The Effects of Advertising on Milk Demand Elasticities and Structural Changes
in Korean Milk Markets

by

Kwansoo Kim

and

Jae-Sun Roh[*]

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[*] Kwansoo Kim is assistant professor, Department of Agricultural Economics and Rural Development, Seoul National University and Jae-Sun Roh is associate professor, Department of Agricultural Economics and Rural Development, Seoul National University.

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1. Introduction

Two major components of advertisement targeting consumption promotion in Korean milk markets are 'brand advertisement' by each company and 'generic advertisement' by checkoff funds. Since 1975, the proportion of brand advertisement in total advertisement spending in Korean milk industry has been rapidly increasing, with the annual rate of growth reaching almost 90%. Combined with the increased number of milk brands available, this suggests significant changes in terms of marketing and advertisement strategies. In addition, it is also observed that the rate of milk consumption increase has been reduced substantially from 15% during 1975-1990 to 5% at 2001. This could be due to the reduction of 'generic advertisement' in promoting milk consumption and a possible structural change in Korean milk markets such as market segmentation, the introduction of target marketing strategies, etc. In other words, under the suggested hypotheses, genetic advertisement aiming general milk demand increase would be needed to boost up the demand for milk in Korean dairy markets. In this regards, the checkoff program has been introduced since 1999. However, the literature has not put much efforts in assessing the effects of generic commodity promotion program by checkoff funds on promoting milk consumption in Korean milk markets.[†]

On the other hand, the introduction of genetic commodity promotion program using checkoff funds tends to introduce the problem of free-riding; imported milk products would have incentive to enjoy the enhanced milk consumption by a checkoff program without being

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[†] There has been much research on the impacts of generic commodity promotion programs done in the context of U.S. fluid milk and cheese markets (Ronald and Dixon, Kaiser, Sun, Blisard and Blaylock). In the context of Korean dairy sector, Park (2002a ,b) investigated the economic impacts of generic advertisement on milk consumption increase.

participated. There in a need to understand the relationship between this free-rider problem of imported milk products and a possible structural change in Korean milk market. This understanding would allow a dairy checkoff program to cope with market liberalization atmosphere in the dairy sector in Korea.

This paper examines the effectiveness of generic commodity promotion program based on checkoff funds by estimating the demand elasticities of advertisement. Focusing on a possible structural change in terms of advertisement strategies (from generic to brand advertisement), we model the effects of generic advertising on milk demand using (i) a dummy variable approach and (ii) an interaction parameter approach. First, we introduce both intercept and slope dummy variables in our proposed milk consumption function. This allows us to test a hypothesis concerning a structural change in the effects of advertisement on promoting milk consumption. Second, we extend our approach by introducing milk imports in our milk demand function in a way that it is possible to test whether milk imports play a significant role in characterizing a structural change in Korean milk markets and associated free-rider problems.

Econometric results show significant differences in the effects of advertising on milk demand depending on whether the market is mainly characterized by either brand or generic advertisement (the generic advertising regime versus the brand advertising regime). The demand elasticity of advertisement is estimated to be smaller in the brand advertising regime than the generic advertising regime. This suggests a positive impact of generic commodity promotion program in Korean milk market. In addition, it is indicated that milk imports play an important role in characterizing two different regimes: a structural shift occurs when the imported amount of milk is significant.

The paper is organized as follows. Section 2 discusses our model of milk consumption in Korean milk markets. The data and econometric results are presented in section 3. They show how

advertisement strategies affect the effectiveness of advertisement on milk consumption. The concluding section summarizes findings and sketches future research potentials.

2. The Econometric Model

This section summarizes the econometric model we developed in this paper investigating a possible structural change in Korean fluid milk markets. We first define the amount of milk consumption as the dependent variable and introduce factors affecting milk consumption as independent variables including the price of fluid milk price, the real income and advertisement expenditures. This implies the following equation characterizing fluid milk consumption:

$$y_t = f(\mathbf{X}_t, \mathbf{b}) + e_t, \tag{1}$$

where $\mathbf{X}_t$ is a vector of explanatory variables, $\mathbf{b}$ is a vector of parameters to be estimated, and e_t is an error term distributed as iid $N(0, \sigma_t^2)$. We include in $\mathbf{X}_t$ the real price of fluid milk (P_t), the real income per capita (I_t) and advertisement expenditures (A_t). Note that the price of fluid milk was deflated by producer price index and the real income per capita was deflated by GNP deflators. Advertisement expenditure measures real advertisement expenditure in a dairy sector.

Next, we propose both linear and Cobb-Douglas specification for $f(\cdot)$. In particular, given the logarithmic transformation of Cobb-Douglas specification, the elasticities of advertisement can be recovered by the estimated coefficients. The equation (2-1) represents liner specification and (2-2) shows Cobb-Douglas specification (after logarithmic transformation).

$$y_t = á_0 + á_1 P_t + á_2 I_t + á_3 A_t + e_t, \text{ and} \tag{2-1}$$

$$\ln y_t = \beta_0 + \beta_1 \ln P_t + \beta_2 \ln I_t + \beta_3 \ln A_t + ç_t. \tag{2-2}$$

However, equations (2-1) and (2-2) do not allow us to investigate a possible structural change in Korean milk market. In order to do that, we first introduce both intercept and slope dummy variables. This implies equations (2-3) and (2-4).

$$y_t = (á_0 + ã_0 \, D_{1t}) + á_1 \, P_t + á_2 \, I_t + (á_3 + ã_1 \, D_{1t}) A_t + e_t, \text{ and} \qquad (2\text{-}3)$$

$$\ln y_t = (\beta_0 + ä_0 \, D_{1t}) + \beta_1 \ln P_t + \beta_2 \ln I_t + (\beta_3 + ä_1 \, D_{1t}) \ln A_t + ç_t, \qquad (2\text{-}4)$$

where D_{1t} is a dummy variable capturing a structural change in Korean milk market in a binary context: $D_{1t} = 0$ for the first period and $D_{1t} = 1$ for the second period when the sample is divided by two. The characterization of this binary variable is an empirical issue which we will discuss in the following section. Using equations (2-3) and (2-4), one can recover the information on changes in advertisement elasticities corresponding to a structural change during the sample period. For example, in equation (2-4), the advertisement elasticity corresponding to the first period equals β_3, whereas $(\beta_3 + ä_1)$ indicates the advertisement elasticity corresponding to the second period. Furthermore, we extend this binary approach by substituting D_{1t} with the amount of fluid milk import (D_{2t}) which is a discrete measure (as opposed to a binary measure) affecting the elasticities of advertisement. In this specification, we hypothesize the amount of imported fluid milk plays a significant role in characterizing structural changes in the Korean milk market. Note that the elasticities of advertisement in this final Cobb-Douglas specification (shown in (2-5)) is $(\beta_3 + ä_1 D_{1t})$.

$$\ln y_t = (\beta_0 + ä_0 \, D_{1t}) + \beta_1 \ln P_t + \beta_2 \ln I_t + (\beta_3 + ä_1 \, D_{2t}) \ln A_t + ç_t, \qquad (2\text{-}5)$$

In other words, the elasticities of advertisement is hypothesized to be a function of the amount of imported fluid milk thus providing us with the framework evaluating the effects of fluid milk imports and associated free-rider problem on milk consumption in Korea. These models constitute

the econometric specifications used below in the empirical investigation of the impact of structural change on fluid milk consumption in the Korean dairy market.

3.   The Data and Econometric Results

3.1. Data

In this section, the effects of structural change on fluid milk consumption in Korea are analyzed. The empirical analysis is based on yearly data for the period 1975-2001. In order to focus on the overall effects of advertisement we used the advertisement expenditure data from the income statement in a dairy sector available from the Bank of Korea instead of using the total amounts of advertisement expenditures from selected dairy producers. It is noticeable that the data on advertisement expenditure based on checkoff funds are not useful as an independent variable because of their short length (only 3 years). Yearly milk consumption data (measured in ton) are obtained from the Korean Ministry of Agriculture and Forestry (MAF). The actual fluid milk consumption during the sample period is shown in Figure 1. The examination of Figure 1 allows us to identify two different periods in terms of the rate of milk consumption increase: the 1970s and the 1980s when the rate of milk consumption increase was high (about 15%); and the 1990s when the rate was relatively low (about 5%) except the year 1999 (the rate was close to 20%). This leads us to introduce a dummy variable capturing changes in milk consumption during our sample period: $D_t = 0$ for the period of 1975-1990 and $D_t = 1$ for the period of 1991-2001. This division of our sample is also consistent with the observation that differentiated advertisement strategies have been adopted as a means of target marketing since the beginning of 1990s (the generic advertisement regime corresponding to 1975-1990 versus the brand advertising regime corresponding to 1991-2001). Figures 2 and 3 show the real price of fluid milk and the real advertisement expenditure during the sample period. As shown in these figures, the real milk price

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was not changed during the sample period, whereas the movement of real advertisement expenditure demonstrated an increasing trend even after deflating.

3.2. Econometric Results

Following the discussion in the previous sections, models (2-3), (2-4), and (2-5) are applied to the Korean fluid milk market (based on yearly data for the period of 1975-2001) to investigate the changes in milk consumption and associated structural change in advertisement strategies. The model is estimated by the ordinary least squares method, assuming that the error terms e_t and ς_t satisfy the required assumptions for OLS. Assuming a correct specification and satisfaction of assumptions, the OLS procedure produces consistent and efficient parameter estimates.

Table 1 and 2 report the parameter estimates of both linear and Cobb-Douglas models presented in (2-3) and (2-4). First, the effects of own price, income and advertisement expenditure on milk consumption are statistically significant. This is consistent with what economic theory suggests. Second, in both linear and Cobb-Douglas models, the intercept and slope dummy variables are statistically significant implying the presence of structural change during 1990s (compared to 1970s and 1980s). To investigate the effects of this structural change more carefully, let us focus on the changes in advertisement elasticity during two periods. Demand elasticities of advertisement were calculated using the estimated coefficients associated with advertisement expenditure. For the linear model, this elasticity is evaluated at the sample means of milk consumption and advertisement expenditure for each period: the estimated elasticity was 0.297 for the first period and 0.011 for the second period. This suggests that 1% increase of advertisement spending corresponds to 0.297% increase of milk consumption during 1975-1990, whereas 1% increase of advertisement spending is only able to contribute to 0.011% increase of milk

consumption during 1991-2001. Consistent with this, the elasticities from the Cobb-Douglas model were estimated as 0.43 for the period of 1975-1990 (the generic advertisement regime) and 0.004 for the period of 1991-2001 (the brand advertisement regime). In both models, the advertisement elasticity were substantially decreased in the later period suggesting a structural change in Korean milk market in terms of the effects of advertisement on promoting milk consumption. What factors can be contributed to this reduction in advertisement elasticity during the second period?

As discussed in section 2, we rely on equation (2-5) for this question. Table 2 shows estimation results after substituting the slope dummy variable with the amount of milk imports in the Cobb-Douglas specification. All the estimated coefficients were statistically significant except intercept. Especially, as a factor affecting the elasticity of advertisement, the amount of imported milk was estimated to be statistically significant. (Taking a derivative of (2-5) with respect to $\ln A_t$ gives the elasticity of advertisement: $(\beta_3 + ä_1 D_{2t})$, where D_{2t} corresponds to the amount of imported milk at time t.) This suggests that milk imports play a significant role in explaining significant difference in terms of advertisement elasticity during the sample period. The negative sign of estimated coefficient $(ä_1)$ associated with milk import variable (D_{2t}) implies that an increase in imported amount of milk is associated with lower advertisement elasticity. This relationship is shown in Figure 4.

It is often hypothesized that imported milk products have an incentive to free-ride positive impacts of generic advertisement (for example, from checkoff funds) on milk consumption promotion. This is particularly plausible under open economy context and WTO agreements. If this is true, then an increased generic advertisement by checkoff funds targeting milk consumption promotion would result in boosting market share of imported milk products. In this regards, it is of interest to investigate the implications of the negative relationship between milk imports and advertisement elasticity on free-rider problems of imported milk products. One can argue that if (i)

there is no additional spending on advertisement accompanied by milk imports; and (ii) domestic milk and imported milk are homogeneous then imported milk products can enjoy the milk consumption promotion effects made available by domestic and generic advertisement. Since the data show evidence supporting no additional advertisement spending by milk importers and also the homogeneous nature of milk products, our finding of negative relationship between milk imports and advertisement elasticity can serve as indirect empirical evidence supporting free-rider problems in Korean milk markets.

4. Concluding Remarks

This paper has investigated econometrically the effects of advertisement on milk consumption focusing on a possible structural change. Milk consumption model with linear and Cobb-Douglas specification was specified and estimated. A dummy variable approach was utilized to test a hypothesis concerning a structural change. The models are applied to the Korean milk market. The econometric analysis provides empirical evidence on a structural change and a free-rider problem in the Korean milk market: imported milk products tend to enjoy the effects of generic advertisement on milk consumption increase without incurring additional advertisement costs. First, we found evidence on structural change in terms of differentiated advertisement elasticity during the period of 1975-1990 and 1991-2001. The effects of advertisement on milk consumption were estimated to be different between two periods: the elasticity of the former period characterizing the generic advertisement regime was higher than that of the latter period (the 1990s, the brand advertisement regime). Second, our analysis demonstrates relevant policy implications. We found empirical evidence on milk imports contributing to the reduction of advertisement elasticity. This identifies a free-rider problem in the Korean milk market. This indirect evidence on

a free-rider problem calls for an attention from a policy-making arena in the Korean dairy sector under open economy.

While these findings are consistent with structural changes and associated free–rider problems in the Korean milk markets, the analysis needs several improvements. First, a checkoff program needs to be included explicitly in the model. Although we included all advertisement expenditures (including both generic and brand advertisement spending), we were unable to separate the effects of generic versus brand advertisement on milk consumption increase. A future study could take advantage of increased degree of freedom in terms of sample information on generic advertisement. Second, it would be of interest to examine the economic impacts of a check-off program in the Korean dairy sector. Considering the fact that a generic commodity promotion program (e.g., a check-off program) is in its early stage in Korea only in a dairy sector, it is useful to investigate the economic evaluation of its efficiency. This would set out a step stone for analyzing the benefits and costs associated with a generic commodity promotion program in other commodity sectors in Korea.

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Table 1. Parameter Estimates Linear and Cobb-Douglas Consumption-Advertisement Relationship: Korean Milk Market, 1975-2001.

The Linear Model

Parameters	Definition	Estimates	Standard Errors
$á_0$	Intercept	147117849	(352502166)
$á_1$	Price of fluid milk at time t (P_t)	-1843744**	(827239)
$á_2$	Income at time t (I_t)	-313.6***	(34.5)
$á_3$	Advertisement expenditure at time t (A_t)	0.0094***	(0.0022)
$ã_0$	Intercept dummy (D_{1t})	-0.0091**	(0.0016)
$ã_1$	Slope dummy (D_{1t})	330191726***	(127116465)

Adjusted $R^2 = 0.993$

The Cobb-Douglas Model

Parameters	Definition	Estimates	Standard Errors
β_0	Intercept	10.21**	(3.879)
β_1	Price of fluid milk at time t (P_t)	-2.564***	(0.523)
β_2	Income at time t (I_t)	-1.007***	(0.2)
β_3	Advertisement expenditure at time t (A_t)	0.435***	(0.067)
$ä_0$	Intercept dummy (D_{1t})	-0.431**	(0.183)
$ä_1$	Slope dummy (D_{1t})	10.836**	(4.678)

Adjusted $R^2 = 0.986$

<u>Note</u>: Standard errors are provided in parentheses, and asterisks indicate statistical significance at the 10 percent (*), 5 percent (**), and 1 percent (***) level, respectively.

Table 2. Parameter Estimates Cobb-Douglas Consumption-Advertisement Relationship with Milk Imports: Korean Milk Market, 1975-2001.

Parameters	Definition	Estimates	Standard Errors
β_0	Intercept	4.628	(3.478)
β_1	Price of fluid milk at time t (P_t)	-2.269***	(0.430)
β_2	Income at time t (I_t)	-1.382***	(0.210)
β_3	Advertisement expenditure at time t (A_t)	0.357***	(0.064)
$\ddot{a}_0$	Intercept dummy (D_{1t})	-0.241**	(0.087)
$\ddot{a}_1$	The amount of milk imports (D_{2t})	1.6E-11**	(6.4E-12)

Adjusted $R^2 = 0.989$

<u>Note</u>: Standard errors are provided in parentheses, and asterisks indicate statistical significance at the 10 percent (*), 5 percent (**), and 1 percent (***) level, respectively.
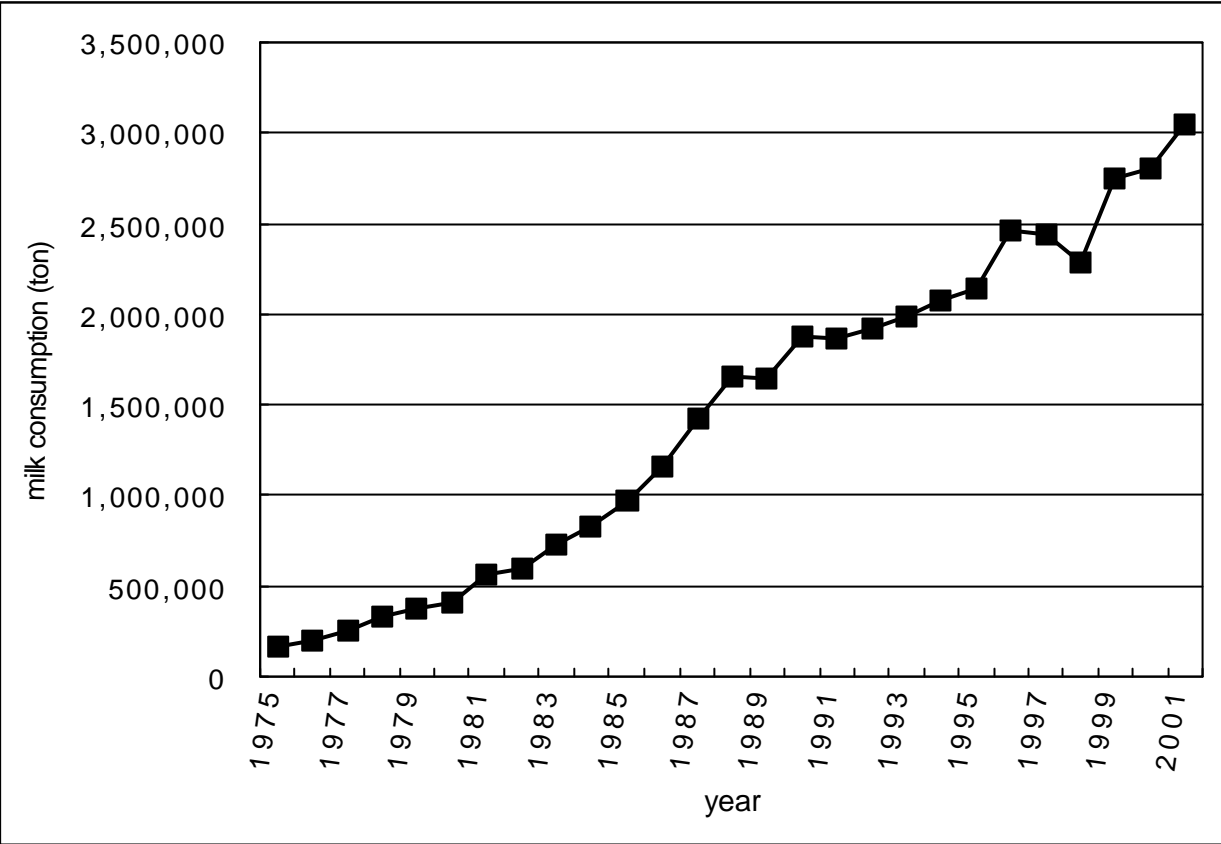
Figure 1. Actual Fluid Milk Consumption

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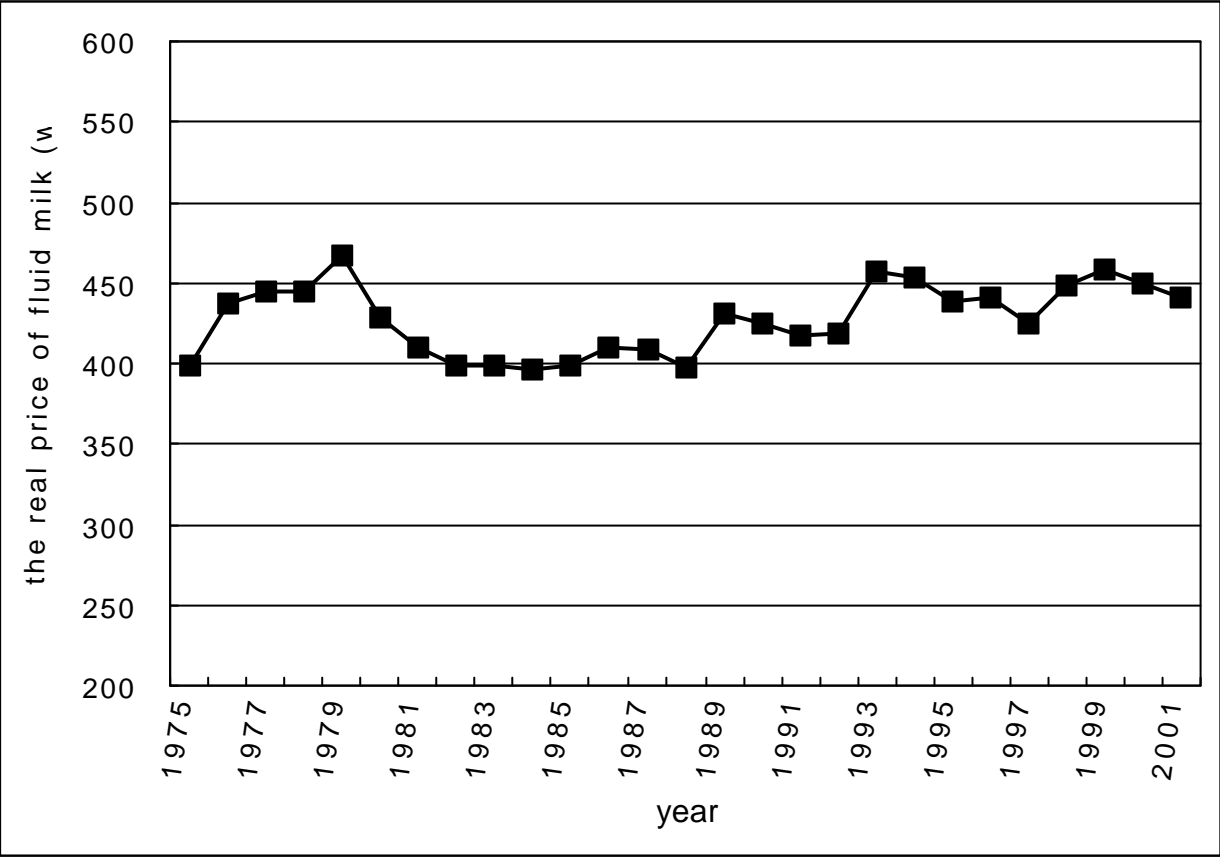**Figure 2. The Real Price of Fluid Milk**
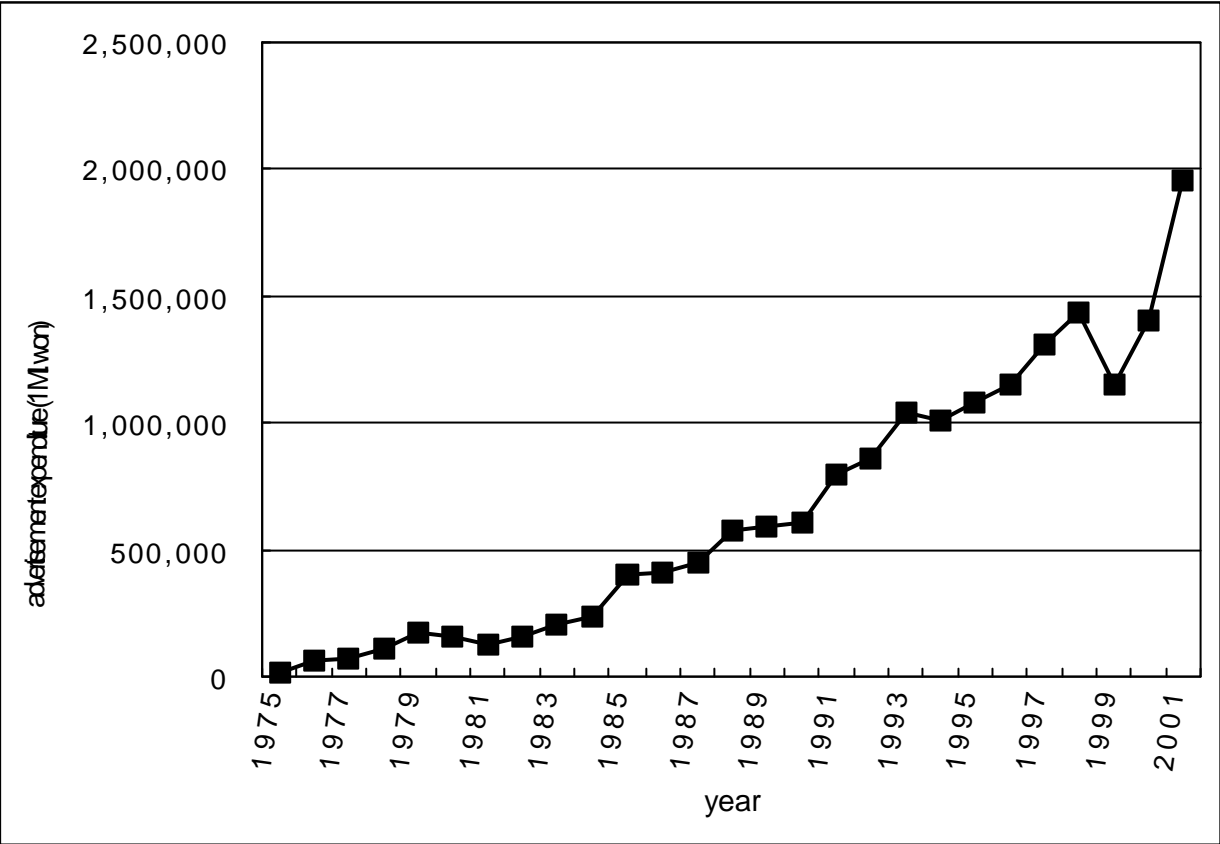
Figure 3. The Real Advertisement Expenditure

Figure 4. The Relationship between Milk Imports and Advertisement Elasticity