Livestock Products Food Expenditure Pattern in Indonesia: Estimation Analysis from Repeated Cross-Section Data

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***Abstract*—The aim of this study is to analyze the livestock products consumption patterns based on a household data and explore the dynamic effects as well as the impact of demographic variables on the demand model specification. This paper used a dynamic LA/AIDS demand model to estimate various food demand parameters for households using household expenditure survey data (SUSENAS) 2012 and 2013. The results show that all important livestock products food has positive expenditure elasticities. Meat, egg and milk are necessities. The estimated point elasticities are consistent with previous studies and a priori expectations. Egg is found to be price inelastic in long run. While meat and milk are price elastic in the long run. The expenditure elasticities for meat and milk are declining, but these for egg is increasing. As per capita income rises and population increases, the demand for these items will continue to increase. Habit effects imply consumption of livestock products having an income effect on current consumption decision Therefore, Indonesia must continue to increase its food production by a greater rate in the future in order to avoid food shortages.**

***Index Terms*—livestock products, dynamic LA/AIDS, Indonesia**

I. Introduction

Livestock products consumption has positive correlation with income (see [1], [2]). Between household comparisons of food budget shares allocated to meat, egg, and milk consumption using household survey consumption data indicate that household in high-income level tend to allocate larger shares of their food budget to meat expenditures compared with household in low-income level [3].

Indonesian diets are dominated by based cereal food (rice). Nevertheless, the Indonesian menu has gradually been changing due to a rise in disposable incomes and a change in dietary habits [4]. Consumers' demands for high-valued livestock products food have been continuously rising [5]. The average level of caloric and protein intake from animal products has substantially increased in Indonesia [6].

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This aim of this study is to analyze the livestock products consumption patterns and explore the change/dynamic effects as well as the impact of socio-economic factors on the demand model specification.

Reference [7] identify the concept of dynamic model analysis that are (1) models the share of expenditure on specific good in terms of total expenditure; (2) model is given by the demand equations for the individual good depending directly on aggregate consumption; and (3) models the demand for specific good as depending directly on personal disposable income. A price change may influence consumers' decisions on consuming livestock products, as well as their expenditure in those foods.

II. Material and Method

The data used in this study were taken from the National Socio-Economic Survey (*Survei Sosial Ekonomi Nasional)* or SUSENAS. This is a cross-sectional household survey conducted annually by the Central Bureau of Statistic (CBS). Data cover 13 foods group includes three livestock products group: (1) Meat including fresh meat (beef, buffalo, mutton/lamb, pork, chicken, native chicken), preserved meat (dried meat, dried shredded meat, canned meat), others (liver, entrails, bones with a bit of adhering meat, meat with bones), (2) Egg such as chicken egg, native-chicken egg, duck egg, quail egg, salted egg, and (3) Milk product; fresh milk, sweetened condensed milk, powdered milk, baby powder milk, cheese. This database consist both quantities and expenditures on food consumption for each sample household.

Dynamic analysis for livestock products consumption in this study is using dynamic Almost Ideal Demand System (AIDS) demand model. AIDS demand model by [8] had widely used in the demand analysis because of its theoretical consistency and functional flexibility. It satisfies the axioms of choice and allows aggregation over consumers [9].

Dynamic AIDS budget share model is used in this study

$$w_{it} = \alpha_i + \sum \left(\gamma_{ij} + \theta_{ij} X_{t-1}\right) \ln p_{jt} + \left(\beta_i + \eta_i X_{t-1}\right) \ln\left(X_t / P_t^*\right) + e_{it} \quad (1)$$

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where w_{it} represents the budget share of livestock products to the total food expenditure, e_{it} denotes error term, X_t is the total food expenditure, and P_t^* denotes the dynamic AIDS price index, that is

$$\ln P_t^* = \sum_i w_{t-1} \ln P_{it} \quad (2)$$

In this study, the dynamic LA/AIDS was used to analyze the panel data. With the use of the Stone's index, w_{it-1} is used in this analysis instead of w_{it} to avoid simultaneity problems. It is also used by [10] and [11].

In this analysis, we also incorporate socio economic variables. These demographic variables are included by replacing the α_i in equations (2) with:

$$\alpha_i = \alpha_0 + \alpha_{i1} \text{ HHSIZE} + \alpha_{i2} \text{ HHHAge} + \alpha_{i2} \text{ Edu} \quad (3)$$

where HHSIZE is household size; HHH age is age of household head, Edu is Education level. To incorporating socioeconomic variables, the following additional restriction we used to satisfy adding-up condition $\sum_{i=1}^{8} \alpha_{ik} = 0, \text{ for } k = 1, 2, \cdots, n$.

Following [12], the Marshallian price elasticities and expenditure elasticities can be expressed as follows:

Expenditure elasticity: $\varepsilon = 1 + (\beta_i + \eta_i x_{t-1}) / w_i$

Price elasticities: $\varepsilon ij = \left(\gamma_{ij} + \theta_{ij} x_{t-1}\right) \Big/ w_j - \lambda_{ij}$

where λ_{ij} is Kroneker's delta: λ_{ij}=1 for i=j and 0 otherwise, x_{t-1}, w_i, and lnP_k will be calculated at sample means. In the AIDS model, a negative β_i implies a necessity good while a positive β_i indicates a luxury food (i.e., with respect to the total expenditure of goods included in the model). We would expect positive β_i's for meat and milk.

III. Result and Discussion

A. Change in Socioeconomic Characteristics of Household

The present study also attempted to explain some of the factors influencing livestock products consumption by using 2-year household survey data. The required data for this investigation was obtained by a survey. Of the total number of respondents, 46% of the household observations used were located in urban areas and the other 54% were located in rural areas.

The general characteristics of the sample household were presented in Table I. Sample household differed considerably in age, education, and sex of the household head. Socioeconomic characteristics of the sampled household, was disaggregated by urban and rural residents. The majority of the household-head (HHH) were in above of 50-year-old age group in urban and rural areas. The majority of HHH education in urban and rural areas reached at least basic education level (literate).

Most of the sample households have total expenditure (income) more than 2000,000.00 IDR. Proportion of expenditure for food was increasing from 42.45% to 47.87% during sample period, while proportion of non-food expenditure quite decreased from 57.55% to 52.13%.

TABLE I. Characteristics of Household Sample

Particulars	2012	2013
Region		
Urban (%)	32.00	68.10
Rural (%)	68.00	31.90
Household size	3.26	3.28
Sex		
Male (%)	81.40	81.10
Female (%)	18.60	18.90
Age of household head (years)	50.56	51.05
Education of HHH		
Illiterate (%)	7.70	7.20
Literate (%)	92.39	92.90
Total Food Expenditure	974,102.60	1,154,668.57
Total Non-Food Expenditure	1,320,600.00	1,257,360.86
Total Expenditure	2,294,700.00	2,412,029.44

B. Change in Expenditure Pattern

The average expenditure for meat, egg and milk compare to other food expenditure in rural and urban. Food expenditures covered all food items included in the survey such as rice, pulses, eggs and milk products, vegetables, fruits and nuts, fish and meat, and beverages.

The changes in the monthly per capita expenditure on various livestock products over two periods cross two locations were worked out and the same were presented in Fig. 1.

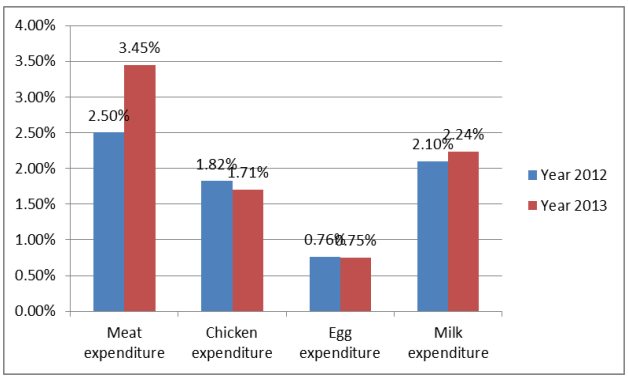

Figure 1. Expenditure share on livestock products consumption

During this period, the expenditure share on livestock products has changed. The total expenditures share for the livestock products food items decreased for egg and chicken. The meat expenditure shares, on the one hand, have sharply increased. This pattern was also similar to the consumption of milk in the same period. The increasing prices caused decreasing purchasing power.

The purchasing power was getting worse during the food soar.

C. Estimation from Dynamic AIDS Model

Most parameters including dynamic elements are found significant at 1% significance level for all four models. Except meat, all of the estimated β's are found significant at 5% level or lower. The sign of β determines the calculated "luxury" or "normal" food items. The estimated β's are negative for necessity food item (eggs) and positive for all more luxury food items (meat, and milk) as expected. We can see that the signs of β's from dynamic LA/AIDS model are the most plausible. The complete sets of price elasticities estimated from the model are reported in Table II. All of the own-price elasticities are negative as expected.

The selected demographic variables help to explain the consumption patterns in DIY Province. From Table III we can see that socio economic variables such as household size, age of household head, and education level, are among the most important factors that affect household consumption behavior. As expected, household size has a significant positive impact on egg and milk consumption and a negative impact on meat consumption. Households with more children choose to consume relatively more milk. The households with higher education level choose to consume relatively high protein. Compared to urban household, rural households allocate more budget share to egg as expected.

TABLE II. PRICE AND EXPENDITURE ELASTICITIES

		Price Elasticity			Expenditure elasticity
		Meat	Egg	Milk	
Urban	Meat	-0.01391	-0.01665	0.020887	1.0625
	Egg	-0.00037	-0.00768	-0.011449	0.84829
	Milk	0.02697	-0.017678	-0.01207	1.022003
Rural	Meat	-0.01265	-0.02226	0.01595	0.99487
	Egg	-0.01581	-0.007199	-0.015	1.00988
	Milk	0.047287	-0.022612	-0.0139	0.94494

TABLE III. ESTIMATION OF PARAMETERS

Parameters	Rural			Urban		
	Meat	Egg	Milk	Meat	Egg	Milk
Constant	0.00081^{ns}	0.002428	0.005643***	-0.00119**	0.00051^{ns}	0.022818***
γ_1	0.013515***	2.98E-06^{ns}	0.000557***	0.011918***	-0.00048***	0.001606***
γ_2	-0.00049***	0.007517***	-0.0004***	-0.00085***	0.007151***	-0.00107***
γ_3	0.000729***	0.000513***	0.011846***	0.000661***	-0.00045***	0.013401***
θ_1	-7.5E-10*	1.45E-10^{ns}	2.88E-10*	1.51E-09**	1.16E-10*	5.18E-10*
θ_2	-6.1E-10^{ns}	-1.7E-09^{ns}	3.22E-10*	-3.6E-11^{ns}	-1E-09^{ns}	1.65E-09*
θ_3	-7.1E-10*	-9.9E-10*	-5.1E-10^{ns}	-3E-10^{ns}	8.08E-11*	-4.3E-11^{ns}
β	1.05E-05^{ns}	0.000814***	-0.00057***	-0.00017***	0.00027***	-0.00183***
η	5.63E-10*	3.22E-10*	-2.6E-10^{ns}	-1.7E-10*	1.27E-10^{ns}	-8.6E-10*
μ_1	-0.00085***	-0.00144***	0.000506***	-0.00156***	-0.00079***	0.000586***
μ_2	5.41E-05***	7.49E-05***	-5.9E-05***	0.000122***	7.57E-05***	-0.00037***
μ_3	0.000481^{ns}	0.003438***	0.001309***	-0.00036^{ns}	0.00141***	0.004082***
δ_1	-1.121E-06***	-1.121E-06***	-5.798E-07***	2.534E-06***	-3.583E-07***	-4.4902E-07***
δ_2	8.5393E-06^{ns}	8.539E-06***	2.2236E-07***	8.0809E-09^{ns}	5.1502E-06***	-2.586E-07***
δ_3	-1.5219E-06***	-1.5219E-06***	3.865E-06***	-7.575E-07***	-5.7241E-07***	2.2422E-06***
R^2	0.600463	0.314912	0.340909	0.560253	0.254103	0.332642
Adj R^2	0.600372	0.314756	0.340758	0.560162	0.253949	0.332504

Note: ***, **, *, and ^{ns} significant at 1%, 5%, 10% level, and non-significant.

In Table III, the estimated habit effect coefficients are presented. Most of the estimated δ's are found at 1% and eggs are not significant. The signs of the δ's are as expected as well, with eggs being positive and meat and milk being negative. Egg has the largest estimated δ coefficients. As we mentioned earlier, δ's do not enter into elasticity computation directly but affect the expenditure elasticity through β_i. We can see that positive δ_i lead to a decreased β_i while negative δ_i lead to an increased β_i. As we noted earlier, these coefficients capture the habit effects of lagged purchases of the individual items. Habit effects imply consumption of livestock products having an income effect on current consumption decision.

These results support that previous purchases do affect current consumption and strong habit effects exist. Without considering these dynamic effects, the demand models may be miss-specified and elasticities for necessity items may be overestimated and more luxury food items be underestimated. Given the trend that average income has been increasing and Engel Coefficients decreasing steadily, we might expect the habit effects would lower the budget shares and therefore reduce the expenditure elasticities for necessity food items.

The expenditure elasticities estimated for the dynamic LA/AIDS systems are reported in Table II. The dynamic LA/AIDS models have meat and milk expenditure elasticities of 1.0625 and 1.02200, respectively, and low expenditure elasticities for egg of 0.848. Meat and milk have the highest expenditure elasticities, which seem to be plausible, particularly in urban area, while egg has high expenditure elasticity in rural area. Meat, egg and milk all have expenditure elasticities larger than one, meaning that the urban households will consume more of these food items at a higher rate than other foods when their income increases

All expenditure elasticities are positive, meaning that all food items selected are normal goods. The expenditure elasticity for meat and milk are all larger than one. Therefore, as income increases, the expenditure for these products would raise more relative to other foods such as fresh vegetables. These results also imply that the proportion of expenditure on these goods may increase as income rises. The magnitudes of income elasticities depend upon the effect of income change on the expenditure of these three food items. If this income elasticity is less than unity (which is mostly likely), the income elasticities for these food items would be smaller than the expenditure elasticities estimated in this study.

IV. Conclusion

In this paper, we expand dynamic LA/AIDS model by incorporating socio-economic household demographic variables to analyze household livestock products consumption pattern and explore the dynamic effects as well as the impact of demographic variables on the demand model specification. Habit effects imply consumption of livestock products having an income effect on current consumption decision and change their behavior until their income change

Economic results from the estimated model suggest that meat is a luxury product, while egg is necessities (as income increases, consumers tend to buy relatively more meat and less egg). Moreover, meat own-price elasticity, although inelastic, shows the highest value, so meat consumption responds more to own-price changes than the rest of the products do. Retail price strategies will become more important in meat markets.

Improving the dynamic model and estimation is being our future work. An analysis of dynamic behavior, particularly in food consumption, is more desirable with long time-series. Price elastic of the livestock products implies that consumer responds to the change of price and retail price strategies will become more important in these markets. The expenditure elasticity showed that consumption of these foods will continue grows. Indonesia must continue to increase its livestock products food production by a greater rate in the future in order to avoid food shortages and there is wide opportunity of livestock development

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