CONSUMPTION OF LIVESTOCK PRODUCTS AT THE REGIONAL LEVEL IN CHINA

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Key words: consumption of livestock products, residents, regional variations, consumer responses

ABSTRACT

Since the late 1970s, consumption of livestock products has increased rapidly in the diet of the Chinese. However, this is accompanied by a notable difference in the level of consumption of livestock products between rural and urban residents, the rich and the poor, and between regions. While there is literature examining the consumption differences between the rural and urban and the rich and poor, studies that examine regional differences have been scarce. This study focuses on examining the differences in the level and pattern of consumption of livestock products between regions and empirically estimates price and income elasticities of demand for various animal products by rural and urban consumers at the regional level. Implications are drawn for animal product market development.

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I. Introduction

In the past two decades, China's per capita consumption of livestock products has increased remarkably. Based on the data published by China's State Statistical Bureau (SSBa), in rural areas, per capita meat consumption had increased from 9.4kg in 1981 to 17.7kg in 2002. During the same period, per capita egg consumption increased from 1.3kg to 4.7kg, and per capita aquatic products from 1.3kg to 4.4kg. The corresponding figures for urban areas are 20.5kg to 32.5kg (meat), 5.2kg to 10.6kg (eggs), and 7.3kg to 13.2kg (aquatic products) (SSBa 2003, pp. 352, 374).

There are, however, significant differences in consumption of livestock products between rural and urban residents, the rich and the poor, and between different regions. Some have examined the rural-urban differences and the difference between the rich and the poor (see, for example, Wu 1995, Cai et al. 1999, Wang and Fan 1999, Wang and Yang 2003). Literature examining variations between regions has been scarce. This study looks into the regional variations of China's consumption of livestock products.

In the next section, we first present the general trend in consumption of livestock products in China and highlight consumption gap between rural and urban residents and between the rich and the poor. We then discuss the difference in animal production consumption between regions in Section 3. Section 4 reports the findings of an empirical analysis on regional consumer responses to price and income changes. The last section concludes the paper.

II. Consumption of Animal Products by the Chinese since the Late 1970s

Prior to China's rural economic reforms that started in the late 1970s, per capita consumption of animal products in China was

very low. The reforms greatly motivated the farmers to work their land to increase agricultural supply. Grain production increased rapidly. As a result, for the first time in the recent history, the Chinese had enough foodgrain to eat. The consecutive bumper harvests of foodgrains in the early 1980s enabled farmers to spare some grains to feed more animals, resulting in increased supply of animal products to the market. Improved agricultural supply coupled with increased consumer income led to the changes in Chinese people's dietary structure with increased consumption of animal products. Although the consumption of foodgrain was also increasing, the rate of growth was much slower than the increase in consumption of animal products. According to Table 1, from 1978 to 1985, the increase in the consumption of foodgrain was 14kg, an increase of 6.2%. However, for the same time period, the increase in meat consumption and egg consumption was 5.5kg (62.1%) and 1.22kg (61.9%), respectively.

Since 1986 China's GDP has been growing rapidly. In the meantime, China's livestock sector has also expanded dramatically. Animal products have become widely available in the market. Higher consumer income has led to further increased consumption of animal products. On the other hand, consumption of foodgrains has started to decline. Comparing 2002 with 1985, consumption of foodgrains has dropped to 185kg from 239kg while the consumption of animal products has increased. For example, the increase in the consumption of aquatic products, milk, eggs, and poultry meat has more than doubled. The consumption of beef and mutton, though still very low in absolute terms, has also almost doubled.

Clearly since the late 1970s, consumption of livestock products has increased rapidly in the diet of the Chinese. In the case of meat, per capita consumption increased from less than 9kg in 1978 to almost 24kg in 2002. This trend is expected to continue. However, there is a notable difference between the levels of animal product consumed by the rural and urban residents.

TABLE 1. Per Capita Consumption of Foodgrain, Livestock Products, and Aquatic Products (selected years, kg)*

Year	Foodgrain	All meat	Pork	Beef and mutton	Poultry meat	Poultry eggs	Milk	Aquatic products
1978	225	8.86	7.67	0.75	0.44	1.97	-	3.50
1980	246	12.79	11.16	0.83	0.80	2.27	-	3.41
1985	239	14.36	11.83	0.98	1.55	3.19	-	2.93
1990	239	15.90	12.63	1.45	1.82	3.69	-	3.60
1995	222	16.17	12.51	1.21	2.45	5.11	-	5.06
1999	206	18.99	14.00	1.76	3.23	6.33	3.10	5.83
2000	199	20.22	14.53	1.93	3.76	7.10	4.28	6.07
2001	189	20.03	14.33	1.91	3.79	6.86	5.23	6.46
2002	185	23.54	16.27	1.89	5.38	6.97	6.87	7.82

* Foodgrain is unmilled raw grain. Consumption data for 1978 and 1980 are obtained directly from SSB publications. Those for 1985-2002 are weighted average based on SSB statistics for urban and rural residents. All meat includes pork, beef, lamb and poultry meat.

Source: SSBa, various issues.

Table 2 shows that per capita consumption of animal products is much higher in urban areas than in rural areas. According to Table 2, although per capita pork consumption by urban residents has exhibited a declining trend since the early 1990s (from 18.46kg in 1990 to 15.95kg in 2001),[1] the consumption of beef and mutton, poultry meat and poultry eggs increased rapidly, by 47%, 185% and 54%, respectively, between 1985 and 2002. In the case of per capita consumption of aquatic products, it increased by 86%.

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[1] There was an irregular jump in per capita pork consumption in urban areas in 2002, together with poultry and aquatic product consumption. The government official publications offered no explanation. There was no such jump for rural consumption.

TABLE 2. Urban-Rural Differences: Per Capita Income and Consumption of Lvestock Products (¥, kg)

Item	1985	1990	1995	1999	2000	2001	2002
Urban							
Per capita income (¥)	739	1,510	4,283	5,854	6,280	6,860	7,703
Total Meat	21.96	25.16	23.65	24.92	25.50	24.42	32.52
Pork	16.68	18.46	17.24	16.91	16.73	15.95	20.28
Beef and Mutton	2.04	3.28	2.44	3.09	3.33	3.17	3.00
Poultry	3.24	3.42	3.97	4.92	5.44	5.30	9.24
Poultry Eggs	6.84	7.25	9.74	10.92	11.21	10.41	10.56
Aquatic Products	7.08	7.69	9.20	10.34	9.87	10.33	13.20
Rural							
Per capita income (¥)	398	686	1,578	2,210	2,253	2,366	2,476
Total Meat	12.00	12.59	13.12	16.35	17.48	17.37	17.74
Pork	10.32	10.54	10.58	12.70	13.44	13.35	13.70
Beef and Mutton	0.65	0.80	0.71	1.17	1.19	1.15	1.17
Poultry	1.03	1.25	1.83	2.48	2.85	2.87	2.91
Poultry Eggs	2.05	2.41	3.22	4.28	4.97	4.72	4.66
Aquatic Products	1.64	2.13	3.36	3.82	3.92	4.12	4.36

Source: SSBa, various issues.

Compared with their urban counterparts, consumption of livestock products by rural residents is lower. In terms of the rate of growth, rural areas experienced faster growth. Between 1985 and 2002, per capita consumption of pork increased by 33%, and beef and mutton together increased by 80%. During the same time period, per capita poultry meat, poultry eggs and aquatic product consumption increased by 183%, 127% and 166%, respectively. These higher rates are due to the low level consumption in 1985. Despite these higher rates, the consumption by rural residents in absolute terms is still much lower than that by urban residents in 2002.

In addition to the different levels of consumption of

livestock products between rural and urban areas that Table 2 reveals, four other important observations are also borne out by further examining the data in Table 2.

(1) As income increases, the demand for animal products increases in both rural and urban areas. The important exception is that when income is high enough, the increase in pork consumption tends to slow down as has been exhibited in the urban areas.
(2) Although total meat consumption is still increasing in urban areas, the rate of increase is relatively small (2002 being an exception but the government sources provided no explanations). On the other hand, the increase in the consumption of poultry meat and aquatic products seems to be much greater.
(3) While there exist differences in the compositions of animal products consumed by urban and rural residents, they seem to be largely comparable. Pork is still the major meat consumed in both urban and rural areas, being about 1/3 of animal products consumed in urban areas and 1/2 in rural areas. Urban residents consume a higher proportion of poultry meat, poultry eggs and aquatic products. The share of beef and mutton consumed in both urban and rural areas is quite similar.
(4) Although the gap between rural and urban consumption levels is reducing due to the faster increase in consumption of livestock products in rural areas, rural consumption of animal products is still far below the urban consumption level. Table 2 indicates that the consumption level of rural residents in 2002 had not reached that of urban residents in 1985. Indeed, the consumption level of rural residents in 2002 was even lower than that of urban residents in 1981. In 1981, per capita consumption by urban residents was 20.52kg meat (including pork, beef, mutton and poultry meat), 5.22kg poultry eggs and 7.26kg aquatic products. This implies that the consumption level of rural residents is

lagging behind that of urban residents by at least 20 years.

There are also differences in the level and pattern of consumption of livestock products by consumers of different levels of income. Table 3 clearly shows that income level plays a major role in determining the composition of food consumption in urban China. As income increases, the consumption of foodgrains declines while that of non-staple food increases, with a few exceptions. All other food items (except cooking oil) exhibit a clear increasing trend when income increases. The per capita consumption of most animal products by the highest income group is two to three times higher than that by the lowest income group. The consumption difference is the greatest for aquatic

TABLE 3. Income level and the composition of food consumption, urban China, 2002 (kg)

Food item	Average	Lowest income	Very low income	Low income	Lower middle	Middle income	Upper middle	High income	Highest income
Foodgrains	78.5	84.2	83.3	82.3	79.6	77.7	77.8	76.8	71.4
Vegetable oil	8.5	7.8	8.2	8.8	8.8	8.7	8.5	8.5	7.8
Edible animal oil	0.5	0.7	0.7	0.6	0.5	0.5	0.4	0.3	0.2
Pork	20.3	4.7	15.7	18.3	20.0	20.8	21.6	22.8	22.4
Beef	1.9	1.1	1.2	1.6	1.8	2.1	2.2	2.2	2.2
Mutton	1.1	0.6	0.7	0.8	1.1	1.3	1.4	1.3	1.2
Poultry	9.2	4.4	5.2	7.0	8.1	9.2	10.4	11.9	13.3
Fresh eggs	10.6	7.9	8.4	9.8	10.5	10.7	11.1	11.6	11.1
Aquatic products	10.9	5.4	6.1	7.7	9.0	10.7	12.4	14.8	17.2
Fresh vegetables	116.5	100.3	102.7	109.1	112.7	116.1	122.0	127.2	126.6
Fresh fruits and melons	56.5	27.0	31.7	44.5	51.0	57.9	64.2	70.7	74.7
Fresh dairy products	15.7	3.6	4.8	8.4	11.8	15.8	20.0	23.6	26.5
Milk powder	0.6	0.3	0.3	0.4	0.6	0.6	0.6	0.7	0.7
Yoghurt	1.8	0.3	0.5	1.0	1.4	1.8	2.3	2.7	3.3

Source: SSBa, 2003, p. 353.

products, poultry meat, and milk and dairy products. It is interesting to note that the increase in the consumption of beef and mutton tends to slow down when income reaches a certain level. On the other hand, the consumption of poultry meat, aquatic products and dairy products increases greatly.

Similarly in rural China, there are also apparent difference in the level and pattern of consumption of livestock products by different income groups. Table 4 suggests that when rural residents' income increases, their consumption level of animal products increases. The very high foodgrain consumption by the highest income group is somewhat surprising. This may be partially due to the fact that a larger portion of the higher income population is concentrated in southern China where rice is the staple foodgrain. However, the milling rate of rice is lower than that of wheat.

TABLE 4. Per capita food consumption by income group, rural China, 2002 (kg)

Food item	Lowest income	Low income	Medium income	High income	Highest income
Foodgrain(unmilled)	215.0	230.0	244.0	244.0	249.0
Vegetables	86.0	105.0	116.0	125.0	127.0
Edible oil	5.9	7.0	8.3	8.0	8.9
Sugar	1.2	1.4	1.6	1.8	2.4
Fruits	12.1	15.0	17.8	22.0	29.6
Pork	11.0	12.5	13.5	14.9	17.8
Beef and mutton	1.0	1.0	1.0	1.1	1.8
Dairy products	1.0	0.8	1.0	0.9	2.5
Poultry	1.4	2.1	2.7	3.5	5.4
Eggs	2.7	3.8	4.8	5.6	7.1
Aquatic products	1.6	2.8	3.7	5.3	9.7
Net income (¥)	857.0	1,548.0	2,164.0	3,030.0	5,896.0

Source: SSBb 2003, pp. 255-59.

III. Regional Variations in the Level and Pattern of Consumption of Livestock Products

Not only are there differences in the level and pattern of consumption between rural and urban residents and between the rich and the poor, there are also distinct variations in the levels of consumption and the patterns of consumption between regions. Tables 5 and 6 reflect such regional differences. Table 5 shows the level of per capita consumption of major animal products in rural China by province. Data comparable to Table 5 for urban residents are not available and instead per capita expenditure on major animal products is used as given in Table 6.

The following regional differences can be established from the data in Tables 5 and 6.

(1) In general, the southeast coastal region (including Guangdong, Hainan, Fujian, Zhejiang, Shanghai and Jiangsu) has a higher level of meat consumption. This is a wealthier region of China.
(2) The consumption level of aquatic products in the above-mentioned six southeast coastal provinces is also higher. On the other hand, the consumption level of aquatic products in the northwest provinces, e.g., Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang, is minimal.
(3) Major meat-producing regions in China's southwest also tend to have a higher meat consumption level (chiefly, pork), e.g., Guangxi, Sichuan, and Hunan.
(4) Northwest pastoral regions tend to consume more beef and mutton. Per capita beef and mutton output in provinces such as Inner Mongolia, Xinjiang, Ningxia, and Qinghai is much higher than the national average.
(5) Central and northeast China tends to consume more poultry eggs. For example, the consumption level of eggs in Shandong, Henan, Hebei, Anhui, Tianjin and Liaoning is much higher than in other provinces.

TABLE 5. Per Capita Consumption of Major Animal Products by Rural Residents in 2002 (kg)

Region	Pork, Beef and Mutton	Poultry Meat	Eggs and Related Products	Aquatic Products
National Average	14.87	2.91	4.66	4.36
Beijing	15.03	3.57	9.74	4.24
Tianjin	10.65	0.73	9.98	7.09
Hebei	7.40	0.40	5.63	2.18
Shanxi	5.21	0.24	6.11	0.55
Inner Mongolia	18.60	1.20	3.48	1.52
Liaoning	15.09	1.67	8.48	4.64
Jilin	12.05	2.05	7.67	3.73
Heilongjiang	7.69	2.50	6.45	3.63
Shanghai	16.79	8.25	10.70	16.36
Jiangsu	12.31	4.16	6.18	8.54
Zhejiang	16.13	5.47	4.89	14.03
Anhui	9.37	3.86	4.74	4.63
Fujian	18.26	5.34	3.54	12.58
Jiangxi	12.86	2.47	2.90	4.42
Shandong	8.05	2.64	11.47	3.88
Henan	12.12	1.77	9.30	1.09
Hubei	18.74	2.07	3.47	7.13
Hunan	19.37	3.85	3.39	5.59
Guangdong	21.56	8.97	2.70	12.04
Guangxi	14.33	7.02	1.12	3.55
Hainan	15.11	8.32	0.60	16.30
Chongqing	25.82	2.33	4.60	1.83
Sichuan	25.33	2.81	3.64	1.55
Guizhou	27.99	1.14	1.22	0.32
Yunnan	24.11	2.35	1.73	1.25
Tibet	12.05	0.03	0.61	
Shaanxi	6.64	0.34	2.06	0.27
Gansu	9.31	0.96	2.26	0.22
Qinghai	20.30	0.45	0.68	0.45
Ningxia	11.01	2.74	2.69	0.77
Xinjiang	11.04	1.36	1.10	0.35

Source: SSBa, 2003, p. 374.

TABLE 6. Per Capita Expenditure on Animal Products by Urban Residents in 2002 (yuan)

Region	Meat including Poultry Meat	Poultry Eggs	Aquatic Products	Milk and Dairy Products
National Average	455	59	170	105
Beijing	566	70	163	219
Tianjin	427	87	232	114
Hebei	330	74	96	96
Shanxi	225	64	35	99
Inner Mongolia	305	44	40	27
Liaoning	386	74	173	101
Jilin	334	57	101	75
Heilongjiang	304	57	80	77
Shanghai	633	68	592	246
Jiangsu	496	66	241	128
Zhejiang	457	48	553	120
Anhui	418	79	106	95
Fujian	609	65	546	130
Jiangxi	417	48	111	79
Shandong	332	75	121	130
Henan	294	63	38	66
Hubei	390	51	115	82
Hunan	434	43	102	62
Guangdong	852	46	365	108
Guangxi	689	39	187	71
Hainan	657	26	354	53
Chongqing	574	65	98	135
Sichuan	531	59	69	110
Guizhou	431	41	42	66
Yunnan	474	49	71	66
Tibet	605	45	59	226
Shaanxi	254	46	49	85
Gansu	273	44	40	83
Qinghai	382	41	49	78
Ningxia	308	35	41	86
Xinjiang	421	44	54	84

Source: SSBa, 2003, pp. 356-58.

(6) The per capita consumption of all animal products in Shanghai and Guangdong, two wealthier coastal provinces in China, is the highest. The two provinces with the lowest per capita consumption of all animal products are Shaanxi and Shanxi, two poorer inland provinces in China.

The above observation tends to suggest that different levels and patterns of consumption of livestock products between regions are largely affected by two factors: local income level and availability of the product. Whether or not a product is consumed in a region and how much of it is consumed are largely determined by the product's output level in the region. Aquatic product is relatively abundant in the southeast coastal region but scarce in the northwest region. Consequently, the consumption levels of aquatic products between these two regions differ greatly. However, residents in the northwest region consume a higher level of beef and mutton. That the level and pattern of consumption of livestock products in a region is influenced by the local output level of an animal product is due to the fact that the animal product market in China was not well integrated, which is further attributable to the low level of marketable surplus and lack of specialised transport facilities. Residents have to eat what is readily available in the local market, which in turn "fosters" their "habit" of eating that particular product. One other major factor that affects the level and pattern of animal production consumption is ethnic background. For example, in areas where a large number of Muslims reside, e.g., some northwest provinces, the level of beef and mutton consumption is higher.

Such vast differences in the levels and patterns of consumption of livestock products between regions in China warrant careful studies. Insight into regional differences will be of great assistance to the Chinese government in terms of food program planning and to industries in terms of medium and long-term strategic planning. Such information will also be invaluable for livestock market development in China. In the next section, an empirical analysis is carried out to estimate consumer

responses to changes in livestock product prices and in disposable income.

IV. Consumer Responses to Price and Income Changes: An Empirical Analysis

Based on the consumption behaviours as observed in the previous section, we place various provinces (except Tibet) into three broad regions: southern China, northern China and north-western China. Southern China includes: Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Hunan, Hubei, Guangdong (including Hainan), Guangxi, Sichuan (including Congqing), Guizhou, and Yunnan. Northern China includes: Beijing, Tianjin, Hebei, Shanxi, Liaoning, Jilin, Heilongjiang, Shandong, Henan, Shaanxi, and Gansu. North-western China includes Inner Mongolia, Qinghai, Ningxia and Xinjiang. The geographical location of the three regions is shown in Map 1.

MAP 1. Map of China indicating Three Regions

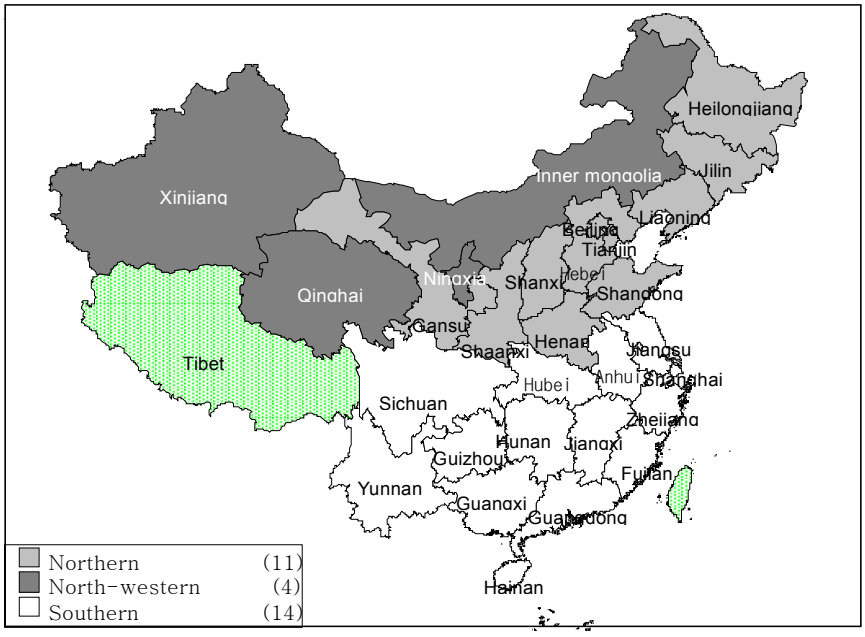

TABLE 7. Price and Income Elasticities of Demand for Livestock Products in China: Earlier Estimates

Author	Product	Urban China		Rural China	
		Income	Own-price	Income	Own-price
Lewis and Andrew 1989 (1983-85, SSB household survey data by province)	Pork			1.02	-0.23
	Poultry			1.95	-0.09
	Aquatic Products			3.65	-0.69
Weiming Tian 1990 (1984-88, SSB household survey data)	Pork	1.04	-0.83	1.41	-0.91
	Mutton & Beef	1.19	-0.97	0.61	-1.66
	Poultry	1.62	-0.68	1.99	-0.04
	Eggs	1.18	-0.93	0.14	-0.05
	Aquatic Products	1.51	-1.17		
	Milk	2.06	-1.30		
Pudney and Wang 1991 (1987 SSB household survey data)	Pork	0.923	-0.040		
	Mutton and Beef	0.320	-0.003		
	Poultry	0.716	-0.005		
	Eggs	1.044	-0.017		
	Aquatic Products	0.893	-0.011		
USDA 1997 (SSB household survey data)	Pork	0.50	-0.96	0.08	-0.65
	Beef	1.75	-1.70	1.80	-0.14
	Mutton	1.75	-1.75	1.80	-1.33
	Poultry	0.99	-1.16	1.10	-0.80
	Eggs	0.31	-0.80	0.52	-0.55
Huang and Rozelle (1998, p. 245) for the year of 1999-2000.	Pork	0.782	0.765		
	Beef and mutton	0.689	0.343		
	Poultry	0.985	0.854		
	Eggs	0.455	0.512		
	Milk	1.637	1.557		
	Aquatic products	1.244	1.053		
Wang and Yang (2003), for the year of 1998.	Pork	0.32	0.25		
	Beef and mutton	0.49	0.57		
	Poultry	0.48	0.22		
	Eggs	0.26	0.36		
	Milk	0.49	0.32		
	Aquatic products	0.51	0.37		

Sources: adapted from He and Tian (2000) and Zhou and Tian (2003).

There have been various studies that attempt to derive price and income elasticities of demand for animal products by the Chinese consumers. Due to differences in data, coverage of time periods, and estimating techniques in various studies, there have been discrepancies in their findings. Table 7 provides a summary of some earlier findings. It is noted, however, few of the earlier studies take into account of regional variations in their estimations. In this section, we estimate the price and income elasticities of demand for the three regions as identified above. Data used for the estimation are from provincial statistical publications and from market prices collected by the Ministry of Agriculture.

1. Urban Residents

An expanded linear expenditure model is used for estimating the elasticities for urban residents. The demand model takes the following form:

$$x_j = x_j^0 + \frac{\beta_j}{p_j}(I - \sum_{k=1}^{n} p_j x_j^0)$$

where:

x_j : quantity consumed of commodity j.
x_j^0 : minimum consumption of commodity j.
p_j : price of commodity j.
$p_j x_j^0$: minimum expenditure on commodity j.
β_j : marginal expenditure share (or marginal income share in the case of expanded model).
I : total expenditure on all commodities (or consumers' total disposable income in the case of expanded model).

We first estimate $p_j x_j^0$ and then derive β_j. Finally, we estimate the price and income elasticites of demand for various livestock products. Given the fact that there are significant consumption differences between regions and that in some parts

of China getting enough to eat is still a challenge for some low income urban consumers, the lowest consumption level during 1995-2000 in each of the three regions is used as $p_j x_j^0$. The minimum consumption level for various products for all the three regions are given in Table 8. β_j is obtained for each of the products through regression and is given in Table 9.

TABLE 8. Assumed Minimum Consumption Level used in the Expanded Linear Expenditure Model (yuan, Urban China)

	Pork	Beef	Mutton	Poultry	Poultry eggs	Milk	Aquatic products	Fresh vegetables	Grain	Total
North-Western	50	20	30	60	40	25	60	110	200	595
Northern	120	5	10	60	50	20	60	150	200	675
Southern	180	8	1	90	45	15	90	140	200	769

Sources: Based on statistical yearbooks of China's various provinces, various issues.

TABLE 9. Estimates of the Coefficients for the Expanded Linear Expenditure Model (Urban China)

	North-Western		Northern		Southern		All Three Regions	
	Parameter	t-value	Parameter	t-value	Parameter	t-value	Parameter	t-value
Pork	0.012	6.09	0.009	11.18	0.015	14.49	0.013	18.89
Beef	0.004	14.46	0.005	14.20	0.003	16.73	0.004	19.96
Mutton	0.019	6.51	0.003	13.42	0.001	13.53	0.003	6.45
Poultry	0.008	11.33	0.017	17.67	0.031	18.20	0.024	20.20
Poultry Eggs	0.002	4.85	0.006	11.52	0.003	9.37	0.004	14.02
Milk	0.006	13.77	0.008	17.64	0.007	13.46	0.008	22.41
Aquatic Products	0.004	21.12	0.013	10.94	0.038	13.83	0.026	14.63
Fresh Vegetables	0.012	9.17	0.010	11.81	0.016	33.76	0.014	28.79
Grain	0.010	4.05	0.008	6.92	0.006	5.75	0.007	9.49

Based on the above regression results, price and income elasticities of demand for various animal products are estimated and presented in Table 10. Table 10 shows that at the all-three-regions level, all the price and income elasticities except those for aquatic products are less than one, indicating that the demand for animal products has become less sensitive in China's urban areas. The price and income elasticities for different products, from the largest to the smallest, are in the order of: aquatic products, beef, poultry meat, lamb, milk and dairy products, pork, poultry eggs, vegetables and foodgrains. The income elasticity of demand for pork is less than 0.5, indicating that the potential to increase pork consumption in urban areas is likely to be limited. It may be expected that the size of this elasticity may decline further. Consumers tend to shift away from pork to other animal products. The consumption of aquatic products and beef is likely to increase as consumers' income further increases. But that of poultry eggs will increase by a much smaller extent. Both

TABLE 10. Income and Price Elasticities of Demand for Livestock Products in Urban China (2000)

	North-western		Northern		Southern		All Three Regions	
	Income	Price	Income	Price	Income	Price	Income	Price
Pork	0.72	-0.64	0.38	-0.34	0.45	-0.40	0.47	-0.42
Beef	0.54	-0.48	1.15	-1.02	0.94	-0.84	0.97	-0.87
Mutton	1.04	-0.92	0.73	-0.65	1.25	-1.11	0.73	-0.65
Poultry	0.40	-0.36	0.76	-0.68	0.86	-0.77	0.83	-0.74
Poultry eggs	0.26	-0.23	0.56	-0.50	0.39	-0.35	0.46	-0.41
Milk and dairy products	0.54	-0.48	0.64	-0.57	0.69	-0.61	0.72	-0.64
Aquatic products	0.51	-0.45	0.87	-0.77	1.29	-1.15	1.21	-1.08
Vegetables	0.42	-0.38	0.34	-0.30	0.51	-0.46	0.46	-0.41
Grains	0.26	-0.23	0.24	-0.21	0.23	-0.20	0.23	-0.20

the income and price elasticities of demand for foodgrains are much smaller, being the lowest in the group of commodities examined, suggesting that majority of urban consumers have no problem to afford foodgrains and the increase in future foodgrain consumption will be limited when income increases. Indeed, per capita foodgrain consumption has been declining. Any future direct grain consumption increase in the urban areas will be chiefly caused by population increase.

At the regional level, clear differences in the consumption of animal products exist. Urban residents in southern China seem to be more responsive to prices changes of aquatic products and lamb. As income increases, the increase in their consumption of these two products also tend to be greater. There is also much room for the increase in beef consumption. In northern China, as consumers income increases, there is still much potential for the increase in beef consumption. However, the result tends to suggest that the increase in pork consumption is likely to be much smaller. In north-western China, lamb is more popularly consumed. It is noted that the room to increase pork consumption is relatively greater in this region.

2. Rural Residents

For rural residents, a log linear demand system is used to model consumption behaviour. The use of a model different from the one used for urban residents is dictated by the availability of data.[2] The demand system is as follows:

$$\ln x_j = a_j + \sum_k b_{jk} \ln p_k + c_j \ln I + u_j, j = 1,2,\cdots,n,$$

[2] It is noted that the use of two different models make the comparison of analytical results limited. It would be most desirable to use the same model to evaluate the price and income responses by both the rural and urban residents. Unfortunately, data for rural residents comparable to urban residents are not available and a different model is hence used.

where:

x_j : quantity consumed of commodity j.
p_k : price of commodity j and substitutes.
I : consumers' total disposable income.
a_j, b_{jk}, *and* c_j : parameters to be estimated.
b_{jk} : cross and own price elasticities of demand.

To capture regional consumption differences, regional dummy variables are used. The results are given in Table 11. Rural residents in southern China consume more aquatic products, poultry meat and pork. More beef, lamb and dairy products are consumed in north-western rural China. In northern China, rural residents tend to consume more poultry eggs. It is noted that pork has a relatively larger price elasticity, which is not the case for urban residents. It is unsure whether this is due to likely substitution from poultry meat and eggs or due to data. Further verification will be useful. For all other items, price elasticities are smaller than income elasticitites and except for pork, the income elasticities of demand for all these other items are greater than one. This tends to suggest that for many rural residents, these items are luxury goods. This is especially so in the case of dairy and aquatic products. The price elasticity for poultry is unexpectedly positive. In rural areas, particularly in economically less developed areas, many households raise hens at home and some eggs consumed are not purchased from the market. This may have contributed to the unexpected sign of the estimated parameter.

It is noted that the above two estimations are based on consumption of livestock products data from SSB household surveys, which do not seem to appropriately account for away-from-home consumption. However, in recent years, eating away from home has been very popular in China. When people eat away from home, they tend to consume more animal products. Hence, estimation that uses data that properly take into account of away-from-home consumption will be valuable.

TABLE 11. Income and Price Elasticities of Demand for Livestock Products in Rural China (2000)

Variable	Pork		Mutton and beef		Poultry	
	Parameter	t-value	Parameter	t-value	Parameter	t-value
Pork price	-1.41	-6.38	0.96	3.38	-0.47	-1.47
Mutton and beef price	-0.29	-1.24	-0.78	-2.58	1.86	5.44
Poultry price	1.20	5.67	0.06	0.22	-0.82	-2.67
Poultry egg price	0.46	3.87	-0.73	-4.80	-0.47	-2.69
Milk and dairy product price	-0.29	-3.62	0.04	0.42	0.22	1.86
Aquatic product price	0.00	-0.01	-0.06	-0.40	-0.93	-5.74
Income	0.58	5.43	1.13	8.21	1.15	7.36
Dummy variable-North-Western	-0.10	-1.05	2.14	17.31	0.42	2.96
Dummy variable-Southern	0.29	2.94	-0.31	-2.44	1.86	12.91
R-squared	0.63		0.99		0.75	
Variable	Poultry eggs		Milk and products		Aquatic Products	
	Parameter	t-value	Parameter	t-value	Parameter	t-value
Pork price	0.33	1.59	0.84	1.51	-0.16	-0.39
Mutton and beef price	-0.30	-1.36	-1.03	-1.73	0.74	1.73
Poultry price	-0.68	-3.37	0.45	0.84	-1.34	-3.48
Poultry egg price	0.42	3.68	-1.38	-4.60	0.65	3.01
Milk and dairy product price	-0.08	-0.99	-0.40	-1.98	0.27	1.85
Aquatic product price	-0.41	-3.84	-0.56	-1.97	-0.17	-0.85
Income	1.33	13.05	2.05	7.59	2.17	11.16
Dummy variable-North-Western	-0.73	-7.97	2.77	11.35	0.18	1.04
Dummy variable-Southern	-0.29	-3.10	-0.84	-3.38	1.32	7.34
R-squared	0.81		0.69		0.79	

V. Conclusions and Implications

Consumption of livestock products has increased remarkably in China in recent decades. This increase, however, is accompanied by a notable difference in the level and pattern of consumption of livestock products between rural and urban residents, the rich

and the poor, and between regions. This study focused on examining the differences in the level and pattern of consumption of livestock products between regions.

Different levels and patterns of consumption of livestock products between regions are largely attributable to three major factors: local income level, availability of the product in the region, and ethnic background of the residents. The level and pattern of consumption of livestock products is importantly affected by the level of income of consumers in a region. On the other hand, the availability of products tends to affect to a great extent what people eat in a region. In regions where a large number of Muslims reside, the level of beef and mutton consumption is higher.

Empirical analysis suggests, as income increases, urban residents in southern China are likely to increase their consumption of aquatic products and lamb. There is also much room for the increase in beef consumption in southern China. In northern China, as consumers income increases, there is still much potential for the increase in beef consumption. However, the result tends to suggest that the increase in pork consumption is likely to be much smaller in northern China. In north-western China, lamb is more popularly consumed. It is noted that the room to increase pork consumption is relatively greater in this region.

Rural residents in southern China tend to consume more aquatic products, poultry meat and pork. More beef, lamb and dairy products are consumed in north-western rural China. In northern China, rural residents tend to consume more poultry eggs. The findings of this study suggest that for many rural residents, most of the animal products are still luxury goods. This is especially so in the case of dairy and aquatic products.

While the low level of marketable surplus of animal products and the lack of specialised marketing facilities have in the past fostered localised consumption of some animal products, both of the conditions are changing. It can be expected that the Chinese animal product market will become increasingly integrated and different kinds of animal products will gradually become

widely available across the country, first in urban areas. Thus, regional difference in consumption of livestock products is likely to reduce. For example, the findings of this study have suggested that beef and lamb consumption, used to be chiefly consumed by Muslims in the north-western regions, is to increase in southern China. As such, strategic investment in specialised animal product transportation, distribution and retailing will be advantageous and rewarding. Such investment will further improve the integration of China's animal product market. This in turn, when coupled with higher consumer income, will lead to further increase in China's total consumption of animal products.

REFERENCES

Cai, H.O., C. Brown, J. Longworth and G.H. Wan. 1999. "A Demand Analysis of Ruminant-meat, Pork and Poultry-meat by Chinese Households Segmented by Three Income Strata." in Z.Y. Zhou, J. Chudleigh, G.H. Wan and G. MacAulay. (eds.). *Chinese Economy towards 21st Century*. vol. 1. pp. 145-159. The University of Sydney.

He, X.R. and W.M. Tian. 2000. "Livestock consumption: diverse and changing preferences." in Y.Z. Yang and W.M. Tian. (eds.). *China's Agriculture at the Crossroads*. pp. 98-117. Macmillan Press: London.

Halbrendt, C. and F. Tuan. 1994. "Rural Chinese Food Consumption: The Case of Guangdong." *American Journal of Agricultural Economics* 76: 794-99.

Huang, J.K. and S. Rozelle. 1998, *China's Grain Economy to the Twenty-first Century*. China Agricultural Press: Beijing.

Lewis, P. and N. Andrews. 1989. "Household demand in China." *Applied Economics* 21: 793-807.

Pudney, S. and L. Wang. 1991. "Rationing and Consumer Demand in China: Simulating Effects of a Reform of the Urban Food Pricing System." The Development Economics Research Program Working Paper. CP no.15. London School of Economics.

SSBa (State Statistical Bureau). various years. *China Statistical Yearbook*. China Statistical Press: Beijing.

SSBb, various years. *Rural Household Survey Yearbook.* China Statistical Press: Beijing.

Wang, J.M. and Y.L. Fan. 1999. "A Study on Animal Product Consumption by Rural and Urban Residents in China." research report for a project commissioned by the Ministry of Agriculture, Chinese Academy of Agricultural Sciences: Beijing.

Wang, J.M. and J. Yang. 2003. "Animal product consumption in China." in Z.Y. Zhou and W.M. Tian. *China's Regional Feedgrain Markets: Developments and Prospects.* Grains Research and Development Corporation: Canberra.

Wu, Y.R. and E. Li. 1995. "Food Consumption in Urban China: An Empirical Analysis." *Applied Economics* 27: 509-15.

Zhou, Z.Y. and W.M. Tian. 2003. *China's Regional Feedgrain Markets: Developments and Prospects.* Grains Research and Development Corporation: Canberra.