Chinese animal product consumption in the 1990s*

Hengyun Ma, Allan Rae, Jikun Huang and Scott Rozelle[†]

Chinese animal product consumption behaviour was analysed for both urban and rural households using a complete regional consumption dataset that was augmented to include away-from-home consumption. Seven animal product expenditure share equations were estimated with an extended Almost Ideal Demand System model. The results suggest that Chinese consumers will continue to increase their consumption of animal products, but that consumption patterns have changed in the 1990s. A large percentage of household animal product expenditure is still on pork. However, the shares for aquatic and poultry products consumption will increase substantially. As a consequence, the pork expenditure share will be gradually reduced as incomes grow and diet preferences change in both urban and rural households. There are significant differences in animal product consumption preferences across regions of China. As a result, studies that omit regional dummy variables in their demand systems can produce different expenditure and price parameters. The present paper also found that many of the estimates of elasticities and marginal expenditure shares would be rather different if the data ignored consumption away from home.

1. Introduction

Understanding food consumption patterns of a large nation like China is essential to the continuing growth of international trade, particularly for exporter nations with significant agricultural surpluses (Halbrendt *et al.* 1994). Because of its large population, any small increase in per capita animal

commodity consumption could also drive a large feed grain demand, which, in turn, has a significant impact on the world feedstuffs market (Brown 1995). Hence, what happens in China's consumption and production of animal products has become of paramount concern to international agricultural and food analysts (Paarlberg 1997; Wu and Findley 1997; Rae and Hertel 2000). Estimation of demand elasticities for animal commodities will be central to trade impact analysis (Cai *et al.* 1998).

Chinese household demand has attracted both domestic and international attention, as is reflected in the published literature (Houthakker 1957; Jacque 1984; Chen 1988; Halbrendt *et al.* 1994; Fan *et al.* 1994, 1995; Wan 1996; Huang and Rozelle 1998; Liang 1998; Chen and Liu 1998; Ma 1998; Wu 1999). These studies were either focused on broad groups of commodities (such as food, clothing and housing) or on whole food groups (such as grain, edible oil and meat) and, hence, none of them were specially aimed at China's household demand for animal commodities. Rae (1998) studied the effect of expenditure growth and urbanisation on food consumption in East Asia, in particular the case of animal commodities, but did not address how consumption patterns changed during the last decade for certain specific animal products. Cai *et al.* (1998) made efforts to provide this kind of information, although they disaggregated animal products into only three categories (ruminant meat, pork and poultry) and excluded eggs, which account for a large share of China's animal product consumption expenditure. Moreover, they used data from China Statistical Yearbooks, which exclude away-from-home consumption; therefore, their results may be distorted as a result of the fact that not all kinds of animal products were proportionally consumed away from home. Recent investigations into urban and rural household food consumption in China confirmed that as incomes have grown, the proportion of animal commodities consumed away from home has increased substantially, particularly during the 1990s; there were also obvious differences in the proportion of various kinds of animal products consumed away from home (Fuller *et al.* 2000; Ma *et al.* 2004; Wang *et al.* 2004).

The aim of the present paper is to seek more refined estimates of demand for animal products (pork, eggs, chicken, aquatic products, beef, dairy products and mutton) for both urban and rural households, using data sets that include animal product consumption both at home and out of the home. Specifically, the present paper estimates the conditional expenditure elasticities and marginal expenditure shares within the commodity demand system for each animal product to provide an insight into differences in consumption levels and patterns across regions in China. The following section will outline the institutional reforms and changes in the patterns of animal commodity consumption for both urban and rural households.

Then the data and model to be used will be discussed, followed by the empirical results and conclusions.

2. Institutional reforms and consumption of animal products

In China, prior to 1979 rigid central planning and low production incentives hindered agricultural productivity. The average per capita income growth in real terms was only 2.4 per cent per annum from 1957 to 1979 for rural households (Fan *et al*. 1995). Likewise, urban income showed slow annual growth (about 3.3 per cent). However, during the past two decades, a series of economic reforms were introduced in food production and marketing. As a result, the rural economy has changed from a subsistence economy to a more market-orientated economy. Rural per capita incomes have increased sharply, rising 5.95 per cent annually from 1991 to 2001. Urban per capita incomes have increased even more rapidly, at a rate of 6.96 per cent per annum. Consequently, food consumption patterns have changed considerably and animal commodities have dominated food consumption in China, particularly in the 1990s.

China's food policy reforms initiated in the late 1970s can be divided into two phases (Gao *et al*. 1996a). During the first phase (1978–1984), farmers were allowed to sell their surplus produce in free markets to increase their income by diversifying agricultural production. Under rigid institutional and infrastructural restraints on the free market, however, only limited quantities of farm goods were available. Consequently, the free market was unable to challenge or substitute for the state distribution system during this phase (Chai 1992). In the second phase (1984–1992), the government gradually deregulated the prices of non-grain food commodities, and the institutional system for food distribution was also transformed (Kueh 1988). In late 1984, price controls were lifted for 15 non-grain foods (including pork and eggs); although government distribution of these foods was still maintained with ration prices set well below those in the free market. Rationing of the 15 non-staple foods was finally eliminated in 1987–1988, after which only grains and edible oils were subject to rationing until 1993 (Gao *et al*. 1996a).

During the economic reforms, controls over the marketing of most commodities were eased considerably and urban and rural free markets were rapidly introduced and expanded (Lewis and Andrews 1989). Over the years, as incomes increased, many urban residents bypassed the state distribution system to pay higher prices to purchase directly from free markets for quality and diversity. The free market channel became more and more important in the dual market system, which eventually led to the complete abolition of the government distribution system in 1993 (Gao *et al*. 1996a).

In fact, the amount of most grains available through the state distribution system generally exceeded the quantities demanded through that system for the majority of households in the early 1980s. As a consequence, the grain ration no longer represented a binding constraint of food consumption (Li *et al*. 1985). Further reforms in marketing and pricing have been introduced since 1988 (Tan 1993). Therefore, food rationing no longer represented a constraint to animal product consumption during the 1990s; nor did it encourage consumption of animal products because of ration constraints on consumption of grains.

China's reforms brought significant increases in living standards and dramatic changes in food consumption patterns for both urban and rural economies (Fan *et al*. 1994; Huang and Rozelle 1998). Some of the most pronounced changes in food consumption include the declining portion of expenditure on food (Fan *et al*. 1995) and the shift from staple foods (such as rice and wheat) to relatively expensive animal products (Cai *et al*. 1998). Table 1 displays the changing patterns of food consumption during the 1990s in urban and rural China. The food expenditure shares have declined sharply over the past decade, from 54 to 38 per cent for urban households and from 57 to 48 per cent for rural households. The shares for animal commodity consumption in total food expenditure, however, have increased from 38 to 44 per cent in urban areas and from 34 to 37 per cent in rural areas.[1]

While China's consumers substantially increased their expenditure shares of animal product consumption, they also changed their consumption preferences among these products over time.[2] Pork and eggs used to dominate Chinese animal product consumption, accounting for very large expenditure shares in the animal commodity food group, with respective shares of 44 per cent and 20 per cent for urban households, and 55 per cent and 19 per cent for rural households in 1991 (table 2). However, their shares declined rapidly during the 1990s. For example, pork's expenditure share fell to 36 per cent for urban households and to 51 per cent for rural households by 2001. The share of egg expenditure for urban households halved (from 20 to 10 per cent); although it fell only marginally in rural areas (from 19 to 17 per cent).

In contrast, the expenditure shares for other animal products (e.g., chicken, aquatic products and dairy products) increased considerably. For

---

[1] The expenditure share of animal commodity consumption actually appears to have stagnated if consumption away from home is excluded (table 8).

[2] Excluding away-from-home expenditures also markedly alters animal product expenditure shares (table 9). For example, excluding consumption away from home would lead to a lower pork expenditure share and a higher expenditure share for aquatic products (urban households) than was actually the case.

Table 1 Food consumption patterns in urban and rural China: 1991–2001

Year	Food expenditure (yuan)	Food share in total expenditure	Animal product expenditure (yuan)	Animal share in food expenditure
Urban Households:				
1991	783	0.5385	300	0.3835
1992	888	0.5311	345	0.3887
1993	1058	0.5012	396	0.3748
1994	1422	0.4988	567	0.3988
1995	1766	0.4992	713	0.4040
1996	1905	0.4861	807	0.4237
1997	1943	0.4642	801	0.4121
1998	1927	0.4448	811	0.4210
1999	1932	0.4185	774	0.4007
2000	2009	0.4185	813	0.4046
2001	2014	0.3794	892	0.4429
Rural Households:				
1991	352	0.5677	118	0.3365
1992	374	0.5675	123	0.3278
1993	447	0.5805	151	0.3373
1994	598	0.5880	215	0.3588
1995	768	0.5863	270	0.3521
1996	885	0.5630	311	0.3515
1997	890	0.5504	329	0.3694
1998	850	0.5346	313	0.3688
1999	829	0.5257	291	0.3507
2000	862	0.5253	302	0.3505
2001	831	0.4771	307	0.3700

Source: Food (and also total) expenditure data come from China Statistical Yearbook (National Bureau of Statistics, Beijing, China) and animal product expenditure (including aquatic products) was calculated based on the adjusted per capita consumption series for both urban and rural economies (for details, see Ma *et al*. 2004). Since the aim is to show only the structure of food consumption, expenditure data was measured in nominal terms.

instance, the chicken expenditure share has increased during the last decade by 57 per cent in urban areas (from 11 per cent in 1991 to 17 per cent in 2001) and by 70 per cent in rural areas (from 8 per cent in 1991 to 13 per cent in 2001). Aquatic and dairy products expenditure shares in urban areas have also increased dramatically: from 15 per cent in 1991 to 20 per cent in 2001 for aquatic products and 2 per cent in 1991 to 9 per cent in 2001 for dairy products.

Differences in animal product consumption levels and consumer preferences can be observed across regions in China. First, in 1999–2001 urban households in the south-west averaged a very high level of pork consumption (37 kg), while those from the west only consumed 18 kg pork. Households in the west averaged more than 26 kg of milk, but those in the south-west

Table 2 Animal product expenditure shares in urban and rural China: 1991–2001

Year	Pork	Eggs	Chicken	Aquatic products	Beef	Dairy products	Mutton
Urban Households:							
1991	0.4417	0.1994	0.1058	0.1466	0.0475	0.0201	0.0389
1992	0.3914	0.1773	0.1047	0.1860	0.0515	0.0509	0.0382
1993	0.3787	0.1718	0.1117	0.1961	0.0527	0.0498	0.0391
1994	0.4186	0.1514	0.1095	0.1848	0.0501	0.0461	0.0395
1995	0.4249	0.1396	0.1097	0.1849	0.0573	0.0441	0.0396
1996	0.3962	0.1715	0.1179	0.1796	0.0534	0.0453	0.0360
1997	0.4077	0.1239	0.1269	0.1938	0.0598	0.0517	0.0362
1998	0.3849	0.1390	0.1321	0.1952	0.0543	0.0592	0.0353
1999	0.3546	0.1303	0.1456	0.2085	0.0587	0.0725	0.0297
2000	0.3652	0.1123	0.1422	0.2014	0.0551	0.0844	0.0394
2001	0.3573	0.1020	0.1666	0.1951	0.0543	0.0898	0.0349
Rural Households:							
1991	0.5530	0.1946	0.0761	0.1239	0.0252	–	0.0272
1992	0.5432	0.1916	0.0844	0.1240	0.0268	–	0.0300
1993	0.5166	0.1899	0.0876	0.1447	0.0276	–	0.0337
1994	0.5518	0.1699	0.0882	0.1270	0.0264	–	0.0368
1995	0.5263	0.1670	0.0958	0.1425	0.0300	–	0.0383
1996	0.5234	0.1776	0.1040	0.1277	0.0278	–	0.0395
1997	0.5323	0.1587	0.1151	0.1223	0.0278	–	0.0438
1998	0.5177	0.1661	0.1198	0.1187	0.0310	–	0.0467
1999	0.4751	0.1825	0.1329	0.1226	0.0335	–	0.0534
2000	0.5113	0.1720	0.1304	0.1153	0.0286	–	0.0424
2001	0.5100	0.1700	0.1297	0.1143	0.0292	–	0.0468

Source: Animal product expenditures (including aquatic products) were calculated based on adjusted per capita consumption series (including away-from-home animal consumption) for both urban and rural economies (for details, see Ma *et al*. 2004).
Note: Rural expenditure did not include dairy products (–).

consumed only 16 kg over the same period. Likewise, there are also variations across regions in the levels and patterns of egg, chicken and aquatic products consumption. Second, for rural households, those in the south-west averaged a very high level of pork consumption (about 24 kg), while those from the west consumed less pork (below 8 kg) over 1999–2001. Beef consumption levels in the south and the west demonstrate a completely opposite scenario. Over 1999–2001 rural households from the west consumed almost 2 kg of beef per capita, while those from the south consumed less than 1 kg of beef per capita. Finally, there are obvious differences in consumption patterns of animal products between urban and rural households. Generally, urban households consumed larger shares of chicken, aquatic products and dairy products, but rural households consumed larger shares of pork and eggs. These differences can also be observed across regions.

3. The demand model

Since Deaton and Muellbauer (1980) the Almost Ideal Demand System (AIDS) has been a popular framework for estimating price and income elasticities when expenditure or budget share data are available (Halbrendt *et al*. 1994). Much of the published literature on China's household demand has employed this methodology (Huang and David 1993; Fan *et al*. 1994, 1995; Wu *et al*. 1995; Gao *et al*. 1996b; Cai *et al*. 1998; Huang and Rozelle 1998; Han and Wahl 1998; Huang and Bouis 2001). The current study also used the AIDS specification to estimate an animal product demand system for urban and rural households in China. The basic share equation for the AIDS model is defined as:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln(X/P) \tag{1}$$

where w_i is the expenditure share of animal commodity i, p_j is the price of animal commodity i, X is the total expenditure within the animal demand system over time, and P is an overall price index. As in most empirical work using the AIDS, the price index, P, is approximated by the Stone price index:

$$\ln P = \sum_i w_i \ln p_i \tag{2}$$

The resulting model is referred to as the linear approximate almost ideal demand system, which can be estimated using Zellner's Iterative Seemingly Unrelated Regression procedure. The adding up, homogeneity and symmetry restrictions were imposed (and one share equation was dropped from the system for estimation).

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

$$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i}{w_i}\left[w_j + \sum_k w_k \ln P_k (\eta_{kj} + \delta_{kj})\right] \tag{3}$$

and

$$e_i = 1 + \frac{\beta_i}{w_i} \tag{4}$$

where δ_{ij} is equal to one when $i = j$, and zero otherwise. Note that the β_is in equation (3) will be equal to zero only if preferences are homothetic.

Fan *et al*. (1994) modified this model to incorporate consumer habit formation over time and Huang and Bouis (2001) allowed food consumption behaviour to change geographically. In the present paper, we permit consumption behaviour to vary both over time and across geographical regions. Therefore, we define the three parameters in equation (1) as a function of time and regional dummy variables:

$$\alpha_i = \alpha_{i0} + \alpha_{i1} T_t + \sum_k \alpha_{i2k} D_k \tag{5}$$

$$\gamma_{ij} = \gamma_{ij0} + \gamma_{ij1} T_t + \sum_k \gamma_{ij2k} D_k \tag{6}$$

and

$$\beta_i = \beta_{i0} + \beta_{i1} T_t + \sum_k \beta_{i2k} D_k \tag{7}$$

where T_i denotes a time variable and D_k are regional dummy variables. These modifications add a large number of parameters to the equations to be estimated. Therefore, we conduct tests of various null hypotheses of all parameters on the right-hand-sides of equations (5)–(7) before making a final choice of models. Since we believe food rationing did not affect our animal demand system during the 1990s (see previous section), we did not need to include dummy variables to test the impact of food rationing on the demand system.

4. Data

We used the Household Expenditure and Income Survey (HIES) annual data aggregated to the provincial level and covering 28 provinces (autonomous regions or municipalities), adjusted to include food consumption away from home. Two provinces (Hainan and Chongqing) and one autonomous region (Tibet) were excluded because of incomplete data.[3] Further explanation of this data source can be found in Chern and Wang (1994), Wu *et al*. (1995) and Cai *et al*. (1998). The animal commodities were disaggregated into pork, eggs, chicken, aquatic products, beef, dairy products and mutton.[4] However, because of minimal consumption, dairy consumption of rural households was excluded.

To avoid inconsistency in data as a result of changed definitions of statistics and survey approaches of HIES, along with changing food market

---

[3] Before 1996, Sichuan includes Chongqing.

[4] We thank a reviewer for suggesting the addition of aquatic products to the demand system.

institutions prior to the 1990s, the present study covers the 1991–2001 period.[5] We note that many studies exist on Chinese animal product demand in the 1980s and up to the early 1990s (Wu *et al.* 1995; Cai *et al.* 1998; Lewis and Andrews 1989; Gao *et al.* 1996a; Chern and Wang 1994) and, moreover, it was not until the 1990s that consumption away from home became significant for animal products.

Unlike other studies based on traditional HIES data (e.g., Wu *et al.* 1995; Chern and Wang 1994; Cai *et al.* 1998; Gao *et al.* 1996a), the present study augmented that data set with the adjusted animal commodity expenditure data of Ma *et al.* (2004) to incorporate consumption away from home. In the HIES, data on food consumption away from home is not dissaggregated across food products. Therefore, we took the food expenditure away-from-home category in the HIES and apportioned it among the various animal and other food products based on the procedure and estimates of Ma *et al.* (2004). Since that source provided adjusted consumption series only up to 1999, we followed the same procedure to update the data to 2001. Also, adjusted aquatic products consumption data are unavailable from Ma *et al.* (2004), so we followed the same procedure and data sources to derive an adjusted consumption series for aquatic products that included away-from-home consumption.

Accounting for consumption away from home is an important data improvement, because consumption of animal products away from home has increased substantially in China, especially over the 1990s. As consumer incomes have grown, it is implausible that the share of animal products in total food expenditure stagnated or even trended down during the 1990s, yet this is what the traditional HIES consumption data show. Ignoring consumption away from home can also lead to a misunderstanding of animal product consumption patterns because the proportions of animal product consumption that occurred away from home differ considerably across animal products. For example, the share of pork consumption in total animal expenditure was almost the same in 1991 (about 44 per cent) for both adjusted and unadjusted data, but it deviated substantially in 2001 as a result of the large quantity of pork consumed away from home (table 2; table 9 in Appendix). This contrasts strongly, for example, with the very low level of away-from-home dairy consumption

Price data for individual foods within the animal commodity demand system were obtained from the market survey conducted by the Ministry of Agriculture of China (MOA). This market price survey covered 100 free food markets in rural areas and 70 in urban areas, and price data were

---

[5] We thank a reviewer for turning our attention to these issues.

recorded every 10 days. The average of each set of 36 price observations was taken to generate annual price series from 1991 to 2001.[6] As a result, separate price datasets were generated for rural and urban households. Since retail price data are not available from the MOA market survey, an implicit price series for fresh milk was derived from the purchased quantity and expenditure data. Households also consume milk powder as well as fresh milk and 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.

Data for all 28 provinces (or autonomous regions and municipalities) were aggregated into seven regions.[7] This aggregation was based on our understanding of China's food culture across the country and designed so as to maintain greater variance in consumption between regions and less within regions. As a result, the data are expected to demonstrate large variances in animal consumption across these aggregated regions. For example, expenditure shares of pork and aquatic product consumption change considerably from the coastal urban areas to the south-west urban areas (only 33 per cent and almost 30 per cent in the former, but close to 50 per cent and only 10 per cent in the latter). Expenditure shares of beef and mutton consumption change sharply from the west rural areas to the south rural areas (13 per cent and 25 per cent in the former and below 3 per cent and 2 per cent in the latter). This aggregation also recognises smaller consumption variances within each region. For example, all provinces in the south-west urban areas have similar pork consumption levels, ranging between 35.8 and 39.3 kg, as do those in the north-east urban areas (21.7–23.6 kg).[8]

5. Estimation and results

As in Wu *et al.* (1995), we first estimated the unrestricted model (equation (1)), with parameters defined as in equations (5)–(7), simultaneously using

---

[6] Specifically, the price of aquatic products was the average of prices of crucian, carp and chub for rural households and crucian, carp, chub and hairtail for urban households. The chicken price was computed as the average of hen, cock and duck prices.

[7] Regions are defined as follows: coastal: Shanghai, Jiangsu, Zhejiang and Shandong; north: Beijing, Tianjin, Hebei and Shanxi; west: Mongolia, Gansu, Qinghai, Ningxia and Xinjiang; North-east: Liaoning, Jilin and Heilongjiang; south: Fujian, Guangdong and Guangxi; south-west: Sichuan, Guizhou and Yunnan; central: Anhui, Jiangsu, Henan, Hubei, Hunan and Shaanxi.

[8] We do not tabulate consumption levels and shares for each region, but these data are available upon request to the senior author.

iterative Seemingly Unrelated Regression (SUR) techniques. We then estimated two restricted models to test the null hypotheses of symmetry and homogeneity. Being unable to reject the null hypotheses of symmetry and homogeneity in both the urban and rural models, we then proceeded to conduct various hypothesis tests regarding the behaviour of the price and expenditure parameters over time and across regions. These involved tests of whether the coefficients of the time trend and regional dummy variables in equations (5)–(7), either as a group or individually, were equal to zero. Variables whose parameters were not significantly different from zero at the 5 per cent level were excluded. The system was then re-estimated including all remaining trend and regional dummy variables, with symmetry and homogeneity restrictions imposed.

The estimated parameters are presented in table 3 for the urban, and table 4 for the rural, household model. All coefficients have the expected signs. Most of the own-price and expenditure coefficients are significant at the 5 per cent level or better. It can be seen that not all animal expenditure parameters changed significantly over time. For example, aquatic product and dairy product shares changed significantly over time in the urban household model, while only egg and aquatic product expenditure shares changed significantly over time in the rural household model. A number of price parameters also showed significant change over time. The estimated coefficients of the regional dummy variables showed that animal product consumption patterns varied across regions as a result of social and economic factors (although the coefficients of regional dummy variables are not shown in the tables). These parameter estimates were used to compute conditional expenditure elasticities, marginal expenditure shares and conditional own-price elasticities for the 1991–1993 and the 1999–2001 periods.

5.1 Conditional expenditure elasticities

Focusing first on urban consumption in the more recent time period, conditional expenditure elasticities exceed unity for four of the seven animal products (table 5). Those for pork, eggs and mutton are less than one, indicating that consumption of these products is declining relative to that of other animal commodities in urban areas. Comparing changes in these conditional expenditure elasticities between the two periods, we found that the estimates of some (e.g., pork, eggs and mutton) remained about the same, but that others (e.g., chicken, aquatic products and dairy products) declined, and quite substantially in the case of dairy. The conditional expenditure elasticity for aquatic products is the highest (1.81) while those for chicken and dairy products are almost the same (1.14–1.20).

We also found significant differences in conditional expenditure elasticities across urban regions and animal commodities (table 6). For example, in

H. Ma *et al.*

Table 3 The estimated parameters of the Linear Approximate AIDS (LA/AIDS) model for animal product consumption in urban China: 1991–2001

Commodity	Variables (*t*-statistics are given in parentheses)														
	$\ln p_1$	$\ln p_2$	$\ln p_3$	$\ln p_4$	$\ln p_5$	$\ln p_6$	$\ln p_7$	$\ln X/P$	$T \ln X/P$	$\ln p_1 T$	$\ln p_2 T$	$\ln p_4 T$	$\ln p_5 T$	$\ln p_6 T$	$\ln p_7 T$
Pork (1)	0.2406	−0.0196	0.0051	−0.1257	−0.0126	0.0382	−0.1260	−0.2962	0.0046	−0.0067	−0.0005	0.0048	−0.0030	−0.0013	0.0099
	(3.18)	(0.51)	(0.29)	(2.87)	(0.54)	(1.83)	(4.01)	(6.57)	(1.20)	(0.99)	(1.40)	(1.07)	(1.19)	(0.58)	(3.23)
Eggs (2)	−0.0196	0.0817	−0.0497	−0.0442	−0.0084	−0.0239	0.0641	−0.0759	0.0016	−0.0019	0.0028	0.0061	−0.0031	−0.0007	−0.0066
	(0.51)	(2.41)	(4.57)	(1.57)	(0.54)	(1.54)	(3.02)	(2.65)	(0.66)	(0.55)	(0.98)	(2.17)	(1.91)	(0.46)	(3.02)
Chicken (3)	0.0051	−0.0497	0.0916	−0.0092	−0.0001	−0.0342	−0.0034	0.0505	−0.0014	−0.0054	0.0015	0.0008	−0.0002	0.0095	−0.0006
	(0.29)	(4.57)	(11.06)	(0.74)	(0.02)	(6.04)	(0.33)	(2.79)	(0.92)	(3.26)	(1.50)	(0.55)	(0.28)	(11.46)	(0.55)
Aquatic Products (4)	−0.1257	−0.0442	−0.0092	0.1617	−0.0110	0.0231	0.0052	0.2746	−0.0074	0.0077	0.0032	−0.0140	0.0049	−0.0029	0.0018
	(2.87)	(1.57)	(0.74)	(3.80)	(0.65)	(1.32)	(0.22)	(8.14)	(2.57)	(1.90)	(1.32)	(3.42)	(2.67)	(1.62)	(0.71)
Beef (5)	−0.0126	−0.0084	−0.0001	−0.0110	0.0042	0.0193	0.0087	−0.0035	0.0014	0.0004	0.0007	0.0020	0.0015	−0.0022	−0.0022
	(0.54)	(0.54)	(0.02)	(0.65)	(0.23)	(1.65)	(0.64)	(0.22)	(1.00)	(0.21)	(0.51)	(1.19)	(0.99)	(2.14)	(1.62)
Dairy products (6)	0.0382	−0.0239	−0.0342	0.0231	0.0193	0.0094	−0.0130	0.0772	−0.0044	−0.0059	−0.0003	−0.0006	0.0011	−0.0016	−0.0005
	(1.83)	(1.54)	(6.03)	(1.32)	(1.65)	(1.27)	(1.12)	(5.17)	(3.40)	(3.08)	(0.23)	(0.34)	(1.06)	(2.02)	(0.39)
Mutton[†] (7)	−0.1260	0.0641	−0.0034	0.0052	0.0087	−0.0319	0.0322	−0.0268	0.0005	0.0117	−0.0074	0.0010	−0.0012	−0.0007	−0.0018
	(4.01)	(3.02)	(0.33)	(0.22)	(0.64)	(1.67)	(1.20)	(0.86)	(0.20)	(4.02)	(3.86)	(0.63)	(0.66)	(0.27)	(0.60)

Note: Run with constant term and provincial dummy variables but not reported. [†]Derived from imposed restrictions.

Table 4 The estimated parameters of the Linear Approximate AIDS (LA/AIDS) model for animal product consumption in rural China: 1991–2001

Commodity	Variables (*t*-statistics are given in parentheses)											
	$\ln p_1$	$\ln p_2$	$\ln p_3$	$\ln p_4$	$\ln p_5$	$\ln p_6$	$\ln X/P$	$T\ln X/P$	$\ln p_1 T$	$\ln p_2 T$	$\ln p_3 T$	$\ln p_5 T$
Pork (1)	0.0300	0.0188	0.0234	0.0835	−0.1194	−0.0363	−0.0253	0.0012	0.0102	−0.0015	−0.0123	0.0020
	(0.33)	(0.34)	(0.78)	(2.60)	(3.05)	(1.51)	(0.67)	(0.59)	(1.41)	(0.35)	(3.25)	(0.45)
Eggs (2)	0.0188	0.2037	−0.1022	−0.1336	−0.0105	0.0238	−0. 1732	0.0049	−0.0080	−0.0047	0.0108	−0.0027
	(0.34)	(3.85)	(3.94)	(6.87)	(0.37)	(1.57)	(7.71)	(3.73)	(1.70)	(1.27)	(3.98)	(0.91)
Chicken (3)	0.0234	−0.1022	0.0938	−0.0107	0.0129	−0.0172	0.0279	−0.0003	−0.0052	0.0073	−0.0027	0.0019
	(0.78)	(3.94)	(4.04)	(0.99)	(0.63)	(2.01)	(2.35)	(0.46)	(2.11)	(3.92)	(1.25)	(1.00)
Aquatic products (4)	0.0835	−0.1336	−0.0107	0.0601	0.0007	0.0000	0.1021	−0.0046	−0.0106	0.0065	0.0039	0.0050
	(2.60)	(6.87)	(0.99)	(2.74)	(0.05)	(0.00)	(4.60)	(3.08)	(3.95)	(3.69)	(1.96)	(2.33)
Beef (5)	−0.1194	−0.0105	0.0129	0.0007	0.0160	0.0046	0.0252	−0.0005	0.0096	−0.0030	0.0014	−0.0026
	(3.05)	(0.37)	(0.63)	(0.05)	(3.32)	(0.40)	(1.63)	(0.57)	(2.92)	(1.61)	(0.65)	(2.58)
Mutton[†] (6)	−0.0363	0.0238	−0.0172	0.0000	0.1004	0.0025	0.0434	−0.0001	0.0004	−0.0004	−0.0001	−0.0003
	(1.15)	(1.57)	(2.01)	(0.00)	(8.73)	(0.23)	(3.20)	(0.09)	(0.20)	(0.35)	(0.08)	(0.22)

Note: Run with constant term and provincial dummy variables but not reported. [†]Derived from imposed restrictions.

Table 5 The conditional expenditure elasticities, marginal expenditure shares and conditional own-price elasticities for household animal product consumption in the selected periods

Commodity	Conditional expenditure elasticities		Marginal expenditure shares		Conditional own-price elasticities	
	1991–1993	1999–2001	1991–1993	1999–2001	1991–1993	1999–2001
Urban Households:						
Pork	0.3466	0.3677	0.1400	0.1320	−0.2575	−0.3849
Eggs	0.6459	0.5477	0.1181	0.0629	−0.5319	−0.1145
Chicken	1.3791	1.1947	0.1481	0.1810	−0.1880	−0.4249
Aquatic products	2.2645	1.8120	0.3992	0.3654	−0.8614	−1.4033
Beef	1.1223	1.3079	0.0568	0.0733	−0.7131	−0.5355
Dairy products	2.1598	1.1442	0.0870	0.0941	−1.0923	−1.1905
Mutton	0.4040	0.4566	0.0156	0.0158	−0.4633	−0.8140
Rural households:						
Pork	0.9682	0.9846	0.5205	0.4911	−0.7944	−0.6255
Eggs	0.2764	0.4294	0.0531	0.0751	−0.3267	−0.5305
Chicken	1.3373	1.2129	0.1106	0.1589	−0.1188	−0.6172
Aquatic products	1.5335	1.2804	0.2007	0.1504	−0.6106	−0.5211
Beef	1.8189	1.5848	0.0483	0.0482	−1.1103	−1.7828
Mutton	2.4167	1.8927	0.0732	0.0899	−0.9603	−0.9898

Note: Both elasticities and shares were calculated using 3-year averages centred in 1992 and 2000.

Table 6 The conditional expenditure elasticities by regions and commodities: 1999–2001

Region	Pork	Eggs	Chicken	Aquatic products	Beef	Dairy products	Mutton
Urban households:							
Central	0.5558	1.3733	1.9052	1.0340	1.3183	0.2937	−0.1796
Coastal	0.0037	0.0075	1.3005	1.9587	1.2226	1.9177	−0.1966
North	0.5254	0.2947	1.5179	2.0811	1.0900	1.2275	0.3407
North-east	0.3751	0.5975	1.2648	2.1377	0.8297	1.0241	0.6128
West	0.6346	−0.1254	1.2297	0.7957	2.1912	0.6363	1.2974
South	0.3606	1.2156	0.4013	2.0503	−0.2813	1.8260	−0.1082
South-west	0.2433	0.5781	1.2730	3.1145	1.4493	1.0636	2.1514
Rural households:							
Central	1.2063	0.2138	1.3088	1.4459	−0.0225	–	1.1741
Coastal	0.7935	0.8237	1.8011	0.9871	1.1335	–	1.9678
North	0.7735	0.9122	2.2404	2.5485	1.3489	–	0.4236
North-east	1.4369	0.5147	0.6224	0.9879	0.9883	–	0.6945
West	0.4424	−0.0624	1.3797	1.2629	1.7995	–	2.0536
South	1.3405	−1.3981	1.0956	0.6083	2.1828	–	1.3348
South-west	0.8553	0.6621	0.9957	4.6809	1.6837	–	2.3584

Note: Rural expenditure did not include dairy products (–). Regions are defined as follows: coastal: Shanghai, Jiangsu, Zhejiang and Shandong; north: Beijing, Tianjin, Hebei and Shanxi; west: Mongolia, Gansu, Qinghai, Ningxia and Xinjiang; North-east: Liaoning, Jilin and Heilongjiang; south: Fujian, Guangdong and Guangxi; south-west: Sichuan, Guizhou and Yunnan; central: Anhui, Jiangsu, Henan, Hubei, Hunan and Shaanxi.

the central and southern regions, the conditional expenditure elastitities for egg consumption are greater than 1.20, while they are less than one (even zero and negative) in other regions. The conditional expenditure elasticities for chicken consumption are close to 2.0 in the central region, but only 0.40 in the south; while they are more than 3.0 for aquatic products in the south-west, but only 0.80 in the west. The conditional expenditure elasticity exceeds 2.0 for beef in the west, but is negative in the south; while they are close 2.0 for dairy products in the coastal and southern regions, but below 0.70 in the central and western regions. The urban conditional expenditure elasticities for pork and egg consumption in the coastal and western regions are amongst the smallest for these products. In the west, eggs appear to have become an inferior good (negative conditional expenditure elasticity).[9]

The estimated conditional expenditure elasticities for rural consumption demonstrate somewhat similar patterns (table 5). A noticeable difference is that mutton has the largest expenditure elasticity (1.89), but eggs have the smallest (0.43) in 1999–2001. It is also noted that the pork conditional expenditure elasticity is much larger in rural areas (0.97) than in urban areas (0.35), indicating potential market expansion for this product in rural areas. Substantial variations in the conditional expenditure elasticities can be found across regions for rural households. For example, the pork conditional expenditure elasticity exceeds 1.20 in the central, north-east and southern regions while it is less than one in the other regions, and the mutton elasticities are greater than one in all but two regions (table 6).

5.2 Marginal expenditure shares

Marginal expenditure shares for each commodity are given by the product of the conditional expenditure elasticity and the expenditure share (Halbrendt *et al*. 1994). The results indicate how future animal product consumption patterns will continue to evolve. For a given increase in animal product expenditure by urban consumers in 1999–2001, the largest share of that increase was estimated to be allocated to aquatic product consumption (36.5 per cent, table 5). Although down from a marginal share of 40 per cent in 1991–1993, these marginal values were well above this product's average expenditure share. Marginal expenditure shares for chicken, beef and dairy products in 1999–2001 were all above their levels at the beginning of the decade, and all exceeded their average expenditure shares in 1999–2001. Therefore, average

---

[9] In fact, in the coastal urban area, the expenditure shares decreased sharply, from 43.7 per cent in 1991 to 33.3 per cent in 2001 for pork and from 18.1 per cent in 1991 to 9.7 per cent in 2001 for eggs. The expenditure share of eggs also decreased in the west, from 14 per cent in 1991 to 10 per cent in 2001.

Table 7 The estimated marginal expenditure shares by regions and commodities: 1999–2001

Region	Pork	Eggs	Chicken	Aquatic products	Beef	Dairy products	Mutton
Urban households:							
Central	0.2315	0.1814	0.2591	0.1532	0.0852	0.0202	−0.0061
Coastal	0.0012	0.0007	0.1635	0.5588	0.0443	0.1785	−0.0058
North	0.1775	0.0482	0.1273	0.3183	0.0831	0.1479	0.0222
North-east	0.1307	0.0847	0.1409	0.3636	0.0761	0.0911	0.0294
West	0.1937	−0.0137	0.1066	0.0710	0.2442	0.0614	0.2614
South	0.1248	0.0876	0.0624	0.6096	−0.0125	0.1123	−0.0025
South-west	0.1176	0.0532	0. 1933	0.3272	0.0762	0.0882	0.0688
Rural households:							
Central	0.6536	0.0405	0.1467	0.1312	−0.0007	–	0.0422
Coastal	0.3345	0.1748	0.2389	0.1791	0.0224	–	0.0640
North	0.3908	0.2709	0.0728	0.2053	0.0552	–	0.0185
North-east	0.6514	0.1577	0.0477	0.1164	0.0288	–	0.0116
West	0.1770	−0.0242	0.0746	0.0319	0.2254	–	0.5137
South	0.6537	−0.0866	0.2654	0.0992	0.0557	–	0.0261
South-west	0.6212	0.0778	0.0932	0.1664	0.0221	–	0.0329

Note: Rural expenditure did not include dairy products (–). Regions are defined as follows: coastal: Shanghai, Jiangsu, Zhejiang and Shandong; north: Beijing, Tianjin, Hebei and Shanxi; west: Mongolia, Gansu, Qinghai, Ningxia and Xinjiang; North-east: Liaoning, Jilin and Heilongjiang; south: Fujian, Guangdong and Guangxi; south-west: Sichuan, Guizhou and Yunnan; central: Anhui, Jiangsu, Henan, Hubei, Hunan and Shaanxi.

shares of all these products in total animal product expenditure should continue to increase. In contrast, the expenditure shares for pork, egg and mutton consumption are expected to decline considerably since their marginal shares in 1999–2001 (13.2 per cent, 6.3 per cent and 1.6 per cent, respectively) are well below their current expenditure shares (35.7 per cent, 10.2 per cent and 3.5 per cent in 2001; table 2).

Turning to the regions, marginal expenditure shares in the north-east and south-west are rather similar to the national estimates for 1999–2001, but there exists considerable variation across other regions. Nearly half of additional animal product expenditure in the west is on beef and mutton, and between 55 and 60 per cent of that in coastal and southern regions is on aquatic products (table 7). The central and the coastal regions could increase their current chicken expenditure shares (13.6 per cent and 8.4 per cent in 2001, respectively), while the south could see a decline from its current chicken expenditure share (15.6 per cent in 2001). In contrast, the share of dairy products in animal product spending could increase in the coastal region and the south, but fall in the central and western regions.

For rural consumers, the estimates of marginal expenditure shares for 1999–2001 suggest that the pork expenditure share will likely remain

unchanged, but that of eggs is likely to decline as consumption of aquatic products, chicken and red meats increases in future (table 5). There are also significant differences in patterns of marginal expenditure shares across regions in rural areas (table 7). For example, pork average expenditure shares are likely to increase in central, north-eastern and southern regions, while the reverse could occur in remaining regions.

5.3 Own-price elasticities

All conditional own-price elasticities have the expected negative signs, but the absolute magnitudes vary substantially (table 5). For urban households, the two highest own-price elasticities for 1999–2001 are −1.40 for aquatic products and −1.19 for dairy products; while these elasticities are around −0.40 for pork, chicken and beef; and egg is the most price-inelastic animal product. The conditional own-price elasticities for rural households are greatest for ruminant meats (−1.78 for beef and −0.99 for mutton).[10]

5.4 Effect on estimates of including away-from-home consumption

To demonstrate the significance of including consumption away from home in the analysis, we re-estimated both urban and rural models after replacing our adjusted consumption and expenditure data with those based on the official HIES animal product consumption data (tables 8 and 9). The conditional expenditure elasticities, marginal expenditure elasticities and conditional own-price elasticities were then computed at the national level (table 10). Comparing the 1999–2001 estimates of urban conditional expenditure elasticities in table 10 with those in table 5, we found that, although there are generally no major differences in the patterns of conditional expenditure elasticities, most of these elasticities are underestimated when official data are used. The expenditure elasticities for pork and mutton consumption by urban consumers were considerably underestimated. Such underestimation appears to be not such a problem with the rural results, because of the relative unimportance of away-from-home consumption in rural areas.

   The omission of away-from-home consumption also changes urban average expenditure shares, which combine with underestimated expenditure elasticities when marginal expenditure shares are computed. Particularly noticeable are the resulting overestimate of the aquatic marginal expenditure share and the underestimation of that for pork.

---

[10] Regional own-price elasticities are not reported here, but can be obtained from the senior author.

Table 8 Food consumption patterns excluding away-from-home consumption

Year	Food expenditure (yuan)	Food share in total expenditure	Animal product expenditure (yuan)	Animal share in food expenditure
Urban Households:				
1991	783	0.5385	266.54	0.3364
1992	888	0.5311	301.60	0.3341
1993	1058	0.5012	337.78	0.3132
1994	1422	0.4988	470.37	0.3249
1995	1766	0.4992	571.85	0.3174
1996	1905	0.4861	632.79	0.3253
1997	1943	0.4642	625.38	0.3145
1998	1927	0.4448	620.25	0.3136
1999	1932	0.4185	594.69	0.2988
2000	2009	0.4185	612.78	0.2950
2001	2014	0.3794	672.14	0.3228
Rural Households:				
1991	352	0.5677	103.70	0.2946
1992	374	0.5675	106.46	0.2847
1993	447	0.5805	129.49	0.2897
1994	598	0.5880	181.25	0.3031
1995	768	0.5863	224.73	0.2926
1996	885	0.5630	252.23	0.2850
1997	890	0.5504	267.76	0.3009
1998	850	0.5346	249.34	0.2933
1999	829	0.5257	227.76	0.2747
2000	862	0.5253	240.46	0.2790
2001	831	0.4771	241.78	0.2910

Source: China Statistical Yearbook (National Bureau of Statistics, Beijing, China). Since the aim is to show only the structure of food consumption, expenditure data was measured in nominal terms. Note: Rural animal product expenditure data do not include dairy products.

6. Conclusions

Chinese animal product consumption behaviour was analysed for both urban and rural households using a complete consumption dataset that not only included consumption within the home, but also that away from home. Seven animal product expenditure share equations were estimated with an extended LA/AIDS model. The results suggest several points of potential interest to domestic and overseas policy makers, planners and traders.

First, Chinese consumers will continue to increase their consumption of animal products, but consumption patterns have changed since 1991. Although pork and eggs accounted for a large share of total animal product expenditure in the early 1990s, consumption preferences have shifted to chicken (for urban and rural households) and aquatic products and dairy products (for urban households). Apart from pork, eggs and mutton for urban households, conditional expenditure elasticities in 1999–2001 were

Table 9 Animal product expenditure shares excluding away-from-home consumption

Year	Pork	Eggs	Chicken	Aquatic products	Beef	Dairy products	Mutton
Urban Households:							
1991	0.4444	0.1704	0.1077	0.1652	0.0481	0.0227	0.0414
1992	0.3803	0.1513	0.1062	0.2129	0.0514	0.0582	0.0396
1993	0.3621	0.1437	0.1133	0.2302	0.0519	0.0585	0.0402
1994	0.3933	0.1297	0.1111	0.2227	0.0474	0.0556	0.0402
1995	0.3904	0.1199	0.1121	0.2306	0.0525	0.0550	0.0395
1996	0.3603	0.1462	0.1225	0.2291	0.0484	0.0578	0.0357
1997	0.3463	0.1159	0.1323	0.2482	0.0555	0.0662	0.0356
1998	0.3262	0.1206	0.1385	0.2553	0.0481	0.0775	0.0338
1999	0.2960	0.1105	0.1516	0.2715	0.0511	0.0944	0.0250
2000	0.2960	0.0948	0.1490	0.2671	0.0446	0.1119	0.0367
2001	0.2812	0.0836	0. 1834	0.2589	0.0425	0.1191	0.0312
Rural Households:							
1991	0.6065	0.1319	0.0732	0.1323	0.0275	–	0.0286
1992	0.5958	0.1285	0.0813	0.1335	0.0294	–	0.0315
1993	0.5679	0.1248	0.0839	0.1575	0.0304	–	0.0355
1994	0.6011	0.1113	0.0807	0.1405	0.0287	–	0.0377
1995	0.5725	0.1100	0.0866	0.1603	0.0323	–	0.0383
1996	0.5751	0.1173	0.0912	0.1472	0.0296	–	0.0397
1997	0.5722	0.1106	0.1028	0.1404	0.0297	–	0.0443
1998	0.5608	0.1152	0.1043	0.1395	0.0333	–	0.0470
1999	0.5167	0.1278	0.1175	0.1463	0.0365	–	0.0552
2000	0.5539	0.1238	0.1164	0.1354	0.0299	–	0.0406
2001	0.5527	0.1183	0.1154	0.1358	0.0312	–	0.0465

Source: China Statistical Yearbook (National Bureau of Statistics, Beijing, China). Note: Rural expenditure did not include dairy products (–).

greater than one in value. Also, with the same product exceptions, marginal expenditure shares in 1999–2001 were greater than average expenditure shares. Consequently, pork and egg expenditure as shares of total spending on animal products will continue to fall as incomes grow and diet preferences change in both urban and rural households.

Second, there exist important differences in the consumption of animal products between urban and rural households. While urban households have rapidly reduced their expenditure shares of pork and eggs, rural households still maintained relatively high shares for these products during the 1990s. In contrast to their urban counterparts, the shares of aquatic products and beef in total animal product expenditures in rural households did not increase over the past decade, and dairy consumption is much lower in rural regions than urban regions. Also in contrast to the urban situation, mutton had the highest expenditure elasticity of all animal products in rural households, and rural spending on this product as a share of animal product expenditure is likely to continue to increase.

Table 10 The conditional expenditure elasticities, marginal expenditure shares and conditional own-price elasticities for household animal product consumption in the selected periods using data excluding consumption away from home

Commodity	Conditional expenditure elasticities		Marginal expenditure shares		Conditional own-price elasticities	
	1991–1993	1999–2001	1991–1993	1999–2001	1991–1993	1999–2001
Urban households						
Pork	0.2649	0.2088	0.1048	0.0608	−0.1847	−0.3943
Eggs	0.7576	0.5523	0.1176	0.0532	−0.5496	−0.0574
Chicken	1.4275	1.1383	0.1557	0.1836	−0.1728	−0.4314
Aquatic products	2.1854	1.6406	0.4432	0.4361	−0.9340	−1.3348
Beef	0.8043	1.2352	0.0406	0.0569	−0.8940	−0.6675
Dairy products	2.1735	1.0713	0.1010	0.1162	−0.9574	−0.9981
Mutton	−0.3639	−0.5781	−0.0147	−0.0179	−0.5143	−0.7970
Rural households						
Pork	0.9890	0.9978	0.5836	0.5399	−0.8885	−0.7235
Eggs	0.0950	0.3293	0.0122	0.0406	−0.2637	−0.6499
Chicken	0.8568	0.9022	0.0681	0.1050	−0.2769	−0.5684
Aquatic products	1.5381	1.2056	0.2170	0.1678	−0.7052	−0.6528
Beef	1.6513	1.4876	0.0481	0.0484	−1.0314	−1.6371
Mutton	1.9147	1.6179	0.0611	0.0768	−0.9239	−0.9585

Note: Both elasticities and shares were calculated using 3-year averages centred in 1992 and 2000.

Third, there are significant differences in animal product consumption preferences across regions in China. As a result, studies that omit regional dummy variables in their demand systems may produce biased expenditure and price parameters. A detailed explanation of such regional differences is beyond the scope of the present paper, but a few possibilities come to mind. The first is the wide variation in household incomes and expenditures on animal products across regions, and the statistically strong relationship between consumption of animal products and expenditure. Second, regional patterns of animal product consumption are probably closely related to regional production. For example, pork and eggs are traditional livestock consumption staples and are produced nation-wide. In contrast, the west is an important beef and mutton producing area, where consumption of these products tends to be high. The same can be said for aquatic products in the coastal and southern regions. The tendency of regional consumption to reflect regional production will be further strengthened by any lack of market development coupled with lack of development of food processing and transportation facilities, as is especially the case in rural areas of China (Huang and Rozelle 1998).

Finally, the present study has demonstrated the importance of including away-from-home consumption in animal product demand analysis in China.

Where this is not the case, reported estimates of marginal expenditure shares and elasticities for various animal products are likely to be biased and must be interpreted with caution. This will also be the case in regional demand studies, since the relative contribution of consumption outside the home to total consumption of animal products varies widely across regions as well as across product types.

References

Brown, L.R. 1995, 'Who will feed China? Wake-up call for a small planet', The Worldwatch Environmental Alert Series, 1st edn, Worldwatch Institute, Washington, DC.

Cai, H., Brown, C., Wan, G. and Longworth, J. 1998, 'Income strata and meat demand in urban China', *Australian Agribusiness Review*, vol. 6, paper 11.

Chai, Joseph, C.H. 1992, 'Consumption and living standard in China', *The China Quarterly*, vol. 131, 720–749.

Chen, L.Y. and Liu, C.Y. 1998, 'Application of linear approximate expenditure system to consumption patterns of urban and rural consumers in Ningxia', *Consumer Economics. Beijing*, vol. 1, pp. 13–15. (In Chinese.)

Chen, S.M. 1988, 'Using AIDS model to predict consumption structure of China pre-2000', *Consumer Economics. Beijing*, vol. 5, pp. 10–13. (In Chinese).

Chern, W.S. and G. Wang 1994, 'The Engel function and complete food demand system for Chinese urban households', *China Economic Review*, vol. 4, pp. 35–57.

Deaton, A. and Muellbauer, J. 1980, 'An almost ideal demand system', *American Economic Review*, vol. 70, pp. 312–326.

Fan, S., Cramer, G. and Wailes, E. 1994, 'Food demand in rural China: evidence from rural household survey', *Agricultural Economics*, vol. 11, pp. 61–69.

Fan, S., Wailes, E.J. and Cramer, G.L. 1995, 'Household demand in rural China: a two-stage LES-AIDS model', *American Journal of Agricultural Economics*, vol. 77, pp. 54–62.

Fuller, F., Hayes, D. and Smith, D. 2000, 'Reconciling Chinese meat production and consumption data', *Economic Development and Cultural Change*, vol. 49, pp. 23–43.

Gao, X.M., Wailes, E.J. and Cramer, G.L. 1996a, 'Partial rationing and Chinese urban household food demand analysis', *Journal of Comparative Economics*, vol. 22, pp. 43–62.

Gao, X.M., Wailes, E.J. and Cramer, G.L. 1996b, 'A two-stage rural household demand analysis: microdata evidence from Jiangsu Province, China', *American Journal of Agricultural Economics*, vol. 78, pp. 604–613.

Green, R. and Alston, J.M. 1990, 'Elasticities in AIDS models', *American Journal of Agricultural Economics*, vol. 72, pp. 442–445.

Halbrendt, C., Tuan, F., Gempesaw, C. and Dolk-Etz, D. 1994, 'Rural chinese food consumption: the case of Guangdong', *American Journal of Agricultural Economics*, vol. 76, pp. 794–799.

Han, T. and Wahl, T.I. 1998, 'china's rural household demand for fruits and vegetables', *Journal of Agricultural and Applied Economics*, vol. 30, pp. 141–150.

Houthakker, H.S. 1957, 'An international comparison of household expenditure patterns, commemorating the centenary of Engel's Law', *Econometrica*, vol. 59, pp. 141–148.

Huang, J. and Bouis, H. 2001, 'Structural changes and demand for food in Asia: empirical evidence from Taiwan', *Agricultural Economics*, vol. 26, pp. 57–69.

Huang, J. and David, C.C. 1993, 'Demand for cereal grains in Asia: the effect of urbanisation', *Agricultural Economics*, vol. 8, pp. 107–124.

Huang, J. and Rozelle, S. 1998, 'Market development and food demand in rural China', *China Economic Review*, vol. 9, pp. 25–45.

Jacques Van der Gaag, J. 1984, 'Private household consumption in China: a study of people's livelihood', World Bank staff working paper no. 701, Washington, DC.

Kueh, Y.Y. 1988, 'Food consumption and peasant income in the post Mao era', *The China Quarterly*, vol. 116, pp. 634–670.

Lewis, P. and Andrews, N. 1989, 'Household demand in China', *Applied Economics*, vol. 21, pp. 793–807.

Li, X.Z., Yang, S.M. and He, J.H. 1985, 'Structure of China's domestic consumption: analysis and preliminary forecast', World Bank staff working paper no. 755, Washington, DC.

Liang, Z.H. 1998, 'A study on animal product consumption in China', *Agricultural Economy and Technological Development*, vol. 6, pp. 158–169. (In Chinese.)

Ma, C.W. 1998, 'Analysis of consumption structure of urban and rural residents in China', *Consumer Economics*, vol. 1, pp. 8–10, Beijing. (In Chinese.)

Ma, H., Huang, J. and Rozelle, S. 2004, 'Reassessing China's animal statistics: analyzing the discrepancies and creating new data series', *Economic Development and Cultural Change*, vol. 52, pp. 445–473.

Paarlberg, R.L. 1997, 'Feeding China: a confident view,' *Food Policy*, vol. 22, pp. 269–279.

Rae, A.N. 1998, 'The effects of expenditure growth and urbanisation on food consumption in East Asia: a note on animal products', *Agricultural Economics*, vol. 18, pp. 291–299.

Rae, A.N. and Hertel, T. 2000, 'Future developments in global animal and grains markets: the impacts of animal productivity convergence in Asia/Pacific', *Australian Journal of Agricultural and Resource Economics*, vol. 44, pp. 393–423.

Tan, R.Q. 1993, 'China's grain purchase and sale evolution from plan to market', *Rural Economy Documents*, vol. 4, pp. 14–22. (In Chinese.)

Wan, G.H. 1996, 'Income elasticities of household demand in rural China: estimates from cross-sectional survey data', *Journal of Economic Studies*, vol. 23, pp. 18–33.

Wang, J.M., Zhou, Z.Y. and Yang, J. 2004, 'How much animal product do the Chinese consume: empirical evidence from household surveys,' *Australian Agribusiness Review*, vol. 12.

Wu, H.X. and Findley, C. 1997, 'China's grain demand supply: trade application', Chinese Economic Research Unit, The University of Adelaide, Adelaide.

Wu, Y., Li, E. and Samual, S.N. 1995, 'Food consumption in urban China: an empirical analysis' *Applied Economics*, vol. 27, pp. 509–515.

Wu, X.F. 1999, 'Comparison of and household background and consumption structure between urban and rural residents in China', *Quantitative and Technical Economic Study*, vol. 6, pp. 18–22, Beijing. (In Chinese.)