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The Impact of the Melamine Scandal and other Factors Influencing China's Dairy Imports

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Abstract: A single equation demand and a sourced differentiated Almost Ideal Demand System (AIDS) model are employed to investigate factors influencing the dairy import demand in China and competition among different exporters from 2002 to 2012. Results from both models are compared and own-price, cross-price, income elasticities are calculated.

Key words: milk powder; imports; Almost Ideal Demand System; elasticities.

JEL Codes: Q11; Q17; Q13.

Introduction

China has been a key player in global dairy market given its demand for an ever-growing share of dairy supplies since 2002. The average annual growth rate of China's dairy imports during 2002-2011 was around 30.57%, the dairy import value reached 2.6 billion US\$ in 2011. Compared to dairy imports, China's dairy exports were non-substantial. In 2011, the export value was 79 million US\$, accounting for only 3% of the dairy imports.

Milk production in China enjoyed a dramatic increase from 2002 to 2007. After a drop in 2008 due to the melamine milk scandal, production has been catching up again since 2010. Milk production in 2012 is predicted to achieve at 33.705 million metric tons (MT). Nonetheless, China's dairy sector is still lagging far behind compared to many developing countries in many respects. In terms of productivity, from 2003-2011, fluid milk production per cow produced an average of 4.02 metric tons of milk annually, lower than that of its major exporters (Table 1). There is a huge gap between urban and rural per capita consumption of dairy products (Table 2),

illustrating the growth potential of China's dairy market, given the rapid increase in the income of the rural population and fast urbanization.

This article is organized as follows: first a single equation demand function is estimated using OLS method, and a sourced differentiated Almost Ideal Demand System (AIDS) model is employed to investigate the trade competition and diversion between different milk powder products from different sources. The article concludes with some suggestions for government policies.

Empirical Model Specification and Data

Single equation demand estimation has been used extensively due to its simplicity. From the consumer demand theory, we know that demand is affected by its own price, income, prices of substitutes, etc. (Khan & Ross, 1977; Thursby and Thursby, 1984; Rickard, St. Pierre and Becker, 2008.). Data from 1995-2011 is used to examine the factors influencing the dairy import of China.

$$(1) \quad IM_t = \alpha_t + \beta_1 IP_t + \beta_2 GDP_t + \beta_3 DP_t + \beta_4 TO_t + \beta_5 C_t + e_t$$

Where IM_t is a scalar outcome variable: quantity of dairy import China- HS0402 (net weight kg); IP_t is the annual averages price of whole milk powder (Oceania, indicative export prices, f.o.b. US\$/kg); GDP_t is the GDP per capita (current US\$); DP_t is the national fresh milk average retail price (\$/kg); C_t is the milk and dairy consumption per capita (kg); TO_t is the trade openness, indicated by the ratio of total trade value of dairy import (HS0402) to GDP; e_t is a scalar disturbance term; t indexes time. All variables are transformed into natural log. The demand quantity and other independent variables are in logarithmic values, so their coefficients represent their demand elasticities.

In the empirical model, only the import of dairy products (HS0402) is used for analysis. One reason for choosing this commodity category is that it accounted for more than half of the total dairy import in value for most of the years. Another reason is that this category is a final product, which can be consumed directly without any further processing.

Next, a source differentiated AIDS model is used to analyze the import demand system of China for milk powder (including three types: skimmed milk powder (SMP, HS04021000), whole milk powder, not containing added sweeteners (WMP, HS04022100) and other whole milk powder (HS04022900)). These three types accounted for the majority of the commodity coded as HS0402. Exporting countries include New Zealand, Australia and the U.S., which are the three primary exporting countries for milk powder to China and the rest of the world (ROW). The Almost Ideal Demand System (AIDS) model has been widely used in analyzing demand elasticities and substitution effects since its introduction. The popularity of the AIDS model is mainly attributed to the fact that it is consistent with consumer demand theory in that it could satisfy the three types of theoretical restrictions: adding-up (Engel aggregation), homogeneity and symmetry requirements (Deaton and Muellbauer, 1980; Ramirez and Wolf, 2008; Wan, Sun and Grebner, 2010; Nzaku, Houston and Fonsah, 2012). Ramirez and Wolf (2008) used a restricted source almost ideal demand system to estimate the demand for dairy products imported into Mexico. Dairy products were categorized into cheese, milk powder and other dairy, imported from the U.S., Oceania, the EU and other countries. They found that fierce competition for the Mexican market among the U.S., Oceania, and “other countries”, primarily from South America.

A conventional AIDS model for milk powder imports of China can be expressed as follows:

$$(2) \quad w_{ijt} = \alpha_i + \beta_{ij} \ln \left(\frac{m_t}{P_t^*} \right) + \sum_{j=1}^N \gamma_{ij} \ln p_{jt} + \lambda D_t + u_{ijt}$$

where w is the import share of milk powder products by the origin of country and product type ($w_{ijt} = p_{ijt}q_{ijt}/m_t$); m is the total expenditure on all imports ($m_t = \sum_{ij=1}^N p_{ijt}q_{ijt}$, where q_{it} is the import quantity); P^* is the aggregate price approximated by the Paasche index, $\ln P^* = \sum_{ij=1}^N w_{ij,t-1} \ln \left(\frac{p_{ij,t}}{p_{ij}^0} \right)$, using lagged expenditure shares to avoid endogeneity and simultaneity (where p_{ij}^0 is the first observation of p_{ij} in the data set) (Moschini, 1995); p is the import price for each exporting country; D is the dummy variable for the milk powder safety issues happened in 2008 and 2010; α is the constant term, β and γ are the coefficients to be estimated; and u is the disturbance term. For subscripts, i indicates country names in the import share for each equation ($i=1, 2, \dots, N$); j represents the three types of milk powder, t indicates time ($t=1, 2, \dots, T$). Total observation is $T=125$ (monthly data from Jan 2002-Mar 2012). All the data are from the General Administration of Customs of China.

Based on the estimated parameters from the AIDS models and the average import shares, expenditure elasticities, uncompensated (Marshallian) price elasticities, and compensated (Hicksian) price elasticities are calculated.

$$(3) \quad \eta_i = 1 + (\beta_i / \bar{w}_i)$$

$$(4) \quad \varepsilon_{ij}^m = -\delta_{ij} + (\gamma_{ij} / \bar{w}_i) - (\beta_i \bar{w}_j / \bar{w}_i)$$

$$(5) \quad \varepsilon_{ij}^h = -\delta_{ij} + (\gamma_{ij} / \bar{w}_i) + \bar{w}_j$$

where η , ε^m , ε^h and are the expenditure elasticity, uncompensated price elasticity, and compensated price elasticity, respectively; δ_{ij} is the Kronecker delta, which equals to 1 if $i = j$ (i.e., own-price elasticity) and 0 if $i \neq j$ (i.e., cross-price elasticity); and \bar{w} is the sample mean of import share.

Empirical Results

As expected, dairy import and international whole milk powder price are negatively related, while the income is positively related to dairy import. More specifically (Table 3), a 1% increase in GDP per capita will result in a 1.21% increase in dairy import approximately, holding other things constant. The coefficient for the international whole milk powder price is negative and greater than 1 in absolute value, indicating that the dairy import is elastic in terms of prices. The coefficient of the trade openness is positive; indicating that the more open for the dairy trade, the more likely the import of dairy products is to increase.

Results in Table 4 show that all own-price elasticities are negative, and all of the elasticities are greater than 1 in absolute value, meaning that all goods are elastic. Almost all are statistically significant, excluding Australian SMP. Australian WMP has the largest own-price elasticity among them, increasing the price by 1% will reduce the demand by 2.632%, other things constant. The expenditure elasticities are all positive as expected. The results show that New Zealand (WMP) importation is the most sensitive to income changes, while Australia (SMP) import is the least sensitive to income changes. The signs for the coefficients of the safety dummy variable are in disaccord, while the magnitudes of them are in common, less than 1 in absolute value. The safety scandals happened in domestic milk powder products would boost import from Australia for both SMP and WMP, and the imports of SMP from New Zealand,

ROW, and other WMP were likely to decrease. One possible explanation is that the import from New Zealand is already at a large amount. So when the scandals occurred, it is urged to explore sources that have relatively exported volumes, such as Australia.

The cross-price elasticity could reveal the competitive pattern and trade diversion effect between different exporters and products. From Table 5, we could see that the majority of the significant cross-price elasticities are positive, denoting substitutes relationships between those products from different countries. For instance, in response to a 1% increase in the price of WMP from New Zealand, the demand of SMP from ROW would decrease by 1.195%. It is worth noticing that for the import of other WMP, cross-price elasticities are mostly negative, indicating a complementary relationship with other products from different exporters.

Conclusions

From both models, China's dairy import was significantly correlated to income. China's import demand for dairy products would likely continue to strengthen as the GDP per capita increases. All the own-price elasticities were elastic; the import demands for those products were sensitive to the price changes. Surprisingly, the reactions of dairy imports to the safety scandals of the domestic dairy products were not so drastic and accordant among the products from different sources. Some imports even decreased in response to the domestic issues. The cross price elasticities revealed that those categorized products were substitutes and the competition between products of different sources is not so fierce.

In order to meet the increasing demand of dairy consumption and reduce the growing dependence on import, the Chinese government is suggested to promote the domestic production

by introducing new technologies, food safety control over production, enhancing consolidation in the supply chain. For the sake of food safety, more stringent regulations should be imposed by the government in the domestic dairy sector to eliminate some of the monitoring problems associated with small-scale production.

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Table 1. Annual Fluid Milk Production Per Cow (Metric Tons) 2003-2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011
China	3.91	4.14	4.05	4.04	4.03	4.00	4.00	4.00	4.03
New Zealand	3.73	3.83	3.65	3.71	3.82	3.71	3.69	3.67	3.88
Australia	5.19	5.10	5.11	5.56	5.28	5.79	5.56	5.84	5.93
European Union - 27	5.10	5.15	5.31	5.30	5.48	5.54	5.53	5.73	5.97
U.S.	8.51	8.60	8.87	9.02	9.16	9.25	9.33	9.59	9.67

Source: USDA FAS: Dairy World Market and Trade Circular Archives,

http://www.fas.usda.gov/dairy_arc.asp. 2006-2011.

Table 2. Urban and rural Per Capita Consumption of Dairy Products (kg)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Urban	18.12	18.62	20.30	17.92	18.32	17.75	15.19	14.91	13.98	17.97
Rural	1.19	1.70	2.00	2.86	3.15	3.52	3.43	3.60	3.55	4.00

Source: China Agricultural and Economic Database, USDA. <http://www.ers.usda.gov/data-products/china-agricultural-and-economic-data/national-and-provincial-data.aspx>.

Table 3. Demand Single Equation Regression Estimation Results

Dairy import	Coefficients	Expected sign
GDP per capita	1.215**	+
Whole milk powder, FOB price	-1.132***	-
Trade openness	0.925***	+
National fresh milk average retail price	0.005	+
Milk and dairy consumption per capita	-0.344	+
R2	0.9703	

Note: * indicates 10% statistically significant.

** indicates 5% statistically significant,

*** indicates 1% statistically significant.

Table 4. Estimates of the Expenditure Elasticity (η_i), Compensated Own-Price Elasticity (ε_{ij}^h) and Coefficient for the Dummy Variable

	ε_{ij}^h	η_i	λ
New Zealand (SMP)	-1.499**	0.831***	-0.047*
Australia (SMP)	-0.722	0.317***	0.036**
ROW(SMP)	-1.559**	0.497***	-0.054**
New Zealand(WMP)	-1.219***	1.304***	-0.037
Australia(WMP)	-2.632***	0.636**	0.067***
Other WMP	-1.638***	1.072	-0.018**

Note: ***, **, * denote significance at the 1%, 5%, and 10% level respectively.

Table 5. Compensated Cross-Price Elasticity

Quantity	Price					
	New Zealand (SMP)	Australia (SMP)	ROW (SMP)	New Zealand (WMP)	Australia (WMP)	Other WMP
New Zealand (SMP)		0.020	0.178	0.731*	0.728***	0.082*
Australia (SMP)	-0.395		-0.243	1.133	0.007	-0.258**
ROW(SMP)	0.087	-0.087		1.195***	0.170	0.100
New Zealand(WMP)	0.707*	0.652*	0.745***		0.640**	0.667***
Australia(WMP)	-0.926	-0.052	0.182	1.546**		-0.161
Other WMP	2.913***	-0.419***	0.021	-1.949***	-1.594***	

Note: ***, **, * denote significance at the 1%, 5%, and 10% level respectively.