding explains why milk consumption per capita in Vietnam is low and a binary model analysis is important to find factors affecting the probability of participation in the dairy products market.

Table 2.4. Share of households consuming milk products surveyed in VHLSS 2010 (in %)

Powdered milk	Milk (Fresh milk)	Other milk products	Total (Dairy products)
25.30	22.61	24.91	48.65

Source: Based on VHLSS 2010 (GSO)

Table 2.5 shows annual per capita expenditure on milk products per person by income quintiles in 2010. The results of an ANOVA analysis indicate that there are significant differences between income quintile groups in expenditure on dairy products and that expenditure on all kinds of milk products increases with income quintiles.

Table 2.5. Per capita expenditure on milk products by income quintile in 2010 thousand VND per year)

Products	Powdered milk		Fresh milk		Other milk products		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Quintile 1	5.021	34.831	2.783	12.182	1.319	4.889	9.123	39.412
Quintile 2	10.355	32.307	6.554	23.776	2.851	9.430	19.760	43.801
Quintile 3	15.595	47.140	10.448	29.984	4.476	12.557	30.520	60.460
Quintile 4	27.650	72.393	15.503	40.883	9.002	21.416	52.155	93.269
Quintile 5	56.578	142.279	26.500	60.024	21.591	50.910	104.668	179.417
Total	23.035	79.539	12.355	38.004	7.846	26.788	43.236	103.650
F_test	132.374		115.701		190.553		280.565	
Sig.	0.000		0.000		0.000		0.000	

Source: Based on VHLSS 2010 (GSO)

On average, one person in the richest quintile spends more than 10 times more than a person in the poorest quintile. Especially, with other milk products e.g. cheese, butter, milk ice-cream, etc., this number is more than 15 times. These results give a first indication that income growth is a major driver of increasing expenditure on milk products in Vietnam.

2.5. Multivariate Analysis

A double hurdle model was estimated by maximizing the logarithm of the likelihood functions corresponding to the above given equations. The same list of variables was used in both the participation and consumption equation. Most of explanatory variables included in the models have statistically significant effects on the participation to consume milk products. Parameter estimates obtained from double-hurdle model are presented in table 2.6. All VIF values of independent variables are less than 5. Hence, we conclude that there is no major multicollinearity problem. In addition, the elasticity and effects of binary variables of participation, conditional and unconditional level of expenditure are calculated at sample means. The results are presented in table 2.7.

Table 2.6. Parameter estimates of double-hurdle censored models for dairy products expenditure

Variables	Participation		Expenditure		Heteroskedasticity	
	Parameter	S.E.	Parameter	S.E.	Parameter	S.E.
Intercept	-1.942***	0.103	2.631***	0.113	0.836***	0.059
Income	0.013***	0.001	0.028***	0.002	0.005***	0.001
Income squared	-4.57e-06***	4.5e-07	-0.0001***	0.00001		
HHsize	0.026**	0.011	-0.180***	0.013	0.013*	0.007
Urban	0.275***	0.034	0.331***	0.035		
Female	0.175***	0.035	0.141***	0.036		
Ethnic	0.544***	0.047	0.306***	0.056		
Age	-0.003*	0.001	0.003**	0.001		
Edu	0.059***	0.005	0.039***	0.005		
Child1	1.041***	0.040	0.951***	0.036		
Child2	0.484***	0.035	0.138***	0.036		
Older	0.114***	0.40	0.162***	0.043		
REG2	-0.106**	0.052	-0.276***	0.058		
REG3	0.143***	0.043	-0.089**	0.045		

REG4	0.171***	0.063	-0.021	0.064		
REG5	0.309***	0.053	0.138***	0.053		
REG6	0.129***	0.045	-0.012	0.048		
Number of observations	9399					
Log likelihood	-11862.368					
Wald chi2(16)	1887.46					
Sig.	0.000					

Notes: the dependent variable of expenditure equation is the natural logarithm of expenditure on milk products (thousand VND/capita/year);

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Based on VHLSS 2010 (GSO)

The coefficients of the income variables in both equations are positive which suggests that per capita income in families has a significant positive effect on the probability of participation and the level of expenditure. The probability of dairy products market participation is 0.4%, which means that with one percent increase of income the probability that a household spends money on dairy products increases with 0.4%. In the same way, the amount of money spent on dairy products increases by 2.9% on unconditional level and by 14% on conditional level with a one percent increase of income (table 2.7). Furthermore, expenditure levels increase at a decreasing rate though, as the negative quadratic term in table 5 shows, i.e. dairy products expenditure is a nonlinear function of income. However, the coefficients of the income squared variable are very small compared with the coefficients of the linear income variable. So for a long time of further income growth it can be expected that the probability of milk product consumption and expenditure on these products continues to rise with increasing incomes.

Table 2.7. Elasticity of continuous and binary variables: Dairy products expenditure

Variable	Probability	Conditional Level	Unconditional Level
Income	0.004	0.140	0.029
HHsize	0.008	0.026	-0.052
Urban	0.089	0.272	0.469
Female	0.057	0.173	0.265
Ethnic	0.176	0.538	0.457
Age	-0.001	-0.002	-0.001
Edu	0.019	0.058	0.327
Child1	0.337	1.029	1.626
Child2	0.157	0.478	0.609
Older	0.037	0.112	0.206
REG2	-0.035	-0.105	-0.252
REG3	0.046	0.141	0.119
REG4	0.056	0.169	0.182
REG5	0.100	0.305	0.413
REG6	0.042	0.127	0.139

Source: Based on VHLSS 2010 (GSO)

Household characteristics are important variables that determine milk products consumption patterns and quantities consumed (cf. Njarui et al, 2011). With respect to demographic characteristics of households, household size has a significantly positive affect on participation in dairy market and on the conditional level in the expenditure model. However, the household size variable is significant and negative in the milk products expenditure model with an elasticity of -5.2% on the unconditional level, i.e. when the number of people in the household increases, they spend less on milk products on a per capita basis. This suggests that the number of household members has a positive effect on milk products buying decision but at the same time has a negative effect on how much households spend for these products on a per capita basis. Several studies also found that larger households spend or consume less on food products on a per capita basis, suggesting that such households benefit from economies of scale in food consumption (Stewart et al, 2004; Keelan et al, 2009).

Urban households tend to participate more than rural households in dairy products' markets. The urban variable also appears to effect household expenditure on milk products. The effects of the urban variable in the models are 8.9% on the probability of entering into the market. The numbers on conditional and unconditional level are 27.2% and 46.7%, respectively, i.e. the probability of urban

households to consume dairy products is more than in rural areas and per capita in urban households spend on dairy products is more than in rural households. The results indicate that the degree of urbanization plays an important role in determining the probability of participation in the milk products market and urbanization also contributes increase expenditure for dairy products.

Interestingly, the results also suggest that gender and education of household heads have a positive effect on the probability to consume and the expenditure for dairy products. In particular, households having female household heads and higher education household head would increase the dairy product consumption probability and expenditure. In recent years, the role of women is becoming more important and there are more families that have female household heads. At the same time, increased schooling contributes to raise educational attainment levels in Vietnam (Anh et al, 1998). These results contribute in explaining the increase of milk product consumption in Vietnamese families and they reflect important characteristics of household heads' variables in dairy products' consumption patterns in Vietnam.

The ethnic variable has a significant effect on both market participation and how much the families spend for milk products. Vietnam has a total of 54 ethnics groups that live in the whole country. Still, Kinh ethnic (Vietnamese) is with a share of 87% the largest ethnic category in Vietnam (GSO, 2013). The result suggests that being a Kinh's family increases the probability of milk products consumption by 17.6% compared with being an ethnic minority family. Moreover, the results show that in Kinh' households spent more than ethnic minority families by 53.8% on conditional level and 45.7% on unconditional level. We suppose that this is caused by most ethnic minority households' residence in mountain areas where transportation and market access is difficult – an influence not captured by the urban and regional dummies. In addition, further differences in living standards might be reflected that are not captured in the income variable.

Meanwhile, the age of the household head is significant in both determining participation and dairy expenditure. Children variables show the difference between age groups of children in the families. Variables of the children have been found to be positive and statically significant in both equations and effects of children variables are also positive. In particular, effects of young children (below 7 years old) are 33.7% on the probability of participation, and more than 100% on both conditional and unconditional level. It is the same trend with older children on the probability of market participation or conditional level and unconditional level but with lower percentage, i.e. that dairy products are consumed more in families having children, especially in families that have children aged below 7 years old. This result indicates that children variables, especially infants, are important to explain milk consumption patterns in Vietnam.

An interesting finding in this study is the significant effect of older people on dairy products expenditure. Like the children variables, the estimates of binary variables' elasticity for older people variable are presented in table 6. Compared to families with no older people (more 55 years old), families having older people are about 3.7% more likely to consume milk product and conditional on expenditure, spend about 11.2% more per year than the families without older people. This number on the unconditional level is 20.6%. This finding can explain increasing milk demand in Vietnam when fertility rates are decreasing and the share of older people in the population increases (UNFPA, 2011; GSO 2011). Similar to consumption of milk products with children, the attributed positive health effects of dairy products induce higher probability and higher expenditure levels for household with older people (Mergenthaler et al., 2013).

We also found significant differences in milk expenditure across regions. For example, the probability of participation of households that live in Northern midland and mountain areas are negative, i.e. that the probability of participation in dairy markets in Northern midland and mountain areas is lower than in the Red river delta. Meanwhile, the probability of dairy consumption of families in other areas is higher than in the Red river delta. The results of the expenditure equation shows that Northern midland and mountain areas and North Central area and Central coastal area spend less than in the Red river delta, while families that live in the South East region tend to spend more on milk products than others. South East is also the region where the biggest city of Vietnam is located (Ho Chi Minh City). The result also shows that there is no significant difference between dairy expenditure in households in Central highlands and Mekong river delta. Above differences are due to differences in the socio-economic situation and other variables not included in our models. In addition, cultural diversity in the regions is an important factor effecting on food consumption (Ates and Ceylan, 2010; Valli and Traill, 2005).

3. CONCLUSIONS

The present study utilizes a Double-Hurdle model to analyze the effects of social and demographic variables on the Vietnamese households' decisions on whether to consume dairy products and their levels of expenditure. The Double-Hurdle model is used as in cross-sectional micro-data, zero observations are common (Yen and Jose, 1997, Yen and Huang, 1996,). The study has explained households' behavior in participating in milk markets or not, assuming that some reasons for not consuming milk products are socio-economic, demographic and geographic variables. For a long time, rising income is still expected to increase expenditure on milk products. This outcome is consistent with previous dairy consumption behavior research by Dong (2006) who suggested that income growth is expected to boost milk products demand in Asian countries. Therefore, income policies that aim to increase households' incomes could become more important in promoting milk product consumption and production. However, they might be associated with considerable leakage effects. .

The result suggests that most household-level socio-demographic factors play a key role in determining both the probability of participation and the amount spent for dairy products. Household characteristics are found to be significant in affecting dairy products' expenditure. For instance, urban households and female-headed households have a greater preference than other households as illustrated in their expenditure patterns on dairy products. Age and education have positive effects on the probability of consumption and quantity of products consumed. If current trends are continuing, they will support further demand growth for dairy products putting even more pressure on supply side policies.

With regard to household composition, the results of multivariate analysis indicate that children and older people are important factors for household dairy consumption, implying that Vietnamese families value healthy nutrition for children and for older people. This applies especially in families that have infants. On the background of Vietnam entering into an aging population, this result has important implications that have not been considered in previous studies. Although current demand for dairy products is strongly supported by the high share of children in the population, future demand growth will more strongly build on the growing share of older people in the Vietnamese population.

The results also help to understand how the changing socio-economics and demographics of the Vietnamese population impacts on households' dairy products expenditure. The understanding of demand side factors may help policy makers to implement policies related to the dairy industry, to nutrition for children and older people, and to health and national food security. Especially, policies should concentrate on improving child nutrition in areas with low milk consumption e.g. through school milk programs and food redistributing between the rich and the poor, areas and ethnic groups (Phuong et al. a, 2014) to ensure food security and nutritional status of Vietnam's population.

The study is useful for dairy products marketers in planning and developing strategies, because they will understand the influence of household characteristics on the decision if products are consumed and how much is consumed. This applies equally for domestic and foreign dairy businesses. According to US department of Agriculture, "Vietnam's dairy market is rich with opportunities" due to growing population with a rapidly increasing income per capita and the number of women who join the workforce has increased, led to an increase in bottle feeding (Agrimony, 2011; Industrysourcing, 2012). While foreign dairy companies have started to tap into the Vietnamese growing and immensely potential dairy market, domestic dairy companies are few.

In order to supply the growing demand of Vietnamese consumers for dairy products, growth and development perspectives for domestic dairy producers emerge. While still in their infancy stage, the primary production sector is challenged to expand and to adapt to quality and quantity requirements of the dairy processing companies. For this purpose, well designed agricultural policies have to be implemented in order to facilitate the development of this emergent production sector. Training and education for current and future milky producers should be strengthened to qualify them for the production of high quality raw products. Linked to this, also extension services should be developed. Producer organizations could be the organizational setting to facilitate dairy specific know-how development. At the sectorial level, applied research should be supported to strengthen locally adapted production technologies in the area of dairy cow housing, feeding regimes, milking equipment and milk cooling facilities. Breeding should be supported in order to develop breeds that are adapted to the local climatic and production conditions.

REFERENCE

- AGRIMONEY (2011)** “Vietnamese dairy 'rich with opportunities” – USDA. Available at: <http://www.agrimoney.com/news/vietnamese-dairy-rich-with-opportunities---usda--2998.html>. Accessed Jan. 30, 2014.
- Anh, T. S., J. Knodel, D. Lam and J. Friedman (1998)** “Family size and children’s education in Vietnam”. *Demography*, Vol. 35, No. 1, pp. 57-70.
- Anh, D., V. Thu and P. Duong (2010)** “Developing a taste for dairy”, Sector View, Mekong securities 12 April 2010.
- Ates, H. C. and M. Ceylan (2010)** “Effects of socio-economic factors on the consumption of milk, yoghurt, and cheese: Insights from Turkey”, *British Food Journal*, Vol. 112, No. 3, pp. 234-250.
- Beghin, J. C. (2006)** “Evolving dairy markets in Asia: Recent findings and implications”, *Food Policy*, Vol. 31, pp. 195-200.
- Bittencourt, M.V.L., R.P. Teratanavat and W.S. Chern (2007)** “Food consumption and demographics in Japan: Implications for an aging population”, *Agribusiness*, Vol. 23, No. 4, pp. 529–551.
- BMI (Business Monitor International) (2011)** “Vietnam agribusiness Report Q4 2011- Includes 5-year forecasts to 2015”, Part of BMI's Industry Report & Forecasts Series.
- Burbidge, J. B., L. Magee and A. L. Robb (1988)** “Alternative transformations to handle extreme values of the dependent variable”, *Journal of the American Statistical Association* 83 (March): 12327.
- Cragg, J. (1971)** “Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods”, *Econometrica*, Vol. 39, No. 5, pp. 829- 844.
- Cuong, T.H. and B.T. Nga (2011)** “Actor benefit’s analysis on value chain of fresh milk in Vietnam”, *Journal of Economics and Development*, Vol. 169, No. 2, pp. 32-38.
- Davis, C.G., D.P. Blayney, S.T. Yen and J. Cooper (2009)** “An analysis of at-home demand for ice cream in the United States”, *Journal of Dairy Science*, Vol. 92, No.12, pp. 6210-6216.
- Davis, C.G., S.T. Yen, D. Dong and D.P. Blayney (2011)** “Assessing economic and demographic factors that influence United States dairy demand”, *Journal of Dairy Science*, Vol. 94, No. 7, pp. 3715–3723.
- Dong, D. and B. W. Gould (2000)** “Quality versus quantity in Mexican household poultry and pork purchases”, *Agribusiness*, Vol. 16 No. 3, pp. 333–355.
- Dong, F. (2006)** “The outlook for Asian dairy markets: The role of demographics, income, and prices” *Food Policy*, Vol. 31, pp. 260-271.
- EUROMONITOR (2014)** “Drinking-milk-products-in-vietnam”, Accessed May. 30, 2014. Available at: <http://www.euromonitor.com/drinking-milk-products-in-vietnam/report>.
- Falvey, L. and C. Chantalakhana (2001)** “Supporting smallholder dairying in Asia”, *Asia-Pacific Dev. J.*, Vol. 8, pp. 90-99.
- FAOSTAT (2014)** Different databases. Available at: <http://faostat.fao.org/site/345/default.aspx>. Accessed March 2014.
- Garcia O., T. Hemme, L.T. Nho and H.T.H. Tra (2006)** “The Economics of Milk Production in Hanoi, Vietnam, with Particular Emphasis on Small-scale Producers”, PPLPI Working Paper No. 33.
- GSO (General Statistical Office) (2014)** Different databases. Available at: <http://www.gso.gov.vn>. Accessed March 2014.
- GSO (2011)** “Age-sex structure and marital status of the population in Vietnam”, Viet Nam Population And Housing Census 2009. Available at: http://www.gso.gov.vn /Modules/Doc_Download.aspx?DocID=13286
- Hostiou, N., P.D. Khanh, G. Duteurtre, V.T. Binh and B. Dedieu (2012)** “Relationships between work organisation and size of dairy farms: a case study based in Vietnam” *Tropical animal health and production*, Vol. 44 No. 7, pp. 1709-1716.
- Huyen, L.T.T., U. Lemke and A. Valle Zárate (2006)** “Ruminant breeds and production systems in North Vietnam and their contribution to smallholder households in mountainous areas”, *Institute of Animal Production in the Tropics and Subtropics, University of Hohenheim, Stuttgart*, p. 77.

- INDUSTRYSOURCING (2012)** “Colossal Growth in the Vietnamese Dairy Industry”, Accessed Feb. 3, 2014. Available at: <http://us.industrysourcing.com/articles/252337.aspx>
- JACCAR (2009)** “JACCAR Equity Research – Vietnam’s Dairy sector report”, Accessed Feb. 12, 2014. Available at: <http://vietnamdairy.org.vn/en/publications.php?mnu=5&nid=46&type=1>.
- Jensen, H. and S.Yen (1996)** “Food Expenditures Away From Home by Type of Meal”, Canadian Journal of Agricultural Economics, Vol. 44, pp. 67-80.
- Keelan, C.D., Henschion, M.M. and Newman, C.F. (2009)** “A Double-Hurdle Model of Irish Households' Food Service Expenditure Patterns”, Journal of International Food & Agribusiness Marketing, Vol. 21 No.4, pp269-285.
- Khoi, N. V. (2013)** “Wicked problems: a value chain approach from Vietnam’s dairy product”, SpringerPlus, Vol. 2 No. 1, pp. 1-6.
- Lam, T.Q., N.T. Mai and T.D. Hong (2013)** “Ageing, health and policy response in Vietnam”, XXVII IUSSP International Population Conference, Busan, Korea, Republic of 26 August - 31 August, 2013. Available at <http://www.iussp.org/en/event/17/programme/paper/5877>.
- Lam, V. (2011)** “Milk production on smallholder dairy cattle farms in Southern Vietnam”, Unpublished doctoral dissertation, Acta Universitatis agriculturae Sueciae, 1652-6880; 2011:37.
- Le, C.Q. (2008)** “An empirical study of food demand in Vietnam”, Journal of Southeast Asian Economies, Vol. 25 No. 3, pp. 283-292.
- Mergenthaler, M., N.V. Phuong, C. Wildraut, V. Ebert, C. Kliebisch, T.H. Cuong and B.T. Gia (2013)** “Studie über Verbraucher in Vietnam (Study on food requirements of consumers in Vietnam)” Study commissioned by Bundesanstalt für Landwirtschaft und Ernährung (BLE) Referat 512, Bonn. Soest. Available at: http://www.agrarexportfoerderung.de/fileadmin/SITE_MASTER/content/files/Marktstudien/2013/Vietnam_Verbraucher.pdf
- Mergenthaler, M., K. Weinberger and M. Qaim (2009)** “The food system transformation in developing countries: A disaggregate demand analysis for fruits and vegetables in Vietnam” Food Policy, Vol. 34 No. 5, pp. 426–436.
- Minot, N. and F. Goletti (2000)** Liberalization and Poverty in Vietnam. Research report 114, IFPRI.
- More, S. J. (2009)** “Global trends in milk quality: implications for the Irish dairy industry” Irish Veterinary Journal, Vol. 62 No. 4, pp. 5-14.
- Njarui, D.M., M. Gatheru, J.M. Wambua, S.N. Nguluu, D.M. Mwangi and G.A. Keya (2011)** “Consumption patterns and preference of milk and milk products among rural and urban consumers in semi-arid Kenya”, Ecol Food Nutr, Vol. 50 No. 3, pp. 240-62.
- Phuong, N. V., T. H. Cuong and M. Mergenthaler (2014a)** “Effects of Socio-economic and Demographic Variables on Meat Consumption in Vietnam”, Asian Journal of Agriculture and Rural Development, Vol. 4 No. 1, pp. 972-987.
- Phuong N. V., D .T. M. Hanh, T. H. Cuong, A. Markemann, A. Valle Zárate and M. Mergenthaler (2014b)** “Impact of quality attributes and marketing factors on prices for indigenous pork in Vietnam to promote sustainable utilization of local genetic resource”, Livestock Research for Rural Development 26(07). Available at: <http://www.lrrd.org/public-lrrd/proofs/lrrd2607/phuo26126.html>
- Pingali, P. (2007)** “Westernization of Asian diets and the transformation of food systems: Implications for research and policy”, Food Policy, Vol. 32 No. 3, pp. 281–298.
- Ray, D. K., N. Ramankutty, N.D. Mueller, P.C. West and J.A. Foley (2012)** “Recent patterns of crop yield growth and stagnation”, Nature Communications No. 1293. Doi:10.1038/ncomms2296
- Saenger, C., M. Qaim, Torero, and M. Viceisza (2013a)** “Contract farming and smallholder incentives to produce high quality: Experimental evidence from the Vietnamese dairy sector”, Agricultural Economics, Vol. 44 No. 3, pp. 297-308.
- Saenger, C., M. Torero and M. Qaim (2013b)** “Impact of Third-Party Enforcement of Contracts in Agricultural Markets—A Field Experiment in Vietnam”, Global Food Discussion Papers, No. 18.
- Schröck, R. (2012)** “The Organic Milk Market in Germany Is Maturing: A Demand System Analysis of Organic and Conventional Fresh Milk Segmented by Consumer Groups” Agribusiness, Vol. 28, No. 3, pp. 274–292.

- Stewart, H., N. Blisard, S. Bhuyan and J. R. Nayga (2004)** “The Demand for Food Away From Home: Full- Service or Quick- service?”, United States Department of Agriculture, Economics Research Service, Agricultural Economic Report No: 829
- Su, S. J. B. and S. Yen (1996)** “Microeconometric models of infrequently purchased goods: An application to household pork consumption”, *Empirical Economics*, Vol. 21 No. 4, pp. 513-533.
- Tuan, L. T., N. T. T. Phuong, L. T. B. Ngoc and L. H. Mai (2013)** “Powdered milk consumers’ buying behavior”, *International Journal of Business and Management*, Vol. 8 No. 2, pp. 29-37.
- UNFPA (2011)** “The aging population in Vietnam: Current status, prognosis, and possible policy responses”, Available at <http://vietnam.unfpa.org/public/lang/en/pid/9848>.
- Valli, C., and W.B. Traill (2005)** “Culture and food: a model of yoghurt consumption in the EU”, *Food Quality and Preference*, Vol. 16 No. 4, pp. 291-304.
- Wu, B., Y. Chen, W.mSi and H. Chien (2014)** “A Double-Hurdle Analysis of Demand for Powdered Milk: Evidence from Household Survey Data in an Urban Chinese Province”, *Agribusiness*, Vol. 30 No. 3, pp. 331–344.
- Yen, S. T. (1993)** “Working wives and food away from home: The Box-Cox double hurdle model” *American Journal of Agricultural Economics*, Vol. 75. (November): pp. 884-95.
- Yen, S. T. and C. L. Huang (1996)** “Household demand for finfish: a generalized double-hurdle model”, *Journal of Agricultural and Resource Economics - Western Agricultural Economics Association – WAEA*, Vol. 21 No. 02, pp. 220-234.
- Yen, S.T. (2005)** “Zero observations and gender differences in cigarette consumption”, *Applied Economics*, Vol. 37 No. 16, pp. 1839-1849.