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How Much Animal Product do the Chinese Consume? Empirical Evidence from Household Surveys

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Abstract

Reliable information about animal product consumption in China is extremely important for policy formulation and marketing activities. However, publications by China's State Statistical Bureau underestimate animal product consumption. Such underestimated statistics affect policy making and marketing initiatives and also lead to the estimation of distorted parameters that are crucial for other research work. Based on a large-scale household survey, this paper presents findings on animal product consumption in China. Our results show that the consumption of animal products in China has reached a much higher level than was previously held and the SSB statistics underestimate this consumption by as much as 30 to 60%. The paper also identifies the major factors that affect animal product consumption in China. Implications of the findings are discussed.

1. Introduction

Since the rural economic reforms in the early 1980s, China's livestock industry has grown rapidly and animal products have increased tremendously. In the meantime, per capita consumption of animal products has also increased rapidly. However, animal product consumption data provided by the State Statistical Bureau (SSB) (based on household surveys) only show the average amount of per capita animal product consumption, and lack the necessary details that are indispensable for market research and policy making. One other major shortcoming of the SSB consumption data is related to accuracy. The SSB data tend to underestimate the level of consumption by both rural and urban residents. For example, according to SSB, average per capita consumption of pork, beef and mutton in urban areas was 19.2 kg and that of poultry was 4.7 kg in 1998. The corresponding level of consumption in rural areas was 13.2 kg and 2.3 kg, respectively. Using a weighted average, per capita meat consumption in China was 18 kg in 1998. However, per capita meat output in 1998 was 45.9 kg. Considering that the amount of China's meat export is small, there is a huge gap between production and consumption that was not explained; SSB's consumption data can only explain about 40% of the production.

Some believe that the output level of China's animal products is inflated. Zhong (1997) believes China's meat production statistics could have been inflated by 50% or even more. Lu (1998) believes output of meat, poultry eggs and aquatic products for 1981-1995 could have been inflated by at least 40%. Aubert (1999), Colby et al. (1999), and Fuller et al. (2000) also believe that China's official meat production statistics have been overstated. However, Yuan (1999) disagrees with these claims and argues that the level of inflation for meat output is significantly below 40%. Jia (1999) even believes that the previously published meat production statistics are reasonable and there is little inflation.

On the other hand, some may have underestimated the consumption of animal products by the Chinese; for example, Liang (1998), Fuller (1999), Huang, Roselle and Bouis (1998) and the SSB surveys. In many studies, away from home consumption and retail processed animal products, which have become an increasingly important part of total animal product consumption, are often overlooked.

In response to the increasing gap between production and consumption data and aided by the 1996 national agricultural census

findings, the Chinese government adjusted downwards the output level of animal products for 1996 and 1997. Yuan (1999) believes that pork, beef and mutton output figures since 1996 are now reasonable, although poultry and egg output remain inflated to some extent. Keeping this fact in mind, the still present gap between production and consumption levels in 1998 (per capita meat consumption reported by SSB was 18 kg; per capita meat output was 45.9 kg) suggests that it is most likely that consumption level was seriously underestimated.

Accurate data with greater details about animal product consumption by the Chinese consumers are extremely important for policy formulation and marketing activities. In this paper, we report findings from a household survey on animal product consumption in both rural and urban areas of China. In the next section, we present key results from the survey about the quantity and composition of animal product consumption. Section 3 examines key factors that affect animal product consumption in China. The last section provides some concluding comments.

2 Quantity and Composition of Animal Product Consumption in China

Based on carefully planned sampling procedures, [1] household surveys were conducted in capital cities, towns and rural villages in six provinces of China, namely, Jilin, Inner Mongolia, Shandong, Jiangsu, Sichuan, Guangdong. The surveys were conducted simultaneously in the six provinces in June 1999, collecting household animal product consumption data for 1998. Most of the interviewers were researchers specialising in livestock economics and a few were postgraduate research students. Before the surveys, pilot surveys were carried out to test the questionnaires and all the interviewers were trained.

In each province 110 households were surveyed. Three hundred and fifty-nine valid questionnaires were obtained from urban surveys and 274 from rural surveys, resulting in 633 valid questionnaires in total. The surveyed families were sufficiently diverse, covering those engaged in various careers in cities, towns and villages. Key characteristics of both the urban and rural samples were compared with the national averages to ascertain how representative the samples were. Most of the sample features are comparable to the national averages. However, per capita income level is somewhat higher in the samples than in the national averages, especially in the rural sample (¥6218 in the urban sample, compared with ¥5952 of the national urban average; ¥3015 in the rural sample, compared with ¥2554 of the national rural average). Two major reasons that are probably responsible for this higher sample income are: (1) non-inclusion of any of the poorest provinces in the survey, such as Yunnan, Guizhou, Gansu and Shaanxi; and (2) the proportion of households falling into higher income groups in the samples is slightly higher, especially in the rural sample. Given that consumer income is generally regarded as the key factor affecting the consumption level of animal products, the estimates of animal product consumption from our surveys are probably biased slightly upwards.

Given that the surveys by the State Statistical Bureau only include the quantity purchased by households for in-house consumption, in our surveys, we tried to overcome this shortcoming by modifying our survey instrument in the following ways.

- For urban households, animal product consumption includes in-house and away from home consumption.
- At home consumption includes not only the purchased quantity but also that given by their firms as staff welfare and that given by friends and relatives as gifts.
- Away from home consumption comprises all food containing animal products eaten outside the house including breakfast, lunch and dinner.
- For rural residents, animal product consumption includes the quantity consumed from self-produced products, the quantity purchased, and the quantity consumed away from home.

With these modifications to our survey instrument, we believe that our survey can cover the majority of animal products consumed by households in both rural and urban China. In the rest of this section, we report the findings on animal product consumption by households in the surveyed provinces.

2.1 Animal Product Consumption in China has reached a Higher Level

Based on the survey, the per capita meat consumption in 1998 was 33.73 kg at the all China level. This is composed of pork (22.54 kg), beef and mutton (4.73 kg), and poultry (6.54 kg) (see Table 1). This weight does not include the amount consumed of animal heads, hoof and paws, tails and offal, and was calculated at the retail weight. The per capita consumption of eggs, which does not include eggs contained in retail processed foods, was 9.68 kg. Dairy products, converted into fresh milk, were 6.31 kg and fish was 8.97 kg. Using the information in Table 1, it is calculated that in 1998 total meat consumption in China was 42.1 million tons, in which pork accounted for 28.1 million tons, beef and mutton accounted for 5.9 million tons, and poultry 8.1 million tons. Eggs, milk and fish consumption was 12.1, 7.9 and 10.9 million tons, respectively (see Table 1).

Table 1. Per Capita and Total Animal Product Consumption in China, 1998

	Per Capita Consumption				Total Consumption (1000 tonnes)				
	(kg)				Urban		Rural		All China
	Urban	Rural	All China	Urban-Rural Ratio	Quantity	% of All China	Quantity	% of All China	Quantity
Total Meat	49.81	26.83	33.73	1.9:1	18899	44.9	23200	55.1	42098
Pork	30.72	19.04	22.54	1.6:1	11656	41.4	16476	58.6	28132

Beef and Mutton	8.86	2.96	4.73	3.0:1	3362	56.9	2542	43.1	5904
Poultry	10.24	4.83	6.45	2.1:1	3885	48.3	4165	51.7	8050
Eggs	15.84	7.04	9.68	2.3:1	6010	49.7	6072	50.3	12082
Dairy Products	13.96	3.04	6.31	4.6:1	5297	67.3	2579	32.7	7876
Aquatic Products	16.10	5.65	8.79	2.8:1	6109	55.7	4862	44.3	10971

Source: Based on the survey.

The survey reveals that the consumption of animal products in China has reached a much higher level than previously held. The amount of various animal products consumed by Chinese consumers is clearly much higher than the reported amount from the SSB surveys (see Table 2). Therefore, the SSB household surveys significantly underestimate the consumption level of animal products by residents in both rural and urban China. Nonetheless, the SSB survey confirms that the consumption level of animal products by urban residents is higher than that of rural residents, and the urban-rural ratio is largely comparable to that revealed by the current survey (Table 2).

Table 2. Comparison of Per Capita Animal Product Consumption between this Study and SSB, 1998

	Per Capita Consumption			Per Capita Consumption			Underestimation by SSB			
	(This Survey)			(SSB Survey)			Urban		Rural	
	Urban (kg)	Rural (kg)	Urban- Rural Ratio	Urban (kg)	Rural (kg)	Urban- Rural Ratio	Quantity	%	Quantity	%
Total Meat	49.81	26.83	1.9:1	23.90	15.50	1.5:1	-25.91	-52	-11.33	-42
Pork	30.72	19.04	1.6:1	15.88	13.20	1.2:1	-14.84	-48	-5.84	-31
Beef and Mutton	8.86	2.96	3.0:1	3.34	*	n.a.	-5.52	-62	n.a.	n.a.
Poultry Meat	10.24	4.83	2.1:1	4.65	2.33	2.0:1	-5.59	-55	-2.50	-52
Poultry Eggs	15.84	7.04	2.3:1	10.76	4.11	2.6:1	-5.08	-32	-2.93	-42
Dairy Products	13.96	3.04	4.6:1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Aquatic Products	16.10	5.65	2.8:1	9.84	3.31	3.0:1	-6.26	-39	-2.34	-41

* Included in pork

n.a.: not available.

Sources: Based on the survey; SSB (1999), China Statistical Bureau, pp. 322, 346.

Another observation emerging from the survey results is that pork consumption still accounts for a major portion in total meat consumption, being 67%. Beef and mutton together accounts for about 14% while poultry accounts for 19% (see Table 3). In rural areas, the proportion of pork consumption is even higher, being over 70%. However, beef and mutton consumption is much lower. Urban residents tend to consume more poultry meat.

Table 3. Composition of Meat Consumption, 1998

	Urban	Rural	All China
Per Capita Consumption (kg)			
Pork	30.72	19.04	22.54
Beef and Mutton	8.86	2.96	4.73
Poultry	10.24	4.83	6.45
Total Meat	49.81	26.83	33.73
% out of Total Meat Consumption			
Pork	62	71	67
Beef and Mutton	18	11	14
Poultry	21	18	19
Total Meat	100	100	100

Source: Based on the survey.

2.2 The Consumption Gap between Rural and Urban Residents is still very Large

Both this survey and the SSB surveys show that the per capita consumption level of animal products by urban residents is higher than that of rural residents. In some cases, the gap is as large as 3 to 4 times (e.g., the consumption of beef and mutton and dairy products). It is interesting to note that the consumption gap between more traditional animal products is smaller (e.g., pork and poultry meat). This tends to suggest that income increase and urbanisation are likely to affect the composition of animal product consumption.

At the aggregate level, urban residents consume almost the same amount of animal products as do rural residents, and in some cases this proportion is much higher (e.g., beef and mutton, dairy products and aquatic products) (see Table 1). However, China's urban population is less than 30% of its total population and the rest is rural. This further shows that the consumption gap between the urban and the rural populations is still very large.

The fact that the per capita consumption level in rural areas is low suggests that there is greater potential for rural areas to increase consumption of animal products in the future. This is simply because the rural population base is huge. When their income increases, their demand for animal products will increase. A small per capita increase in animal product consumption by the large rural population will result in a huge increase in total quantity demanded.

2.3 Away from Home Consumption is on the Increase

Table 4 shows that away from home consumption of animal products now accounts for an important portion of total consumption. About 21% of meat, 30% of aquatic products, 15% of dairy products and 13% of eggs are consumed outside the home. Among all the meats, the consumption of poultry meat away from home has the highest portion, being 32.2%, followed by beef and mutton, 28%. Pork has the lowest proportion, being 17%. The possible reason for a lower proportion of pork and eggs being consumed away from home is perhaps that their consumption by urban residents has reached a plateau and that cooking them at home is relatively easier. Table 4 also shows that urban households have a much higher away from home consumption compared to their rural counterparts for most of the animal products. The only exception is dairy consumption. This is because, influenced by urban people, some farm family members working in urban areas tend to consume some dairy products. But on the other hand, dairy production by rural households is too low. When combined, this produces a higher proportion for away from home consumption of dairy products by rural households.

Table 4. At Home and Away from Home Consumption of Animal Products in China

	Per Capita At Home Consumption		Per Capita Away from Home Consumption		Proportion of Away from Home Consumption by Urban Residents	Proportion of Away from Home Consumption by Rural Residents
	Quantity (kg)	% of Total Consumption	Quantity (kg)	% of Total Consumption		
Total Meat	26.54	78.7	7.19	21.3	33.6	11.5
Pork	18.77	83.3	3.77	16.7	26.6	9.9
Beef and Mutton	3.39	71.6	1.34	28.4	37.5	16.7
Poultry	4.37	67.8	2.08	32.2	51.3	14.8
Eggs	8.40	86.8	1.28	13.2	13.0	13.4
Dairy Products	5.38	85.2	0.93	14.8	4.2	35.5
Aquatic Products	6.16	70.1	2.63	29.9	43.5	13.3

Source: Based on the survey.

2.4 The Consumption of Fatty Meats is on the Decrease but that of Lean Meats is on the Increase

Some 20 years ago, many Chinese people, particularly rural people, liked to buy very fatty meats - the fatter, the better. This seems to have changed significantly. The survey results in Table 5 indicate that the consumption of fatty meats by both urban and rural residents accounts for only a very small portion of their meat consumption, being 2.3% and 7%, respectively. On the other hand, the consumption of lean meat accounts for an important proportion, 53.1% for urban residents and 34.7% for rural residents. In rural areas, there is still a significant preference for meats that are not very fatty but not very lean either (44.5%). This is perhaps because rural workers still require some fats in the body so as to perform heavy manual work and in the meantime rural people are perhaps less aware of potential problems animal fats may cause to health. It seems the Chinese consumers more readily accept the head, claws, tails and offal of pigs than of cattle and sheep (Table 5).

Table 5. Composition of Various Parts of Animals Consumed by Urban and Rural Residents (%)

	Animal	Head, Foot and Claws, Tails and Offal	Ribs	Fatty Meat	Lean Meat	Fatty and Lean Meat	Total
Urban	Pig	7.4	22.1	4.0	33.7	32.8	100
	Cattle	1.2	1.5	0.3	87.0	10.1	100
	Sheep	1.6	6.0	0.1	70.2	22.1	100
	Average	6.0	14.1	2.3	53.1	24.5	100
Rural	Pig	6.6	10.6	9.4	24.9	48.5	100
	Cattle	0.8	1.8	0.6	88.5	8.3	100
	Sheep	1.4	5.4	1.3	43.0	48.9	100
	Average	5.1	8.7	7.0	34.7	44.5	100

Source: Based on the survey.

2.5 Consumption of Retail Processed Meat Products is Relatively Low

According to the extent of meat product processing, meat products may be put into three categories: raw, semi-processed, and processed. In Table 6, semi-processed products are treated as part of the raw products. Table 6 suggests that the consumption of processed meat products by Chinese urban residents is generally low, being only about 10%. Almost 90% of meat products consumed at home is unprocessed. The proportion of semi-processed products is very low. While these results tend to suggest that there is potential to develop the semi-processed and processed animal product market, they also reflect the fact that many Chinese consumers' incomes are not yet high enough to afford a large portion of semi-processed or processed meat products. Future consumer income increase may lead to increased consumption of such processed products.

Table 6. Proportion of Processed and Unprocessed Animal Products Consumed In-House by Urban Residents

	Raw		Processed	Total
		Of which, Semi-Processed		
Pork	90.5%	1.2%	9.5%	100%
Beef	79.4	1.1	20.6	100
Mutton	92.5	2.5	7.5	100
Poultry	81.0	1.9	19.0	100
Aquatic Products	96.6	2.3	3.4	100
Average	89.6	1.7	10.4	100

Source: Based on the survey.

Among different kinds of processed products, beef has a higher proportion consumed at home by urban residents (20.6%), followed by poultry meats (19.0%) (see Table 6). This may be partially attributable to (1) the fact that beef is not traditionally consumed by the majority of Chinese consumers and they may lack the skills to cook beef dishes at home and (2) some specially cooked poultry products cannot be prepared at home. On the other hand, Chinese people are well used to cooking pork at home. As for mutton (or lamb), the popular way of preparing it in China in recent years is by the "hot pot" method. Sliced lamb is quickly dipped into the boiling soup in the "hot pot" and then consumed by mixing with other seasonings and side dishes. In this case, raw meat must be used. Chinese people do not like buying too many pre-cooked aquatic products, preferring instead to use fresh raw materials for cooking.

3. Major Factors Affecting Animal Product Consumption in China

Clearly, the demand for animal products by Chinese consumers has increased rapidly in the past two decades. What are the main forces driving this demand? Identification of the factors that affect animal product consumption is very useful not only for understanding why demand for animal products has increased in the past but also for foreseeing the likely future demand. In this section, based on the information and data gathered in the surveys, we try to identify such factors that affect Chinese consumers' demand for animal products by estimating a demand function for animal products.

3.1 Variables Determination

Major factors that affect animal product consumption include income, prices of animal products, prices of other goods, characteristics of households, local economic development level, consumer tastes and preferences, etc. In the surveys,

information on the following major indicators were collected: family income, price of animal products, age of family members, education level, ethnic background, profession, employment status, managerial role at work, and local urbanisation level.

The price of animal products is an important explanatory variable that affects animal product consumption. However, the prices we obtained from the household surveys are, strictly speaking, not comparable due to quality difference in animal products. Households with higher disposable income are able to purchase more animal products but also tend to buy higher quality but more expensive products. Given this relationship and the fact that we are more interested in how income affects the level of animal product consumption, we decided to exclude the price variable in the estimation.

The following major explanatory variables are included in our model estimation: family income, character variables of households such as number of family members, age and education level, urbanisation level. The independent variable is per capita consumption of animal products.

Per capita family income

Family income is a very important factor that affects animal product consumption. Per capita family income is used. The higher the per capita family income, the higher the per capita consumption of animal products.

Age of family members

Age of family members is an important variable that reflects the characteristics of a household. Younger or elderly families may have different levels and patterns of animal product consumption. Average age of family members is used. In addition, a quadratic term for age is included in the model in order to capture any non-linear relationships between age and consumption.

Education level

Generally, one's knowledge of nutrition is closely related to one's education level. A person with a higher education level is more likely to pay more attention to nutritional aspects of food intake and to try new ways of consumption. An average of school/university years of family members is used. Similar to the age variable, a quadratic term for education is also included.

Family size

Families with different sizes may have different patterns of animal product consumption. In the case of China, limited by income, larger families may have a lower per capita animal product consumption.

Urbanisation and local social and economic development

The levels of urbanisation and local economic development are other important factors that affect animal product consumption. However, obtaining appropriate quantitative indicators for them is not easy. Dummy variables are used to capture their influence on animal product consumption. Our surveys covered various kinds of cities or centres from provincial capital, prefecture capital, county capital, and rural towns and villages. Hence, the statuses of cities are used as the dummy variable to reflect the level of urbanisation. The province, prefecture, and county where the surveyed households reside are used as the dummy variable to reflect the local economic development level.

A number of other factors, such as ethnic background, profession and managerial role at work were also trialed. However, their t-test was not significant and hence they were excluded from the model. One reason for the insignificant t-test for the ethnic background variable is that not enough samples of minority households were obtained in the surveys.

3.2 The Model

When the price factor is excluded, theoretically, linear, double logarithm, semi logarithm and inverse logarithm models can be used. We use the semi logarithm model. That is, we take the logarithm of per capita income. The advantage of using the semi logarithm model is that it makes the income elasticity of demand change as the income changes. Thus, when the per capita income increases, the corresponding income elasticity of demand becomes smaller. This is in accordance with the actual situation of livestock product consumption.

The final model for our livestock product demand function is as follows:

$$\begin{aligned}
 \text{pork} &= C_1 + \alpha_1 \ln(\text{avin}) + \beta_1 \text{avage} + \gamma_1 (\text{avage})^2 + \delta_1 \text{avedu} + \pi_1 (\text{avedu})^2 + \omega_1 \text{peop} + \sum I_i + \mu_1 \\
 \text{beef} &= C_2 + \alpha_2 \ln(\text{avin}) + \beta_2 \text{avage} + \gamma_2 (\text{avage})^2 + \delta_2 \text{avedu} + \pi_2 (\text{avedu})^2 + \omega_2 \text{peop} + \sum I_i + \mu_2 \\
 \text{mutton} &= C_3 + \alpha_3 \ln(\text{avin}) + \beta_3 \text{avage} + \gamma_3 (\text{avage})^2 + \delta_3 \text{avedu} + \pi_3 (\text{avedu})^2 + \omega_3 \text{peop} + \sum I_i + \mu_3 \\
 \text{poultry} &= C_4 + \alpha_4 \ln(\text{avin}) + \beta_4 \text{avage} + \gamma_4 (\text{avage})^2 + \delta_4 \text{avedu} + \pi_4 (\text{avedu})^2 + \omega_4 \text{peop} + \sum I_i + \mu_4 \\
 \text{egg} &= C_5 + \alpha_5 \ln(\text{avin}) + \beta_5 \text{avage} + \gamma_5 (\text{avage})^2 + \delta_5 \text{avedu} + \pi_5 (\text{avedu})^2 + \omega_5 \text{peop} + \sum I_i + \mu_5 \\
 \text{milk} &= C_6 + \alpha_6 \ln(\text{avin}) + \beta_6 \text{avage} + \gamma_6 (\text{avage})^2 + \delta_6 \text{avedu} + \pi_6 (\text{avedu})^2 + \omega_6 \text{peop} + \sum I_i + \mu_6 \\
 \text{fish} &= C_7 + \alpha_7 \ln(\text{avin}) + \beta_7 \text{avage} + \gamma_7 (\text{avage})^2 + \delta_7 \text{avedu} + \pi_7 (\text{avedu})^2 + \omega_7 \text{peop} + \sum I_i + \mu_7
 \end{aligned}$$

where:

pork, beef, mutton, poultry, egg, milk, fish are deponent variables, representing per capita consumption of pork, beef, mutton, poultry, eggs, dairy products, and aquatic products, respectively;

C_i : constant term;

avin: per capita income;

avage: average age of a family;

avedu: average school/university years of a family;

peop: family size;

$\alpha_i, \beta_i, \gamma_i, \delta_i, \pi_i, \omega_i$: parameters to be estimated, corresponding to avin, avage, (avage)², avedu, (avedu)², peop;

I_i : dummy variables;

μ_i : error term.

3.3 Estimation of Parameters

Using SUR (seemingly unrelated regression) estimation procedures and with the survey data, we estimated urban and rural demand functions for various animal products separately. Based on the derived parameters, income elasticities of demand for animal products are estimated.

3.3.1 Urban demand functions for animal products

The estimated demand functions for urban residents are presented in Table 7. Figures below the various parameters are t-test values. It can be seen that α_i passed t-test for all animal products, indicating that income has an important influence on animal product consumption in urban areas. Animal product consumption will increase when urban residents' income increases.

Table 7. Demand Functions for Animal Products by Urban Residents in China

Variable	Pork	Beef	Mutton	Poultry	Eggs	Milk	Fish
α	12.06	2.82	3.93	8.84	4.39	10.38	11.64
	5.74	4.37	3.59	7.06	3.97	3.36	6.65
β	0.03	-0.08	-0.35	0.83	-0.20	-2.99	0.59
	0.04	-0.40	-1.00	2.07	-0.58	-3.02	1.05
γ	0.00	0.00	0.00	-0.01	0.00	0.04	-0.01
	0.10	0.75	0.70	-2.17	1.11	3.04	-1.05
δ	1.66	1.16	0.59	2.94	1.14	-1.92	3.07
	1.00	2.29	0.69	2.98	1.31	-0.79	2.22
π	-0.05	-0.06	-0.03	-0.14	-0.05	0.17	-0.14

	-0.54	-2.24	-0.76	-2.72	-1.05	1.34	-1.89
ω	-1.89	-0.05	-0.56	-1.86	-0.95	-1.02	-3.28
	-1.58	-0.15	-0.89	-2.61	-1.51	-0.58	-3.29
Aprovi_2	-10.64	0.92	-9.06	-3.74	1.46	8.26	-99.96
	-2.50	0.71	-0.76	-1.48	0.65	0.24	-5.22
Aprovi_3	7.36	1.56	-24.90	5.23	0.99	3.80	-98.35
	1.74	1.20	-2.10	2.07	0.44	0.11	-5.20
Aprovi_4	-12.76	-1.64	-24.76	-4.29	1.54	3.35	-99.09
	-3.18	-1.33	-1.98	-1.80	0.73	0.10	-4.95
Aprovi_5	-13.22	-1.69	-21.01	0.39	14.58	5.23	-92.84
	-3.22	-1.34	-1.75	0.16	6.75	0.15	-4.84
Aprovi_6	(dropped)	(dropped)	-25.44	(dropped)	(dropped)	-2.59	-93.52
			-2.06			-0.07	-4.73
Aprovi_1	-13.39	0.13	-22.38	-5.96	1.99	4.18	-98.91
	-3.03	0.10	-1.90	-2.27	0.86	0.13	-5.24
Bcgrad_2	-62.23	-21.05	1.94	-76.52	-24.18	-8.22	9.73
	-2.67	-2.93	1.14	-5.51	-1.97	-1.71	3.57
Bcgrad_3	-62.23	-20.71	3.02	-75.28	-26.15	-13.40	8.47
	-2.72	-2.94	1.76	-5.52	-2.17	-2.77	3.09
Bcgrad_1	-72.20	-22.16	(dropped)	-79.73	-26.39	(dropped)	(dropped)
	-3.04	-3.03		-5.63	-2.11		
R-sq	0.81	0.64	0.46	0.77	0.78	0.49	0.73

Age affects milk and poultry consumption. Age has a positive influence on poultry consumption while its quadratic term has a negative influence. This suggests that middle-aged families have a larger consumption of poultry meat than younger or elderly families. On the other hand, age has a negative effect on milk consumption while its quadratic term has a positive one. This shows that milk is consumed mainly in younger and elder families (by babies, children and the elderly). This is largely in accordance with China's situation where dairy products are treated as nutrition supplements and are mainly for children and the elderly. With the age increasing, milk consumption first decreases and then increases.

The size of family has a negative impact on the consumption of pork, poultry, eggs and aquatic products. This agrees with our anticipation that in China, limited by family income, when family size increases, a family's ability to afford animal product consumption generally decreases and hence per capita consumption decreases. Among these four products, ω_1 has greater statistical significance for aquatic products, indicating that aquatic products are relatively more expensive and are luxury foods. Ceteris paribus, the larger the family is, the more expenditure it has to spend on aquatic products compared to buying other animal products.

The coefficients of education for beef, poultry, and fish consumption are also statistically significant. Families with higher education level tend to consume more of such products. This is perhaps because, with a higher education level, consumers become more conscious of nutritional aspects and the health implications of food intake. However, it is noted that the signs of the coefficients of π_1 (the quadratic term of education) are negative for all animal products except the one for dairy products. This suggests that, with a certain high level of education, consumers tend to reduce the consumption of animal products – perhaps animal protein intake has reached a sufficient level. They may turn to consume more other foods such as vegetables and fruits. Thus, consumers with a higher education level are more knowledgeable about food nutrition and are more rational about their food intake. The education variable does not have a significant influence on dairy product consumption – this is not surprising because Chinese people do not customarily consume dairy products. Nonetheless its quadratic term shows that higher education level tends to have a positive effect on dairy product consumption, though only with a low level of statistical significance. Thus, families with higher education level are likely to consume more dairy products.

3.3.2 Rural demand functions for animal products

The estimated demand functions for rural residents are presented in Table 8. Comparison of the demand functions for animal products by rural and urban residents in Tables 7 and 8 shows some similarities and some differences. In the case of rural residents, income again has a positive influence on the consumption of all animal products studied in this research, except that the significance level of the coefficients for lamb and dairy products is slightly lower. Unlike urban households, age positively

affects pork, beef, mutton and poultry consumption but its quadratic term is negative with relatively small coefficients. This seems to suggest that younger families are likely to consume more meat in rural areas. In the elderly families, meat consumption is likely to reduce to some extent. Younger people in rural areas are required to do more manual work and perhaps thus demand more meat in their food intake. Education level has a positive influence on poultry, eggs and dairy products consumption. The higher the education level, the larger is the consumption of poultry, eggs and dairy products. However, when education level increases, consumption of poultry, eggs and dairy products may decrease as suggested by the negative coefficients of the education quadratic terms for these products. Larger families tend to have a lower per capita consumption of pork, beef, mutton, poultry and fish but higher consumption of eggs and dairy products. This is probably because larger families are more likely to have children and elderly members who often tend to consume more eggs and dairy products.

Table 8. Demand Functions for Animal Products by Rural Residents in China

Variable	Pork	Beef	Mutton	Poultry	Eggs	Milk	Fish
α	5.78	2.23	2.53	1.44	3.33	1.00	2.59
	4.66	2.88	1.59	2.63	3.22	1.67	4.62
β	0.56	0.24	0.56	0.14	0.16	-0.01	0.06
	2.56	1.73	1.99	1.49	0.86	-0.06	0.58
γ	-0.005	-0.002	-0.004	-0.002	-0.001	-0.000	-0.001
	-2.16	-1.35	-1.51	-1.66	-0.77	-0.04	-1.30
δ	0.90	0.56	-0.26	1.07	1.38	0.60	0.25
	0.99	0.99	-0.22	2.69	1.83	1.37	0.62
π	0.01	-0.02	-0.01	-0.06	-0.08	-0.03	0.02
	0.17	-0.72	-0.08	-2.33	-1.74	-1.06	0.79
ω	-1.36	-0.24	-0.22	-0.27	0.41	0.54	-0.36
	-2.07	-0.58	-0.26	-0.93	0.76	1.72	-1.20
lcounty_2	-14.25	12.70	52.21	-2.16	-6.09	0.12	-5.44
	-3.79	5.42	10.85	-1.30	-1.94	0.07	-3.20
lcounty_3	-15.37	1.34	-1.33	5.29	6.66	-0.60	-2.28
	-4.11	0.58	-0.28	3.21	2.14	-0.33	-1.35
lcounty_4	-6.75	1.62	-1.86	0.62	1.56	0.83	2.95
	-1.82	0.70	-0.39	0.38	0.51	0.46	1.77
lcounty_5	-15.62	1.10	-2.83	1.38	4.89	-0.07	-1.45
	-4.47	0.51	-0.63	0.90	1.68	-0.04	-0.92
lcounty_6	-4.42	-2.51	-3.81	6.53	-7.59	-4.11	-4.73
	-0.98	-0.89	-0.66	3.28	-2.02	-1.89	-2.32
lcounty_7	-5.64	-0.91	-2.00	5.77	-0.77	4.13	10.52
	-1.51	-0.39	-0.42	3.50	-0.25	2.29	6.22
lcounty_8	5.43	0.33	-2.01	2.15	-0.60	2.02	2.22
	1.44	0.14	-0.42	1.30	-0.19	1.12	1.31
lcounty_9	-15.15	0.27	-2.32	1.17	8.24	-1.06	-2.87
	-4.35	0.12	-0.52	0.76	2.84	-0.63	-1.82
lcounty_10	1.06	-0.15	-3.82	7.40	8.91	2.89	9.44
	0.26	-0.06	-0.72	4.02	2.56	1.44	5.00
lcounty_11	-20.77	1.05	-2.10	9.66	11.16	2.17	3.91
	-4.90	0.40	-0.39	5.17	3.16	1.06	2.04
lcounty_12	-9.80	0.87	-0.73	-0.41	0.45	0.05	-0.71
	-2.60	0.37	-0.15	-0.25	0.14	0.03	-0.42

Cons	-26.36	-22.49	-27.43	-13.17	-29.00	-9.37	-14.83
	-2.33	-3.18	-1.89	-2.63	-3.07	-1.72	-2.90
R-sq	0.38	0.27	0.52	0.34	0.25	0.12	0.50

3.3.3 Income elasticities

Income elasticities are obtained by using the following formula:

$$e_i = \alpha_i / Q_i$$

$$= \alpha_i / (C_i + \alpha_i \ln(\text{avin}) + \beta_i \text{avage} + \gamma_i (\text{avage})^2 + \delta_i \text{avedu} + \pi_i (\text{avedu})^2 + \omega_i \text{peop} + \sum I_i)$$

where e_i is the income elasticity of demand for the i -th product. According to this formula, when income changes, the income elasticity also changes. When income becomes higher, the income elasticity of demand becomes smaller, which is most appropriate to describe the relationship between income and the consumption of animal products. The income elasticities of demand for animal products by rural and urban residents are presented in Table 9.

Table 9. Income Elasticities of Demand for Animal Products by Rural and Urban Residents, 1998

	Pork	Beef and Mutton	Poultry	Eggs	Milk	Fish
Rural	0.25	0.57	0.22	0.36	0.32	0.37
Urban	0.32	0.49	0.48	0.26	0.49	0.51

Increase in Income results in increased consumption of animal products. In rural areas, beef and mutton have relatively larger income elasticities (0.57), followed by aquatic products (0.37), eggs (0.36) and dairy products (0.32). Pork and poultry meats have the smallest income elasticities, being 0.25 and 0.22, respectively. This indicates that in rural areas, with the increase in income, there is greater potential for increase in the consumption of beef and mutton. The income elasticity of demand for beef and mutton is as high as 0.57 and with a 10% income increase, the consumption of beef and mutton will increase by 5.7%. In the case of fish, eggs and dairy products, with a 10% income increase, the consumption will increase by 3.7%, 3.6% and 3.2%, respectively. For pork and poultry, the increase in consumption will be 2.5% and 2.2%, respectively. The increase in pork and poultry consumption in rural areas is the smallest resulting from an income increase.

In urban areas, those products that have higher income elasticities are aquatic products (0.51), beef and mutton (0.49), dairy products (0.49) and poultry (0.48). Thus, with every 10% increase in income, the consumption of these products will increase by about 5%. The income elasticity for pork and eggs are 0.32 and 0.26, respectively. When income increases by 10%, the consumption of pork and eggs will increase by 3.2 and 2.6%, respectively. Pork and eggs have smaller income elasticities. This agrees with what happened in the past □ urban residents' income has increased in the past few years but the increase in their consumption of pork and eggs has stagnated. The above results tend to suggest that, with improved standard of living, the composition of food intake by urban residents is changing. They are more concerned about food nutrition and health implications and tend to demand more food with high protein but low fat. Animal products with a higher fat component such as pork are gradually giving way to low fat items in their food basket.

4. Summary and Conclusions

SSB's per capita animal product consumption data are underestimates and there is a lack of reliable data about animal product consumption by the Chinese consumers. In addition, SSB's data provide only consumption quantity but few other details that are necessary for deriving the various parameters needed for policy formulation and marketing activities. This paper represents an important contribution in this area through its provision of more accurate and detailed data about animal product consumption in China. Based on a large-scale household survey in both rural and urban China, this paper reports quantity and composition of animal product consumption by Chinese consumers. It also examines key factors that affect animal product consumption in China.

Per capita meat consumption in 1998 reached 34 kg. This is much higher than SSB's figure of 18 kg. Pork consumption still accounts for a major portion in total meat consumption, being 67%. Beef and mutton together accounts for about 14% while poultry accounts for 19%. In rural areas, the proportion of pork consumption is even higher, being over 70%. Urban residents tend to consume more poultry meat.

The consumption gap of animal products between urban and rural residents is still very large. At the per capita consumption level, the amount of animal products consumed by urban residents is generally higher than that of rural residents and in some cases, the gap is as large as 3 to 4 times. At the aggregate level, urban residents (30% of China's total population) consume almost the same amount of animal products as rural residents (70% of China's total population).

Away from home consumption has increased and now accounts for an important portion of total consumption. Among all the meats, poultry meat consumed away from home has the highest portion, followed by beef and mutton. Pork has the lowest proportion. In recent years, lean meat is more preferred by urban residents. In rural areas, residents have also drastically turned away from fatty meat. However, a significant portion of them still like meat that is lean and fatty mixed. Consumption of retail processed animal products in urban areas is still relatively low.

Depending on the product, factors that affect its consumption may be slightly different. However, among all the animal products studied, income affects the consumption of all these products. Age affects dairy product consumption. Families with children or elderly people tend to consume more dairy products. Education level influences the composition of animal product intake. Consumers with a higher education level tend to shift away from meat products to aquatic products and dairy products. Larger families tend to have lower per capita animal product consumption except in the case of dairy products, perhaps due to the fact that larger families are more like to have children and elderly members.

Income elasticities of demand for various animal products are generally larger in urban areas than in rural areas. However, in both rural and urban areas, income elasticity for aquatic products, beef and mutton are greater. Income elasticity for pork is generally lower. Increase in consumer income will lead to increased consumption of animal products in both rural and urban China.

Findings of this study suggest that income increase and urbanisation will be important factors that affect the consumption of animal products and also the consumption composition of these products. Urban residents are likely to demand more lean meat, aquatic products, and dairy products. Further, those with a higher education level may also shift to consume more other foods such as vegetables and fruits when their animal product consumption reaches a certain high level. In rural areas, meat with mixed fatty and lean parts will be still in demand for some time. Opportunity exists for developing retail processed animal products for the urban market. The potential is likely to be enormous with the increase in income of urban residents. Urban residents' consumption pattern today is likely to be the pattern of the rural residents in the future. Hence, it can be expected that rural residents in the nearby regions of major urban centres will soon be the consumers of retail processed animal products.

Although the market for some animal products seems to be saturated at present in China (mainly dragged by lower demand from rural residents due to recent slow down in rural income increase), the findings from this study suggest that there is still enormous potential for Chinese consumers to increase their animal product consumption in both rural and urban areas. This is supported by the fact that there is a big gap between the consumption level of rural and urban residents and that income elasticities of demand for animal products for urban residents are higher than those for rural residents. Generally, income elasticity of demand for animal product will increase as income increases. When income continues to increase and the consumption of animal products increases to a certain level, the income elasticity will start to decrease. Given that the income elasticities for urban residents are still not lower than those for rural residents, there is still potential for increased animal production in urban areas. For rural residents, income elasticities for animal products are likely to increase when their income increases. Hence, in both rural and urban areas, there is still potential to increase animal product consumption. The major increase will come from rural areas, as a small per capita increase in animal product consumption by the large rural population will result in a huge increase in total quantity demanded.

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[1] Full details will be made available from the authors on request.

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