Projections of Dairy Product Consumption and Trade Opportunities in China

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China Agriculture Working Paper 2/03

Centre for Applied Economics and Policy Studies

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Abstract

China has been rapidly increasing its consumption and imports of dairy products in recent years. A two-stage demand system was estimated for livestock product consumption in urban China over the 1990s. Total expenditure elasticities for the livestock commodity group and expenditure elasticities for dairy products within the livestock commodity group were calculated. The results suggest that dairy products, even in urban areas, remain luxury goods because of a high expenditure elasticity (1.26). Due to rapidly increasing consumption and the likelihood of inadequate supply growth, China will continue to increase its imports of dairy products to meet its domestic demand. Projections imply that China's imports of dairy products may approach 30 percent of its total domestic consumption by 2005. Due to differences in regional income and population growth rates, increases in dairy products consumption may occur especially in central and coastal areas, where potential trade opportunities may exist.

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Introduction

Understanding food consumption patterns is essential to the continuing growth of international trade, in particular for major exporter nations (Halbrendt *et al*., 1994). This is particularly so in a large country like China where, due to its large population base, even small increases in per capita consumption may produce a significant impact on world food trade (Brown, 1995). Enhanced knowledge about livestock products consumption can provide valuable information for both domestic and overseas producers, traders and policy-makers.[1]

According to Zhou *et al*. (2002), increased food supplies and consumer incomes have resulted in a shift towards high quality and healthy food products, such as dairy products, particularly in urban areas of China. Although per capita consumption of dairy products in China is far lower than in many other countries, the potential exists for further increases in consumption as more consumers, especially the younger generation, develop a taste for dairy foods. In fact, dairy products consumption has become very popular in cities where younger consumers are gradually adopting westernized diets, and many dairy products (e.g., fermented milk, yogurt and ice cream) that used to be consumed mostly during warm seasons are now being consumed in large quantities year-round (FAS, 2001).

As a result, China rapidly increased its dairy imports during the 1990s. Between 1995 and 2001, China's dairy product imports rose from US$62 million to over US$220 million, with milk

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[1] This study covers Mainland China only.

powders the dominant product imported (Table 1). With China's dairy exports relatively minor and static, her net imports rose from US$28 million to US$177 million over the same period. China's share of total Asian dairy product imports was only around 3 percent in 1990, but had more than doubled by 1999. Therefore China has become one of the larger importers of dairy products in Asia. This raises the question "what role might China play in global dairy markets in the future?"

Given the substantial recent increase in dairy product demand, China's future participation in world dairy products markets may be expected to have a significant impact on some dairy product net exporter nations. While there exist a few studies on China's dairy consumption (Rae, 1997; Wei and Viney, 1999; Shono *et al*., 2000; Zhou *et al*. 2002), they tend to be rather general and some do not provide any econometric parameters (such as elasticities) for dairy products consumption. For example, in this Journal Zhou *et al*. presented descriptive information on dairy production, consumption and trade and discussed factors affecting future development of China's dairy market, but attempted no quantitative analyses or projections.

This study focuses on dairy products consumption in urban areas[2], estimates expenditure elasticities for dairy product consumption and uses them to make projections of China's future dairy product demand and trade. Production and consumption projections are also formulated on a regional basis to identify those urban locations where trade opportunities may be greatest. The following section will discuss changes in dairy product consumption in urban China over the past two decades. The model and data to be used will then be discussed, followed by the empirical results, projections and conclusions.

[2] Rural residents consume less than 6 percent of urban per capita consumption volumes.

Trends in Dairy Products Consumption in China

China's reforms have resulted in significant increases in urban incomes and living standards and dramatic changes in food consumption patterns for both urban and rural economies (Huang and Rozelle, 1998). Some of the more pronounced changes in food consumption patterns include the declining share of food in total expenditure (Fan *et al*., 1995) and the shift from staple foods (such as rice and wheat) to relatively expensive livestock products (Cai *et al*., 1998). Of six different types of livestock products (pork, beef, mutton, poultry, eggs and dairy products), consumption of dairy products has increased the most. For example, its expenditure share in total livestock products consumption was only about 1.5 percent in 1980 but then rose dramatically, doubling twice by 2000 to more than 6 percent.

Table 2 gives the levels, composition and annual growth of dairy products consumption in urban China. In the mid-1980s, total dairy products consumption (in liquid milk equivalents) was only 7.2 kilograms, while it more than doubled to approximately 17 kilograms over the following 15 years. Along with this rapid increase in dairy products consumption, the composition of dairy products consumption also changed significantly over time. For example, in the mid-1980s drinking milk consumption accounted for about 55 percent of total consumption, but rose to nearly 70 percent of total consumption by 2000. In contrast, the share of powdered milk consumption declined over time, from nearly 40 percent to about 26 percent over the same period. The average annual growth rate of consumption over the past 15 years was faster for drinking milk (7.4 percent) than for dairy products in the aggregate (5.8 percent).

Due to variations in social and economic factors, the levels of dairy products consumption also vary substantially across regions.[3] For example, in some regions (e.g., Shanghai, Xinjiang, Beijing and Qinghai), urban dairy consumption per capita exceeded 40 kilograms, but averaged less than 15 kg in the Northeast, South and Southwest areas.

The Demand Models

Many studies of animal food consumption have used single equation models to estimate expenditure elasticities (Atkins *et al*., 1989; Rae, 1997; Stroppiana *et al*., 1998; Song and Sumner, 1999; Stroppiana and Riethmuller, 2000). To be consistent with consumption behaviour, however, this paper will use a two-stage LES-AIDS model that assumes the consumer's utility maximization decision can be decomposed into two separate steps (see Fan *et al*., 1995 for discussion of the advantages of using this particular two-stage model). The functional form chosen for the first stage is the linear expenditure system (LES):

(1) $$P_I Q_I = P_I R_I + B_I (E - \sum_J P_J R_J)$$

where P_I and Q_I are aggregated price and quantity indices for commodities within group I, E is total household expenditure, and R_I and B_I are parameters to be estimated. An intuitive economic interpretation of LES is possible provided $R_I > 0$, with a two-stage budgeting process implied. The consumer initially buys subsistence quantities (R_I) and associated subsistence expenditures are $P_I R_I$. After those initial purchases are made, the consumer has an amount remaining equal to

[3] Regions are defined as follows – Coastal: Shanghai, Jiangsu, Zhejiang and Shandong; North: Beijing, Tianjin, Hebei and Shanxi; Northwest: Mongolia, Gansu, Qinghai, Ningxia and Xinjiang; Northeast: Liaoning, Jilin and Heilongjiang; South: Fujian, Guangdong and Guangxi; Southwest: Sichuan, Guizhou and Yunnan; Central: Anhui, Jiangsu, Henan, Hubei, Hunan, Shaanxi.

$E - \sum_J P_J R_J$. This amount, the discretionary expenditure, is allocated over all commodity groups according to the marginal budget shares (B_I).

We incorporate regional dummy variables (D_k) and a time variable (T_t) into equation 1 to reflect the assumption that marginal budget shares (B_I) change across regions and over time. The linear expenditure system is estimated in shares because this specification is less likely to involve heteroskedasticity (Pollak and Wales, 1978):

(1a) $$w_I = P_I\theta_I + (B_{I0} + B_{I1}T_t + \sum_k B_{I2\,k} D_k)(1 - \sum_J P_J\theta_J)$$

where $w_I = P_I Q_I / E$ is the share of the *I*th commodity group in total expenditure and $\theta_I = R_I / E_I$ are the new threshold parameters. This linear share formulation implies a threshold level that grows proportionally with total expenditure (Parks and Barten, 1973).

As in Fan *et al*. (1995) and Chern and Wang (1994), the uncompensated own-price (η_{II}) and expenditure elasticities (e_I) associated with equation (1a) are defined as:

(2) $$\eta_{II} = [1 - (B_{I0} + B_{I1}T_t + \sum_k B_{I2\,k} D_k)] \cdot P_I\theta_I / w_I - 1$$

(3) $$e_I = (B_{I0} + B_{I1}T_t + \sum_k B_{I2\,k} D_k) / w_I$$

The functional form chosen for the second stage of the demand system is the Almost Ideal Demand System (AIDS) developed by Deaton and Muellbauer (1980). As in the first-stage model, regional dummy variables D_k (to capture regional effects and also to correct for heteroskedasticity) and time variables (T_t) are specified in the AIDS model. As in much empirical work using the AIDS, the price index *P* is approximated with Stone's index ($\ln P^* = \sum w_k \ln P_k$). Hence the resulting linear approximate AIDS (LA/AIDS) model can be defined as:[4]

(4) $$w_i = (\alpha_{i0} + \sum_k \alpha_{i1k} D_k) + \sum_j \gamma_{ij} \ln p_j + (\beta_{i0} + \beta_{i1}T_t + \sum_k \beta_{i2\,k} D_k)\ln(X / P^*)$$

[4] Since the time variable proved not to be significant, it is excluded from the constant term in equation 4.

where w_i is the expenditure share of livestock commodity i; p_j is the price of livestock commodity j; and X is total expenditure within the livestock commodities system.

Following Green and Alston (1990), the correct formula for estimating conditional uncompensated price elasticities (η_{ij}) from the LA/AIDS model, and that for the conditional expenditure elasticities (e_i) are:

(5) $$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{(\beta_{i0} + \beta_{i1}T_t + \sum_k \beta_{i2\,k} D_k)}{w_i}[w_j + \sum_k w_k \ln P_k (\eta_{kj} + \delta_{kj})]$$

(6) $$e_i = 1 + \frac{(\beta_{i0} + \beta_{i1}T_t + \sum_k \beta_{i2\,k} D_k)}{w_i}$$

where δ_{ij} is equal to one when $i = j$, and zero otherwise. Note that the $\beta_i s$ in equation 5 will be equal to zero only if preferences are homothetic at stage two. The unconditional price elasticities within the livestock commodity group and the unconditional expenditure elasticities can be defined as (Fan *et al*., 1995):

(7) $$\eta_{ij}^* = \eta_{ij} + e_i w_j (1 + \eta_{II})$$

(8) $$e_i^* = e_i e_I$$

Data

This study uses pooled time-series and cross-section data for urban households, including 28 provinces (autonomous regions or municipalities), covering the period 1990 to 2000. Two provinces (Hainan and Chongqing) and one autonomous region (Tibet) were excluded due to incomplete data.[5]

[5] Before 1996, Sichuan includes Chongqing.

For the LES model, all commodities were aggregated into three broad groups: meats and dairy, all other food and a non-food group. The meats and dairy group was further disaggregated into pork, beef, mutton, poultry, eggs and dairy products (fresh milk and dairy products including milk powder, yogurts, cheese and butter) for the second-stage LA/AIDS model.[6]

Expenditure series for the commodity groups and individual livestock products were based on data from the Household Income and Expenditure Surveys (HIES) and from Ma *et al*. (2004). Especially since the 1990s, the consumption of livestock products away-from-home has increased in China. To account for this, we took the 'food expenditure away from home' category in the HIES and apportioned it among the various livestock and other food commodities, based on the procedure explained in Ma *et al*. The exclusion of away-from-home consumption of livestock products risks serious bias in results and conclusions since the proportions of total meat consumption that occurs away-from-home differ substantially across products. For example, because the proportion of pork consumed away-from-home is substantial, but that for dairy products is almost zero, use of the HIES data alone will understate the pork expenditure share and overstate that of dairy products.[7] Provincial price indices for the first-stage commodity groups came from China's Commodity Price Statistical Yearbooks. As is common in the linear expenditure system literature (Fan *et al*., 1995; Lewis and Andrews, 1989; Halbrendt *et al*., 1994), price indices were used for the first-stage demand system analysis.[8] These were calculated for each of the three commodity groups using geometric means with expenditure shares as weights.

[6] Although soymilk is perhaps the most important substitute for drinking milk in China, a full set of provincial price data were unavailable. Therefore while the demand system does not include soymilk, it does specify other protein sources as substitutes for dairy products consumption.

[7] To demonstrate the significance of including away-from-home consumption in our data set, we re-estimated the above models using unadjusted HIES consumption data. The results included an empirically impossible 20 percent marginal expenditure share for urban dairy products consumption.

[8] Ideally, data on price parity across provinces for at least one year should be used to adjust the provincial price indices so that they

Price series for individual foods within the meat and dairy commodity group for the second stage analysis were obtained from the database of the National Price Bureau of China (NPB). The NPB gathers price data from major urban free markets every ten days and uses an average of them as the monthly price. We used such monthly price data and took the average of the 12 monthly prices within each year to generate an annual price series from 1990 to 2000. Since free market fresh milk retail price data are not available from the NPB's database, an implicit price series for fresh milk was derived from the purchased quantity and expenditure data. Households consumed milk powder as well as fresh milk. Since milk powder prices were also unavailable, we used the sum of fresh milk and milk powder expenditures from the HIES to generate an expenditure share for dairy products, while we retained the fresh milk price in the demand system.

Results

Results from the first-stage estimation are presented in Table 3. All parameters are significant at the 1% level. Time variables and most of the regional dummy variables (not reported in Table 3) are also significant, indicating that the consumption patterns for all three groups changed over time and across regions. Own-price elasticities for the meats and dairy, other food and non-food groups are different, ranging from –0.46 for non-food to –1.14 for meat and dairy products (cross-price elasticities are not reported). Demand is price elastic for meats and dairy and for other food, and price-inelastic for non-food. Of the three groups, meats and dairy has the lowest expenditure elasticity (0.73), whereas the non-food group has the highest expenditure elasticity (1.11). We note the negativity of the θ_I parameters for foods. While their popular interpretation

reflect differences among provinces and over time. However, such data were unavailable.

as subsistence quantities is no longer appropriate, such negative values imply and are implied by elastic own-price behaviour for these goods (Parks and Barten 1973).

The second-stage parameter estimates for the disaggregated products within the meats and dairy group are presented in Table 4. Adding-up, homogeneity and symmetry restrictions (specified appropriately to incorporate time and regional dummy variables) were imposed (the mutton demand equation was dropped from system) using the SUR technique. Except for a few cross-price parameters, most of the price coefficients are significant at the 5% level as are all expenditure parameters except that for eggs. All time trend variables are also significant at the 1% level except those for pork and chicken.

Own-price and expenditure elasticities, calculated at year 2000 consumption levels, are presented in Table 5. As regards the unconditional elasticities, we can see that dairy products have the most negative own-price elasticity (-0.99) and mutton has the least negative. Meanwhile, dairy products have the highest expenditure elasticity (1.26), implying that dairy products are still luxury goods even in urban China. Mutton has the smallest expenditure elasticity (0.36). Remaining expenditure elasticities are rather similar, ranging from 0.6 to 0.9. In addition, we found that the expenditure elasticities declined over time. For example, expenditure elasticities for the meats and dairy commodity group decreased from 0.96 in 1990 to 0.73 in 2000 (from the LES estimation), and the (conditional) expenditure elasticity for dairy products within the livestock commodity group decreased from 2.29 in 1990 to 1.73 in 2000 (from the LA/AIDS estimation).

Finally, we divided all provinces (autonomous regions or municipalities) into seven regions based mainly on social and economic characteristics, and estimated both models for each region. For brevity, the resulting regression coefficients are not presented here (most were statistically significant and of the expected sign), but the expenditure elasticities based on those estimated parameters are presented in Table 6. As expected, the unconditional expenditure elasticities for dairy products vary substantially across regions, and in some they are very high. For example, they range from 0.41 to 0.65 in the North and Northeast, from 1.4 to 1.70 in Central and Southwest areas and 3.81 in the South region. The reasons for such large regional variations in dairy expenditure elasticities are unclear, although consumption levels and consumer preferences may be two of the more important. For example, dairy consumption is already high in North and Northeast (more than 25 kg during 1998-2000), but is very low in Central and South (less than 15 kg during 1998-2000). Besides, perhaps due to taste preferences, Southern consumption of dairy products is low even though incomes are relatively high. For example in urban Guangdong, dairy products expenditure per capita was only 37 percent of that in urban Beijing in 2000 even though Guangdong per capita food expenditure was the same as in Beijing.

Projections of Dairy Products Consumption and Production

In this section we make projections of China’s dairy products consumption and milk production to the year 2005, to indicate the possible change in China’s net imports of these products. These projections assume no changes in prices. Since total consumption in any year is equal to the product of consumption per capita and total population, projections must be made of both these elements. For per capita consumption, the relationships between per capita consumption and expenditure, as estimated above, are used. This in turn requires that projections of per capita expenditure are available. Finally, the projected level of consumption per capita is multiplied by the projected population size.

The relevant expenditure elasticities were estimated as a function of time (e_{It} in equation 3 and e_{it} in equation 6). In making extrapolations of these elasticities over the projection period we assumed the same linear relationship with respect to time.[9] To make extrapolations of per capita urban expenditure and total urban population, we assumed that growth rates of the past ten years will continue until 2005. Two three-year averages centred on 1990 and 1999 were used to calculate annual growth rates over the intervening years. Milk production in China was simply projected using the average growth rate over the above period.

The projected levels of per capita dairy products consumption were estimated as:

(9) $$q_{it} = q_0 \prod_{s=1999}^{t-1} (1 + e_{Is} e_{is} g) \quad ; \text{t = 2000, … ,2005.}$$

where q_0 is base year consumption (14.3 kg per person), and g is the projected growth rate of total expenditure per person (0.057, or 5.7 percent). The projections are presented in Table 7. The projected 32 percent increase in urban per capita expenditure over the projection period combines with a 19 percent increase in the total urban population to result in total urban consumption of dairy products increasing from 5.84 million tonnes in the base period to 9.27 million tonnes in 2005, or an increase of 59 percent. This projected increase in consumption may be decomposed into that portion due to the increase in the urban population (32 percent of the total increase) and that due to the rise in per capita expenditure (68 percent). To this projected value we add an amount of one million tonnes to account for rural consumption of dairy products, which has not been explicitly modeled here.[10]

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[9] The estimated 1999 and projected values of e_{Is} and e_{is} were 0.722 and 0.672 (e_{Is}), and 1.878 and 1.231 (e_{is}), respectively.
[10] This assumes rural consumption remains at its current level of about 1.2 kg per capita over the projection period.

China’s total milk production is projected to increase by 21 percent, or from 6.21 million tonnes in the base period to 7.53 million tonnes in 2005. Therefore for the country as a whole, the domestic milk production shortfall of 0.63 million tonnes in the base period is projected to rise to 2.74 million tonnes by 2005. As a result, China’s milk self-sufficiency rate is projected to fall from 91 percent in 1998-2000 to 73 percent by the year 2005 given that the recent trend increase in domestic milk production continues over the projection period.

Constant-price projections of dairy products consumption and production were also made for each region, based on the estimated expenditure elasticities (Table 6) and projected expenditure and population growth rates for each region. Some results are summarized in Table 8. Although not shown in the Table, projected per capita consumption levels are very different across regions in China. For example, the Central, Northeast and Southwest regions have the smallest projected per capita consumption levels (around 14 kg); the North and Northwest have relatively higher projected consumption levels (25-32 kg), while the Coastal region is projected to have the highest per capita consumption by 2005 (38 kg). Projected consumption for other regions is around 16-17 kg per capita. Total consumption levels are projected to grow the most rapidly in the Central and South regions (by more than 80 percent) and projected increases of over 50% are found for the Coastal and Northwest regions. Growth rates in regional milk production also vary considerably from 35% over the projection period in the Northwest to virtual stagnation in Central, South and Southwest regions.

Self-sufficiency rates are projected to decline in all regions, and (as in the base period) only the Northeast and Northwest regions show a surplus of milk production over consumption in 2005. Other regions run very large production deficits (with the exception of the North), with self-sufficiency rates well below 50% in some instances. Decomposition of the projected increases in dairy consumption shows that income growth is the major determinant of consumption growth in the Central and Coastal regions, whereas population growth is the major driver in the South and Southwest. In summary, the greatest opportunities for dairy exporters to China may occur in the Central and Coastal areas, which may account for over half of the total increase in dairy products consumption by 2005 but only 20 percent of the domestic supply expansion.

Conclusions

A livestock product demand system for urban China was estimated using LES and LA/AIDS models, with a particular focus on dairy products. Based on the estimated econometric parameters, constant-price projections of dairy products consumption were made. Coupled with production projections, potential deficits were estimated at the national level as well as for major regions within China. Results should be of interest to dairy market traders, farm producers and policy makers.

Many animal foods consumed in China can be classified as necessities, since their expenditure elasticities are typically less than one. Dairy products do not appear to fall into this classification, however, as their consumption is at an early stage of development. Of the six major livestock products studied here, only for dairy products is the expenditure elasticity greater than one, allowing such products to be classified as luxury goods in urban China. This suggests that future growth of China’s dairy market will depend heavily upon the growth of incomes.

China will most likely continue to import increasing amounts of dairy products into the foreseeable future due to increases in demand outstripping growth in domestic milk supply. The estimated shortfall in production may reach 2.74 million tonnes by 2005, implying a self-sufficiency rate of 73 percent compared with 91 percent five years earlier. This deficit assumes that milk-surplus regions in China will be able to supply milk and dairy products to those regions in deficit. The extent to which this can occur in future depends in part upon further developments in transportation, especially the availability of suitable refrigerated food chains. At a regional level, the greatest opportunities for dairy exporters may occur in the Central and Coastal areas.

Finally, a couple of cautionary points can be noted, that may influence the future evolution of China's dairy imports. First, our assumption of constant prices will almost certainly not hold. For example, China's accession to the WTO in December 2001 requires tariffs on imports of dairy products to be reduced. Applied tariffs on various dairy products were in the range of 42 percent to 50 percent in 2001, and these are to be reduced to between 10 percent and 20 percent by 2004. Counteracting any downward pressure such tariff cuts might have on domestic Chinese prices, international dairy prices might rise in future should the current WTO Round of trade negotiations in agriculture result in significant market liberalization, and global dairy prices may rise by more than for many other foods due to the high protection currently afforded milk production in many developed countries. Although such reforms would not be implemented until after 2005, to the extent that these price rises would be transmitted to the domestic Chinese market then demand growth could be inhibited somewhat as dairy products increase in price relative to other foods, and domestic production could be boosted. Second, our milk supply projections implied extrapolation of past growth in productivity. Milk yields per cow remain low in China relative to many other countries (Rae and Hertel 2000) and improvements in the rate of new technology development and adoption in China could lead to more rapid supply growth than projected here.

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Table 1. China's Dairy Products Trade, 1995-2001 (US$ million)

Year	Exports				Imports			
	Drinking milk	Powders	Other [a]	Total	Drinking milk	Powders	Other [a]	Total
1995	17.1	9.0	8.2	34.3	5.4	28.1	28.5	62.0
1996	19.0	7.5	3.7	30.2	3.6	18.1	31.7	53.9
1997	19.2	14.9	10.5	44.6	3.9	19.2	40.9	64.0
1998	18.2	13.7	15.2	47.1	3.3	39.0	46.7	89.0
1999	18.2	19.5	8.8	46.5	8.5	80.1	76.1	164.7
2000	20.1	20.9	20.2	61.2	8.9	115.3	97.1	221.2
2001	19.1	10.4	15.3	44.7	4.9	114.4	102.4	221.7

Source: FAOSTAT in Chinese version.

[a] Including yogurt, cheese, butter and whey. Note that whey accounts for a significant share of China's dairy products imports, for example about 40 percent of 'other dairy products' imports between 1999-2001.

Table 2. Dairy Products Consumption, Structure and Growth in Urban China

Period	Total Dairy Products [a]	Of Total Dairy Products		
		Drinking Milk	Powdered Milk	Others
Per Capita Dairy Products Consumption (kg):				
1985 [b]	7.2	4.0	2.8	0.4
1990	9.3	5.2	3.7	0.4
1995	10.7	6.5	3.6	0.6
2000	16.8	11.6	4.3	0.8
Structure of Dairy Products Consumption (%):				
1985	100	55.0	39.3	5.7
1990	100	56.1	39.6	4.4
1995	100	62.5	34.5	3.1
2000	100	69.1	25.9	5.0
Annual Growth Rates (%):				
1985-2000	5.8	7.4	3.0	4.6

Source: Consumption data are from the Household Income and Expenditure Survey (HIES), State Statistical Bureau of China.

[a] Liquid milk equivalent (LME) includes drinking milk, powdered milk and other types of dairy products (e.g., yogurt, cheese and butter). The conversion coefficient of powdered milk into drinking milk used in this paper is 8.85; the conversion coefficient of cheese and butter into drinking milk is 28.

[b] In order to obtain a stable base, we used three-year averages centered on the years listed in the table as the consumption levels to calculate consumption structure and annual growth.

Table 3. Estimated Major Parameters and Elasticities for Commodity Groups (Stage One)

Commodity Groups	Parameters			Elasticities	
	θ_I	B_{I0}	B_{I1}	Own-Price	Expenditure
Meats and Dairy	-0.0102 (2.5)	0.1567 (30.7)	-0.0059(9.1)	-1.1370	0.7265
Other Food	-0.0199 (3.0)	0.3667 (51.3)	-0.0137(15.0)	-1.1360	0.8902
Non Food	0.4699 (8.5)	0.4766 (54.3) [a]	0.0197(17.3)	-0.4615	1.1068

Note: Numbers in parentheses are *t* values. For brevity, the estimated parameters were not reported for regional dummy and time variables. The elasticities are calculated using the year 2000 means.

[a] These coefficients were derived from the adding-up condition of demand parameters in the linear expenditure system.

Table 4. Estimated Parameters for Livestock Products (Stage Two)

Commodity	Parameters							
	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	γ_{i6}	β_{i0}	β_{i1}
Pork	0.1785	-0.0263	-0.0151	-0.0277	-0.0715	-0.0379	-0.0862	0.0001
	(21.20)	(8.25)	(2.23)	(5.96)	(15.91)	(7.96)	(7.09)	(1.33)
Beef	-0.0263	0.0416	0.0094	-0.0003	-0.0195	-0.0050	-0.0035	-0.0001
	(8.25)	(13.19)	(2.45)	(0.16)	(8.76)	(1.85)	(1.81)	(7.36)
Dairy	-0.0151	0.0094	0.0159	0.0087	-0.0129	-0.0009	0.0735	0.0001
Products	(2.23)	(2.45)	(2.15)	(2.16)	(2.93)	(0.21)	(6.78)	(3.63)
Chicken	-0.0277	-0.0003	0.0087	0.0179	0.0034	-0.0020	0.0320	0.0000
	(5.96)	(0.16)	(2.16)	(3.81)	(1.08)	(0.89)	(3.33)	(0.52)
Eggs	-0.0715	-0.0195	-0.0129	0.0034	0.1051	-0.046	0.0052	0.0000
	(15.91)	(8.76)	(2.93)	(1.08)	(23.75)	(1.77)	(0.57)	(3.33)
Mutton [a]	-0.0379	-0.0050	-0.0009	-0.0020	-0.0046	0.0504	-0.0209	-0.0002
	(9.77)	(1.83)	(0.19)	(0.90)	(1.66)	(11.91)	(3.52)	(10.91)

Note: The constant term is not reported. Numbers in parentheses are t-values.

[a] These coefficients were derived from the imposed adding-up restrictions.

Table 5. The Estimated Own-Price and Expenditure Elasticities (Stage Two)

Commodity	Conditional Elasticity		Unconditional Elasticity	
	Own-price	Expenditure	Own-Price	Expenditure
Pork	-0.5645	0.8324	-0.6227	0.6047
Beef	-0.3214	0.9215	-0.3292	0.6695
Dairy Products	-0.9687	1.7309	-0.9930	1.2575
Chicken	-0.9184	1.2042	-0.9444	0.8748
Egg	-0.1485	1.0515	-0.1661	0.7639
Mutton	-0.1253	0.4966	-0.1222	0.3607

Note: Unconditional expenditure elasticities with respect to total expenditure are equal to conditional expenditure elasticities with respect to meat and dairy expenditure multiplied by the total expenditure elasticity for the meat and dairy commodity group estimated by the LES model (0.7265, see Table 3). Both conditional and unconditional expenditure elasticities are estimated at the year 2000 consumption levels.

Table 6. Estimated Expenditure Elasticities by Regions

Region	Total Expenditure Elasticities for Meat & Dairy Product Group (Stage One)	Expenditure Elasticities for Dairy Products (Stage Two)	
		Conditional	Unconditional [a]
Central	1.2052	1.4122	1.7020
Coastal	0.4361	2.6722	1.1653
North	0.5351	1.2208	0.6532
Northeast	0.2646	1.5366	0.4066
Northwest	0.7589	1.5795	1.1987
South	1.7516	2.1741	3.8082
Southwest	1.2912	1.1261	1.4540

Source: Calculated from the estimated model parameters.

Note: Regions are defined as in footnote 4.

[a] The numbers in column 3 are the products of the numbers in column 1 and column 2.

Table 7. Constant-Price Projections of Dairy Products Consumption and Production Deficits

	Actual level 1998-2000	Projected level 2005
Urban total expenditure (yuan per capita)[a]	4622	6106
Urban population (million)[a]	408.3	485.3
Urban consumption		
- per capita (kg LME)	14.3	19.1
- total (mmt LME)	5.84	9.27
Total consumption (mmt LME)[ab]	6.84	10.27
Total production (mmt)[a]	6.21	7.53
Production as percent consumption (%)	90.8	73.3
Production deficit (mmt)	0.63	2.74

Note: mmt = million metric tonnes and LME=liquid milk equivalents

[a] Assumed annual growth rates of these exogenous variables were 5.73% (expenditure), 3.51% (urban population) and 3.94% (milk production).

[b] This study did not explicitly model the largely-stagnant rural milk consumption. Given the size of the rural population and their current milk consumption of around 1.2 kg per capita, urban consumption has been increased by 1.0 mmt to derive consumption for mainland China as a whole

Table 8. Projections of Urban Dairy Product Consumption, Milk Production, and Dairy Product Production Deficits By Region

Region	Actual levels 1998-2000 ('000 mt LME)		Projected levels 2005 ('000 mt LME)		Production as percent consumption		Production deficit [a]	
	Consumption	Production	Consumption	Production	1998-2000	2005	1998-2000	2005
Central	869	389	1581	389	44.8	24.6	480	1192
Coastal	2000	1034	3019	1265	51.7	41.9	966	1754
North	949	923	1218	1140	97.3	93.6	26	78
Northeast	841	1350	1032	1385	160.5	134.2	-509	-353
Northwest	790	1939	1207	2632	245.4	218.1	-1149	-1425
South	412	99	766	95	24.0	12.4	313	671
Southwest	478	328	626	326	68.6	52.1	150	300

[a] Negative values indicate a regional surplus of production over consumption

Note: Regions are defined as in Table 6. Column totals do not match corresponding values in Table 7 since some provinces were omitted from this definition of regions, and population and expenditure growth rates are region-specific in Table 8.