# Livestock Product Consumption Patterns in Urban and Rural China

Hengyun Ma, Jikun Huang, Scott Rozelle and Allan Rae*

China Agriculture Working Paper 1/03

Centre for Applied Economics and Policy Studies

Massey University

---

* Hengyun Ma is a visiting research fellow at in the Centre for Applied Economics and Policy Studies, Massey University, New Zealand. Jikun Huang is Director, the Center for Chinese Agricultural Policy (CCAP), Chinese Academy of Sciences. Scott Rozelle is a professor, Department of Agricultural and Resource Economics, University of California Davis and a member of Giannini Foundation of Agricultural Economics. Allan N Rae is Director, Centre for Applied Economics and Policy Studies. The authors would like to acknowledge the financial support of the Venture Trust, the Centre for Applied Economics and Policy Studies and the Department of Commerce, Massey University.

## Abstract

Chinese livestock products consumption behavior was analysed for both urban and rural households using a complete regional consumption dataset. Six livestock product expenditure share equations were estimated with an extended AIDS model. The results suggest that Chinese consumers will continue to increase their consumption of livestock products, but consumption patterns have changed in the 1990s. A large percentage of household livestock product expenditure is still on pork. However, the shares for beef, dairy products and poultry 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 livestock product consumption preferences across provinces of China. As a result, studies that omit regional dummy variables in their demand systems can produce different expenditure and price parameters, which should be interpreted with caution.

# Livestock Product Consumption Patterns in Urban and Rural China

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

Household demand has attracted both domestic and international attention as is reflected in the literature (Houthakker, 1957; Jacque, 1984; Halbrendt *et. al*., 1994; Fan *et. al*., 1994 and 1995; Wan, 1996; Huang and Rozelle, 1998; Han and Thomas, 1998). 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 meat demand. Rae (1998) studied the effect of expenditure growth and urbanization on food consumption in East Asia, in particular the case of livestock commodities, but did not address how consumption patterns changed during the past two decades for some certain specific livestock products. Cai *et al* (1998) made efforts to provide this kind of information, although they disaggregated livestock products into only three

categories (ruminant meat, pork and poultry) and excluded eggs that account for a large share of China's livestock products consumption expenditure. Moreover, they used data from Chinese yearbooks that excludes away-from-home consumption and thus their results underestimate Chinese demand. A recent investigation into urban and rural household food consumption in China confirmed that as income grows, the proportion of meat consumed away from home has increased substantially, particularly during the 1990s (Ma et al., 2002).[1]

This aim of this paper is to seek more refined estimates of demand for livestock commodity consumption (pork, beef, mutton, poultry, eggs and dairy products) for both urban and rural households, using a set of complete meat consumption data sets that include both meat consumed at home and meat consumed out of the home. Specifically, the paper estimates income elasticities for each of those livestock products to provide an insight into differences in meat consumption levels and patterns across regions of China. The following section will outline the income growth and changes in meat consumption patterns 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. Income Growth and Consumption of Livestock Products

Prior to 1979 in China, when rigid central planning and low production incentives hindered agricultural productivity, the average per capita income growth in real terms was only 2.4 percent per annum from 1957 to 1979 for rural households (Fan, *et al*., 1995). Likewise, urban income showed slow annual growth (about 3.3 percent). However, since the 1980s, the rural economy has changed from a subsistence to a more market-oriented economy. As a result, rural per capita incomes have increased sharply. From 1980 to 1999, rural real per

capita income grew at 8.5 percent annually. At the same time, urban real per capita income has also increased substantially at a 7.2 percent per annum. 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 livestock products (Cai *et al*., 1998). Table 1 displays the changing patterns of food consumption during the last two decades in urban and rural China. The food expenditure shares, on the one hand, have sharply declined over the 20 years from 1980, from 58 percent to 42 percent for urban households and from 62 percent to 53 percent for rural households. On the other hand, the shares for livestock products consumption in total food expenditure have sharply increased, from 21 percent to 31 percent in urban China and from 16 percent to 35 percent in rural areas.

While China's consumers substantially increased their livestock product expenditure shares, they also changed their meat consumption preferences over time. Pork and eggs have dominated Chinese livestock products consumption, accounting for very large shares in total expenditure on this food group, with respective shares of 65 percent and 23 percent in urban China, and 74 percent and 16 percent in rural China in 1980 (Table 2). However, their shares have been declining rapidly during the 1990s. For example, pork's expenditure share fell from 65 percent in 1980 to 53 percent in 2000 (urban China) and from 74 percent to 65 percent over the same period in rural China. Though the expenditure share of eggs in rural China fell marginally (from 16 percent to 14 percent), its share in urban China almost halved, from 23

percent to 13 percent.

In contrast, the expenditure shares for other animal products (beef, mutton, poultry and dairy products) increased considerably. First, the poultry expenditure share has increased almost threefold in rural China and by about four times in urban areas over the 1980-2000 period. Second, beef and dairy products expenditure shares in urban regions have also increased dramatically, although their current expenditure shares remain low. These two expenditure shares also increased markedly in rural China.

Apparent differences in livestock product consumption levels and consumer preferences can also be observed across regions. First, rural households from the south average a very high pork consumption level (about 24 kg) while those from western regions have a much lower pork consumption level (less than 6 kg) on average over1998-2000.[2] In contrast, beef consumption levels between the south and west demonstrate a completely opposite scenario. For example, rural households from the west (e.g., Neimeng, Qinghai, Ningxia, Xinjiang and Tibet) consumed almost 3 kg beef per capita, while those from the south only consumed less than one kg beef per capita on average over1998-2000. In addition, there are obvious differences in livestock products consumption patterns between urban and rural economies. Generally urban households consumed larger portions of beef and dairy products, but rural households consumed a larger portion of pork. These differences can also be observed across regions (see data section).

## 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 literature on China's household demand has employed this methodology (Huang and David, 1993; Fan *et al*., 1994 and 1995; Wu *et al*., 1995; Gao *et al*., 1996; 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 livestock product demand elasticities for urban and rural households in China. The basic share equation for the AIDS model is defined as:

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

where $w_i$ is the expenditure share of livestock commodity *i*, $p_j$ is the price of livestock commodity *i*; *X* is the total expenditure within the 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:

(2) $$\ln P = \sum_i w_i \ln p_i$$

The resulting model is referred to as the linear approximate almost ideal demand system (LA/AIDS), which can be estimated using Zellner's Iterative Seemingly Unrelated Regression (ITSUR) procedure (Halbrendt *et al.*, 1994; Fan *et al*., 1995; Cai *et al*., 1998). The adding up, homogeneity and symmetry restrictions were imposed (and one share equation was dropped from the system for estimation). The expenditure elasticities ($\eta_i$) and uncompensated price elasticities ($e_{ij}$) in the LA/AIDS model are given by:

(3) $$\eta_i = 1 + \frac{\beta_i}{w_i}$$

(4) $$e_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i w_j}{w_i}$$

where $\delta_{ij}$ is equal to one when *i* = *j*, and is equal to zero otherwise.

Halbrendt *et al*. (1994) and Heien and Pompelli (1988) extended the AIDS model by including socioeconomic and other demographic variables. However, it may be easier and simpler to directly incorporate regional dummy variables ($D_k$) to identify differences in livestock products consumption behavior across regions since regional differences in consumption tastes are larger than differences in household preferences within the same region (Fan *et al*., 1995). Hence this study used regional dummy variables to capture regional effects (and also to correct for heteroskedasticity). We simply defined both intercepts ($\alpha_i$) and the expenditure coefficients ($\beta_i$) as linear functions of the regional dummy variables, assuming that income elasticities differ across regions. In addition, we allow for structural change in the demand system over time. Cai *et al*. (1998) did not assume that meat consumption behavior for urban households changed over time, and Fan *et al*. (1995) did not test whether food expenditure for rural households changed significantly over time (note that though they used a dynamic AIDS model in their estimation, all demands for their commodity groups changed significantly over time except for food). We question acceptance of the hypothesis that livestock products consumption patterns did not change at all during the past two decades in China. Thus this study also assumed that the parameter $\beta_i$ is a function of a dummy variable ($T_{90s}$), which equals 1 in the 1990s and 0 in the 1980s to test for structural change in livestock products consumption. Hence the final model can be defined as:

(5) $$w_i = (\alpha_{i0} + \alpha_{i1} D_k) + \sum_j \gamma_{ij} \ln p_j + (\beta_{i0} + \beta_{i1} T_{90s} + \beta_{i2} D_k) \ln(X / P)$$

Therefore the average expenditure elasticities and uncompensated price elasticities in the 1990s can be calculated as:

(6) $$\eta_i = 1 + \frac{(\beta_{i0} + \beta_{i1} T_{90s} + \beta_{i2} D_k)}{w_i}$$

$$(7) \qquad e_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{(\beta_{i0} + \beta_{i1} T_{90s} + \beta_{i2} D_k) w_j}{w_i}$$

## 4. Data

The per capita livestock products consumption data has traditionally come from Household Income and Expenditure Surveys (HIES) that were started in 1955, suspended during the Cultural Revolution and continued in 1978. Since then, the survey sample sizes for both urban and rural households have increased each year. By the late-1990s, HIES samples, on average, include 37,700 urban households and 67,670 rural households. This study uses pooled time-series and cross-section data for urban and rural households, including 28 provinces (autonomous regions or municipalities), covering the period 1980 to 2000.Two provinces (Hainan and Chongqing) were excluded due to incomplete data.

Unlike other studies, this paper did not directly use the HIES data, since it is well known to include only at-home consumption and hence unable to represent the total levels of livestock products consumption for both urban and rural households. Especially since the 1990s, when consumers spent increasingly in restaurants, the proportion of livestock products consumed out of the home has increased. Thus this analysis uses adjusted meat consumption data sets that include not only at-home but also away-from-home meat consumption[3]. Further consumption adjustments were made as described in Ma et al. (2002).

Price series from 1990 to 2000 were generated from the database of the National Price Bureau of China (NPB). The NPB gathers price data for major urban free markets each ten days and then takes an average of them as the monthly price. The prices we obtained from the NPB database are monthly price data from 1990 to 2000. Being consistent with the HIES's data, we simply took the average of the 12 monthly prices within each year to generate an

annual price series. Since free market retail price data is not available from the NPB's database, an implicit price series for fresh milk was completely derived from the purchased quantity and total expenditure data.

Since market retail price data are not available before 1990, implicit price data sets for individual livestock commodities were derived from the purchased quantity and total expenditure data. This switching of price series generation was not expected to cause serious problems because state-controlled prices did not vary much across regions in most of the 1980s (Fan *et al.,* 1995). Nevertheless, we also estimated demand models separately for the 1980s and the 1990s to test the effect of switching price series generation on the estimated parameters. Expenditure data series for each of the livestock commodities studied were generated by multiplying together the price series and the household per capita livestock products consumption series that included both at- home and out-of-home consumption. For dairy products, households consumed not only fresh milk but also milk powder. Since price data for milk powder were not available, we used the sum of fresh milk and milk powder expenditures from HIES to generate an expenditure share for dairy products, while we retained the fresh milk price in the demand system.[4]

Aggregated cell means of the provincial households were used rather than individual household observations. Aggregation bias may occur with such group data, but regional differences in tastes across China are larger than differences in household preferences within the same region (Fan *et al*., 1995).[5] Finally, the rural expenditure system excluded the milk product equation because of the minimal expenditure share of this item.

## 5. Results

The estimated parameters for both urban and rural household models are presented in Table 3. Apart from a few cross-price parameters, all own-price and expenditure coefficients as well as most of the cross-price coefficients are significantly different from zero at the 5 percent level. As expected, all own-price coefficients are negative and the hypothesis that meat consumption pattern changed from the 1980s to the 1990s is accepted statistically.[6] Most of the regional dummy variables are also significant, indicating that livestock products consumption patterns varied across regions due to social and economic factors (the coefficients of regional dummy variables are not shown in the table).

All coefficients of the $T_{90s}$ dummy variable, except for urban pork and rural eggs, are significant at the 5 percent level, indicating that livestock product consumption patterns changed in the 1990s due to the shifting consumer preference and rapid income growth (Table 3). For urban households, the expenditure share for egg consumption significantly declined, from an average of nearly 26 percent in the 1980s to 18 percent in the 1990s, and the urban pork expenditure share also shows a declining trend although not significant. The urban expenditure shares for the remaining products displayed a rising trend. However, while they were significantly reducing their pork consumption share, rural households were increasing their consumption shares for beef, chicken, egg and mutton. In addition, these differences in meat consumption pattern can also be observed across regions.

The urban and rural expenditure elasticities for the 1980s and the 1990s are calculated to illustrate the change in these elasticities over the last two decades, but expenditure shares, the marginal expenditure shares and own-price elasticities are estimated using average data for

the 1990s since they are more relevant to forward-looking applications (Table 4). Focusing first on urban consumption in the 1990s, most estimates of expenditure elasticities for livestock products are greater than one, meaning that most of these products are still luxury goods for Chinese urban households. However, the estimate of expenditure elasticity for pork is less than one (0.66 in the 1990s), indicating that pork has become a necessary good for urban households. Although the estimates of expenditure elasticities for other products are rather similar, the expenditure elasticity for dairy products is the highest (1.49). These estimates can be compared with those from the recent study by Cai *et al*. (1998). They reported estimates of expenditure elasticities for ruminant meat ranging from 1.10 for low urban income groups to 1.76 for medium urban income groups, for pork from 0.61 for low urban income groups to 0.71 for high urban income groups, and for poultry from 0.54 for medium urban income groups to 1.39 for low urban income groups. Our estimates of expenditure elasticities for pork and ruminant meats are generally consistent with those of Cai *et al.*, but our expenditure elasticity for poultry (1.41) is greater than theirs. In addition, compared with those estimated by Gao *et al*. (0.25 for pork, 0.49 for beef, 0.73 for poultry and 0.75 for eggs), our estimates are even higher. This may be due to the fact that our data included not only meat consumed at home but also the meat consumed out of the home.

We also found significant differences in meat expenditure elasticities across regions. For example, in most costal regions (e.g., Shanghai, Jiangsu, Zhejiang, Fujian, Shandong) and southwest regions (e.g., Sichuan and Guizhou), expenditure elasticities for beef in urban China are more than 1.5, and in most southern regions (e.g., Guangdong, Guangxi, Guizhou and Yunnan), the estimated expenditure elasticities for milk equivalent are nearly 2.0

(Appendix 1).

The estimated expenditure elasticities for rural meat consumption demonstrate a similar pattern even considering the fact that there are obvious differences in many respects between urban and rural economies, in particular in income levels. There are two apparent differences in the estimates of expenditure elasticities between urban and rural consumption. First, besides pork consumption, it seems that mutton consumption has also become a necessary good for rural households even though its elasticity increased from 0.45 in the 1980s to 0.75 in the 1990s. Second, all estimated urban expenditure elasticities (except for eggs) show a declining trend over time, while most of those estimated from rural data (except for pork and chicken) show a slightly rising trend. For example, the expenditure elasticity for beef rose from 1.085 in the 1980s to 1.121 in the 1990s; the expenditure elasticity for mutton rose even more, from 0.454 in the 1980s to 0.749 in the 1990s. Since very few studies (except for Lewis and Andrew, 1989) have reported their expenditure elasticities for rural households, we only compare ours with theirs. Obviously, our estimate of expenditure elasticity for pork is lower than theirs (1.95) while our estimate for poultry is higher (theirs was 1.02). This is most likely because of the long time interval between these two studies, which can contribute to major changes in income levels and consumer preferences.

To calculate the marginal expenditure shares from our estimated expenditure elasticities, we multiply the estimated expenditure elasticities by the expenditure shares (Halbrendt *et al*., 1994). The results (Table 4) suggest that future livestock products consumption patterns will continue to change. For example, for any increase in future urban livestock products expenditure, the largest share of that increase will be still allocated to pork consumption (34.6

percent). Although current urban beef and diary product expenditure shares are smaller, future expenditure allocated to those two commodities will substantially increase as their marginal shares are well above their current average expenditure shares. The average expenditure shares for urban poultry product consumption (chicken and eggs) will also increase significantly. In contrast, the average expenditure share for pork consumption will decline considerably, since the marginal share of 35 percent is considerably less than its current expenditure share. The rural marginal share estimates suggest increasing expenditure shares of poultry products at the expense of pork consumption. All own-price elasticities have the expected signs (negative), but the absolute magnitudes vary substantially (Table 4). For urban consumption, the highest own-price elasticity is -0.82 for chicken and the second highest is around -0.45 for pork, dairy products and eggs. The estimated results show that ruminant meats (beef and mutton) have the lowest own-price elasticities (below -0.13), which may be partly due to their minimal expenditure shares (which may lead to unstable own-price elasticities). In fact, we found that demand of beef and mutton was very price elastic in the regions where the expenditure shares of beef and mutton are quite high, while they are price inelastic in those regions where the expenditure shares are very low. For example, in some regions[7] where urban beef expenditure shares are over 10 percent of total livestock product expenditures, the beef own-price elasticity is very high, ranging from 0.35 to 0.95. On the other hand, in some other regions[8] where urban beef expenditure shares are extremely low (below 3 percent), their beef demand is price inelastic and may even have a positive sign (Appendix 2). The estimated own-price elasticities for rural livestock products consumption show the same patterns except for the observation that almost all estimated own-price

elasticities are slightly higher than those for urban households with the exception of chicken.

## 5. Conclusions

Chinese livestock products consumption behavior 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. Six livestock product expenditure share equations were estimated with an extended 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 livestock products, but consumption patterns have changed in the 1990s. A large percentage of household livestock product expenditure is still spent on pork, however, the shares for beef, dairy products and poultry consumption will increase substantially. As a consequence pork demand, that used to dominate the Chinese meat diet, will be reduced as incomes grow and diet preferences change in both urban and rural households.

Second, there are significant differences in livestock product consumption preferences across provinces of China. As a result, studies that omit regional dummy variables in their demand systems can produce different expenditure and price parameters and which should be interpreted with caution.

Third, few studies have reported cross-price demand elasticities for livestock products because of unexpected signs (e.g., Cai *et al*., 1998). Likewise, we found that some cross-price elasticities had unexpected negative signs. This is most likely caused by the minimal shares of some livestock products. An implication is that when relative price changes, there is little substitution except between beef and mutton. We also found that most cross-price elasticities

are nearly zero except for those involving the major meat in consumption, pork. The continuing increases in consumption of most livestock products in China, changing consumer preferences and apparent differences in meat consumption across regions, along with changes to China's border policies as a result of recent WTO accession, will have important implications for livestock product markets in China. Further study of such changes will be vital for future predictions of domestic livestock product supply, feed grain demand and supply, and China's trade in these commodities with the rest of the world.

**References**

Brown, L.R. “Who Will Feed China? 1995, Wake-Up Call For A Small Planet.” The World Watch Environmental Alert Series. First Edition, Published by World Watch Institute.

Cai, H., Brown, C., Wan G. and Longworth, J. 1998, “Income Strata and Meat Demand in Urban China.” *Australian Agribusiness Review.* 6.

Deaton, A. and Muellbauer, J. 1980, “An Almost Ideal Demand System.” *American Economic Review.* 70(June):312-326.

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.* 77(Feb.):54-62.

Fan, S., Cramer, G. and Wailes, E. 1994, “Food Demand in Rural China: Evidence from Rural Household Survey.” *Agricultural Economics.* 11 (Sep.): 61-69.

Fuller, F., Hayes, D. and Smith D. 2000, “Reconciling Chinese Meat Production And Consumption Data.” *Economic Development and Cultural Change*. 49(Oct.): 23-43.

Gao, X. M., Wailes, E.J. and Cramer, G..L. 1996, “A Two-Stage Rural Household Demand Analysis: Microdata Evidence from Jiangsu Province, China.” *American Journal of Agricultural Economics.* 78(Aug.):604-613.

Halbrendt, C., Tuan, F., Gempesaw, C. and Dolk-Etz, D. 1994, “Rural Chinese Food Consumption: The Case of Guangdong.” *American Journal of Agricultural Economics.* 76 (Nov.):794-799.

Han, T. and Wahl, T.I. 1998, “China’s Rural Household Demand for Fruits and Vegetables.” *Journal of Agricultural and Applied Economics.* 30 (July): 141-150.

Han, T. and Wahl, T.I. 1998, “China’s Rural Household Demand for Fruits and Vegetables.” *Journal of Agricultural and Applied Economics.* 30(July):141-150.

Houthakker, H. S. 1957, “An International Comparative of Household Expenditure Patterns, Commemorating the Centenary of Engel’s Law.” *Econometrica.* 59: 141-8.

Huang, J. and David, C.C. 1993, “Demand for Cereal Grains in Asia: the Effect of Urbanization.” *Agricultural Economics.* 8:107-124.

Huang, J. and Bouis, H. 2001, “Structural Changes and Demand for Food in Asia: Empirical Evidence from Taiwan.” *Agricultural Economics.* 26:57-69.

Huang, J. and Rozelle, S. 1998, “Market development and food demand in rural China”, *China Economic Review*, Vol. 9, No. 1, pages 25-45.

Huang, J. and Rozelle, S. 1998, “Market development and food demand in rural China.” *China Economic Review.* 9:25-45.

Jacques Van der Gaag, J. 1984, “private household consumption in China: a study of people’s livelihood.” Washington DC: World Bank Staff Working Paper. No.701.

Lewis, P. and Andrews, N. 1989, “Household Demand In China.” *Applied Economics.* 21:793-807.

Ma, H., Huang, J. and Rozelle, S. 2002, “Reassessing China's Livestock Statistics: Analyzing the Discrepancies and Creating New Data Series.” Center For Chinese Agricultural Policy, Chinese Academy of Sciences and Department of Agricultural and Resource Economics, University of California, Davis. Working Paper.

Rae, A.N. and Hertel, T. 2000, “Future developments in global livestock and grains markets: the impacts of livestock productivity convergence in Asia/Pacific”. *Australian Journal of Agricultural and Resource Economics.* 44:393-423.

Rae, A.N. 1998, “The Effects of Expenditure Growth and Urbanization on Food Consumption in East Asia: A Note on Animal Products.” *Agricultural Economics.* 18:291-299.

Wan, G.. H. 1996, “Income Elasticities of Household Demand in Rural China: Estimates from Cross-sectional Survey Data.” *Journal of Economic Studies.* 23:18-33.

Wu, Y., Li, E. and Samual, S.N.. 1995, “Food Consumption in Urban China: an Empirical Analysis.” *Applied Economics.* 27:509-515.

**Table 1** Changing Food Consumption Patterns in Urban and Rural China, 1980-2000

| Year | Food Expenditure (yuan) | Food Share in Total Expenditure (%) | Livestock Product Expenditure (yuan) | Livestock Share in Food Expenditure (%) |
|---|---|---|---|---|
| Urban Households: | | | | |
| 1980 | 241 | 58 | 51 | 21 |
| 1985 | 352 | 52 | 86 | 25 |
| 1990 | 694 | 54 | 211 | 30 |
| 1995 | 1766 | 50 | 564 | 32 |
| 1998 | 1927 | 44 | 659 | 34 |
| 1999 | 1932 | 42 | 635 | 33 |
| 2000 | 2009 | 42 | 627 | 31 |
| Rural Households: | | | | |
| 1980 | 110 | 62 | 18 | 16 |
| 1985 | 183 | 58 | 40 | 22 |
| 1990 | 295 | 55 | 90 | 30 |
| 1995 | 768 | 59 | 238 | 31 |
| 1998 | 850 | 53 | 315 | 37 |
| 1999 | 829 | 53 | 286 | 35 |
| 2000 | 862 | 53 | 299 | 35 |

Source: Food (and also total) expenditure data come from China Statistical Yearbook and livestock product expenditure was calculated based on adjusted per capita consumption series for both urban and rural economies (for detail, referring to Ma et al., 2002) and prices stated in a previous section. Since the aim is to show only the structure of food consumption, expenditure data was measured in nominal terms.

**Table 2** Changing Livestock Product Expenditure Patterns in Urban and Rural China, 1980-2000

| Year | Pork | Beef | Mutton | Poultry | Eggs | Dairy Products |
|---|---|---|---|---|---|---|
| | | | Percent | | | |
| Urban Households: | | | | | | |
| 1980 | 65.5 | 1.7 | 3.6 | 4.3 | 23.3 | 1.5 |
| 1985 | 56.1 | 4.1 | 4.7 | 4.8 | 27.0 | 3.4 |
| 1990 | 51.2 | 5.7 | 4.9 | 7.2 | 27.3 | 3.7 |
| 1995 | 54.7 | 7.5 | 5.2 | 11.7 | 17.8 | 3.1 |
| 1998 | 55.3 | 6.3 | 4.4 | 14.1 | 15.9 | 3.9 |
| 1999 | 53.5 | 6.9 | 3.6 | 16.4 | 14.7 | 4.9 |
| 2000 | 53.3 | 6.4 | 4.8 | 16.6 | 13.0 | 6.0 |
| Rural Households: | | | | | | |
| 1980 | 74.1 | 1.6 | 2.3 | 5.2 | 16.4 | 0.3 |
| 1985 | 71.3 | 2.3 | 2.1 | 4.4 | 19.4 | 0.5 |
| 1990 | 64.7 | 3.0 | 2.6 | 5.3 | 23.8 | 0.6 |
| 1995 | 64.7 | 3.4 | 4.4 | 9.6 | 17.5 | 0.5 |
| 1998 | 65.2 | 2.9 | 4.9 | 11.0 | 15.3 | 0.6 |
| 1999 | 61.7 | 3.3 | 5.7 | 13.3 | 15.2 | 0.7 |
| 2000 | 65.0 | 2.8 | 4.5 | 13.5 | 13.5 | 0.6 |

Source: Livestock product expenditures were based on adjusted per capita consumption series for both urban and rural economies (for detail, see Ma et al., 2002) and prices as discussed in a previous section. Expenditures were measured in nominal terms.
Note: Dairy products are measured in milk equivalents.

**Table 3** Estimated Parameters of LA/AIDS model for Livestock Product Consumption in China

| Commodity | $\gamma_{i1}$ | $\gamma_{i2}$ | $\gamma_{i3}$ | $\gamma_{i4}$ | $\gamma_{i5}$ | $\gamma_{i6}$ | $\beta_{i0}$ | $\beta_{i1}T_{90s}$ |
|---|---|---|---|---|---|---|---|---|
| Urban Households: | | | | | | | | |
| Pork | 0.1981 | -0.0316 | 0.0032 | -0.0373 | -0.0937 | -0.0387 | -0.1788 | -0.0001 |
| | (24.09) [a] | （10.00） | (0.70) | (7.84) | (16.89) | (10.88) | (15.75) | (0.05) |
| Beef | -0.0316 | 0.0601 | -0.0200 | 0.0005 | -0.0221 | 0.0131 | 0.0255 | 0.0023 |
| | (10.00) | (15.68) | (5.98) | (0.23) | (7.72) | (4.47) | (4.96) | (2.29) |
| Dairy | 0.0032 | -0.0200 | 0.0364 | 0.0035 | -0.0037 | -0.0195 | 0.0303 | 0.0021 |
| Products | (0.70) | (5.98) | (6.35) | (1.02) | (0.89) | (5.99) | (3.85) | (2.70) |
| Chicken | -0.0373 | 0.0005 | 0.0035 | 0.0271 | 0.0073 | -0.0012 | 0.0479 | 0.0033 |
| | (7.84) | (0.23) | (1.02) | (5.56) | (1.80) | (0.46) | (5.56) | (3.46) |
| Eggs | -0.0937 | -0.0221 | -0.0037 | 0.0073 | 0.1096 | 0.0027 | 0.0625 | -0.0049 |
| | (16.89) | (7.72) | (0.89) | (1.18) | (16.98) | (0.88) | (5.94) | (4.54) |
| Mutton [b] | -0.0387 | 0.0131 | -0.0195 | -0.0012 | 0.0027 | 0.0435 | 0.0126 | -0.0001 |
| | (10.68) | (4.48) | (6.16) | (0.43) | (0.86) | (11.14) | (2.12) | (4.26) |
| Rural Households: | | | | | | | | |
| Pork | 0.2042 | -0.0320 | -0.0364 | -0.0368 | -0.0990 | - [c] | -0.1462 | -0.0151 |
| | (20.46) | (9.36) | (7.80) | (7.96) | (14.66) | | (12.65) | (8.00) |
| Beef | -0.0320 | 0.0268 | 0.0028 | 0.0056 | -0.0031 | - | 0.0020 | 0.0034 |
| | (9.36) | (7.62) | (0.91) | (2.46) | (1.11) | | (3.45) | (5.21) |
| Mutton | -0.0364 | 0.0028 | 0.0367 | -0.0007 | -0.0025 | - | -0.0123 | 0.0030 |
| | (7.80) | (0.91) | (8.16) | (0.23) | (0.63) | | (1.98) | (3.25) |
| Chicken | -0.0368 | 0.0056 | -0.0007 | 0.0244 | 0.0075 | - | 0.0335 | 0.0084 |
| | (7.96) | (2.46) | (0.23) | (6.11) | (1.97) | | (5.52) | (8.88) |
| Eggs [b] | -0.0990 | -0.0031 | -0.0025 | 0.0075 | 0.0971 | - | 0.1230 | 0.0003 |
| | (14.75) | (1.13) | (0.62) | (1.97) | (12.75) | | (11.67) | (0.17) |

Note: Run with constant term and provincial dummy variables but not reported. Wald $\chi^2$ statistics are 37.03 and 113.76 for urban and rural households, significant at the 1% level.

[a] t-statistics are given in parentheses.

[b] Derived from imposed restrictions.

[c] Since the shares of dairy product consumption for rural households are minimal, this commodity was excluded from the rural parameter estimation to improve parameter stability.

**Table 4** Expenditure Elasticity, Expenditure Share, Marginal Expenditure Share and Own Price Elasticity for Urban and Rural Household Livestock Product Consumption

| Commodity | Expenditure Elasticity | | Expenditure Share 1990s | Marginal Expenditure Share | Own-Price Elasticity |
|---|---|---|---|---|---|
| | 1980s | 1990s | | | |
| Urban Households | | | | | |
| Pork | 0.6821 | 0.6594 | 0.5251 | 0.3462 | -0.4439 |
| Beef | 1.6837 | 1.4114 | 0.0648 | 0.0915 | -0.0996 |
| Dairy products | 1.5889 | 1.4880 | 0.0643 | 0.0957 | -0.4649 |
| Chicken | 1.9542 | 1.4119 | 0.1203 | 0.1698 | -0.8240 |
| Eggs | 1.2447 | 1.3338 | 0.1800 | 0.2401 | -0.4513 |
| Mutton | 1.2929 | 1.2463 | 0.0455 | 0.0567 | -0.0547 |
| Total | - | - | 1.0000 | 1.0000 | - |
| Rural Households | | | | | |
| Pork | 0.7954 | 0.7644 | 0.6528 | 0.4990 | -0.5334 |
| Beef | 1.0854 | 1.1212 | 0.0302 | 0.0339 | -0.1168 |
| Mutton | 0.4542 | 0.7491 | 0.0431 | 0.0323 | -0.1367 |
| Chicken | 1.6941 | 1.3887 | 0.0971 | 0.1348 | -0.7863 |
| Eggs | 1.6425 | 1.6967 | 0.1768 | 0.3000 | -0.5741 |
| Total | - | - | 1.0000 | 1.0000 | - |

Note: Marginal expenditure and own-price elasticities were estimated at the 1990s data means.

**Appendix 1** Estimated Expenditure Elasticities for Each Livestock Product and Each Province in the 1990s

| Province | Urban Households | | | | | | Rural Households | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pork | Beef | Dairy [a] | Poultry | Eggs | Mutton | Pork | Beef | Mutton | Poultry | Eggs |
| Beijing | - | 1.322 | - | 1.434 | 1.323 | - | - | 1.078 | - | - | 1.534 |
| Tianjin | 0.584 | 1.364 | - | 1.676 | 1.269 | - | 0.713 | 1.094 | - | 2.050 | 1.431 |
| Hebei | 0.623 | 1.372 | - | 2.225 | 1.247 | 1.128 | - | - | 0.516 | 2.314 | 1.456 |
| Shanxi | 0.610 | - | 1.373 | 2.285 | 1.232 | - | 0.719 | 1.081 | 0.890 | - | 1.500 |
| Mongolia | - | 1.243 | 1.428 | 1.804 | 1.375 | - | 0.509 | 1.041 | 0.989 | - | 1.500 |
| Liaoning | 0.574 | 1.238 | - | - | - | - | - | - | - | - | - |
| Jilin | 0.659 | - | - | 1.674 | 1.315 | - | - | 1.132 | - | - | 1.473 |
| Heilongjiang | 0.594 | - | - | - | - | - | 0.718 | - | - | 1.462 | - |
| Shanghai | 0.558 | 1.780 | - | 1.211 | 1.398 | 1.248 | 0.602 | - | 0.773 | 1.163 | 1.404 |
| Jiangsu | - | 2.002 | - | - | - | - | 0.726 | - | - | 1.320 | - |
| Zhejiang | 0.691 | 1.630 | - | - | - | - | 0.748 | - | - | - | 1.730 |
| Anhui | 0.605 | - | 1.659 | 1.259 | 1.279 | - | 0.748 | - | 0.853 | - | - |
| Fujian | - | 1.575 | - | - | - | - | 0.684 | - | - | 1.152 | 1.755 |
| Jiangxi | 0.742 | - | - | 1.386 | 1.664 | - | 0.79 | - | - | 1.284 | 1.926 |
| Shandong | 0.687 | - | - | - | - | - | - | - | 0.342 | - | 1.392 |
| Henan | 0.580 | 1.304 | - | - | - | - | - | -1.103 | - | 1.712 | 1.359 |
| Hubei | 0.681 | 1.357 | - | - | 1.335 | - | 0.731 | - | - | 1.249 | 1.454 |
| Hunan | - | - | - | - | - | - | 0.786 | 1.159 | - | 1.267 | 1.966 |
| Guangdong | - | 1.410 | - | - | 1.805 | - | - | - | - | 1.123 | - |
| Guangxi | 0.667 | - | - | - | 1.635 | - | 0.792 | 1.128 | - | 1.185 | 3.757 |
| Sichuan | 0.664 | 1.521 | - | 1.257 | 1.494 | - | - | 1.311 | - | 1.381 | 2.312 |
| Guizhou | 0.737 | 1.876 | 1.810 | - | 1.509 | 1.538 | 0.834 | 1.489 | -0.647 | 1.864 | - |
| Yunnan | - | 1.430 | 1.788 | 1.413 | 1.631 | 1.349 | 0.808 | - | - | 1.325 | 2.752 |
| Tibet | - | 1.203 | 1.146 | - | 1.513 | 1.108 | 0.709 | 1.002 | 0.932 | 5.308 | - |
| Shaanxi | 0.668 | - | 1.423 | 1.670 | 1.317 | 1.145 | 0.702 | 1.062 | - | - | 1.399 |
| Gansu | 0.632 | - | - | - | - | - | 0.783 | - | 0.661 | - | - |
| Qinghai | 0.543 | 1.159 | - | - | 1.486 | 1.080 | 0.631 | 1.038 | 0.981 | 3.060 | - |
| Ningxia | 0.553 | 1.262 | 1.557 | - | 1.465 | - | 0.722 | 1.081 | - | - | - |
| Xinjiang | 0.305 | 1.197 | 1.435 | 1.556 | - | 1.042 | 0.651 | 0.982 | - | - | - |

Note: To clearly show the difference in demand for each livestock product across regions, this table only keeps those regions whose estimates are significant from national average.

[a] Including fresh milk and milk product consumption (e.g., milk powder and cheese).

**Appendix 2** Estimated Own-Price Elasticities for Each Livestock Product and Each Province in the 1990s

| Province | Urban Households | | | | | | Rural Households | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pork | Beef | Dairy [a] | Poultry | Eggs | Mutton | Pork | Beef | Mutton | Poultry | Eggs |
| Beijing | - | -0.320 | - | -0.817 | -0.457 | - | - | -0.641 | - | - | -0.539 |
| Tianjin | -0.357 | -0.230 | - | -0.673 | -0.561 | - | -0.597 | -0.487 | - | -0.320 | -0.634 |
| Hebei | -0.406 | -0.222 | - | -0.357 | -0.625 | -0.489 | - | - | 0.493 | -0.146 | -0.612 |
| Shanxi | -0.398 | - | -0.613 | - | -0.656 | - | -0.605 | -0.562 | -0.672 | - | -0.582 |
| Mongolia | - | -0.429 | -0.550 | - | -0.385 | - | -0.334 | -0.805 | -0.876 | - | -0.555 |
| Liaoning | -0.355 | -0.532 | - | - | - | - | - | - | - | - | - |
| Jilin | -0.448 | - | - | - | -0.498 | - | - | -0.212 | - | - | -0.598 |
| Heilongjiang | -0.376 | - | - | -0.721 | - | - | -0.621 | - | - | -0.743 | - |
| Shanghai | -0.326 | - | - | - | -0.306 | -0.128 | -0.454 | - | -0.144 | -0.920 | -0.645 |
| Jiangsu | - | - | - | - | - | - | -0.625 | - | - | -0.820 | - |
| Zhejiang | -0.473 | - | - | -0.890 | - | - | -0.632 | - | - | - | -0.378 |
| Anhui | -0.388 | - | -0.285 | -0.905 | -0.569 | - | -0.643 | - | -0.390 | - | - |
| Fujian | - | 0.299 | - | - | - | - | -0.562 | - | - | -0.930 | -0.367 |
| Jiangxi | -0.532 | - | - | -0.832 | 0.175 | - | -0.685 | - | - | -0.822 | -0.225 |
| Shandong | -0.471 | - | - | - | - | 0.085 | - | - | - | - | -0.661 |
| Henan | -0.361 | -0.365 | - | - | - | - | - | -0.431 | - | - | -0.688 |
| Hubei | -0.464 | -0.243 | - | - | -0.415 | - | -0.601 | - | - | -0.854 | -0.595 |
| Hunan | - | - | - | - | - | - | -0.680 | 0.343 | - | -0.840 | -0.190 |
| Guangdong | - | -0.082 | - | - | 0.374 | - | - | - | - | -0.942 | - |
| Guangxi | -0.460 | - | - | - | 0.031 | - | -0.688 | 0.308 | - | -0.895 | - |
| Sichuan | -0.450 | 0.189 | - | -0.918 | -0.140 | - | - | - | - | -0.779 | 0.079 |
| Guizhou | -0.529 | - | -0.116 | - | - | - | -0.744 | - | - | -0.432 | - |
| Yunnan | - | -0.029 | -0.055 | -0.830 | 0.055 | 0.444 | -0.711 | - | - | -0.796 | 0.414 |
| Tibet | - | -0.556 | -0.883 | - | -0.108 | **-0.502** | -0.560 | -0.905 | -0.865 | - | - |
| Shaanxi | -0.436 | - | -0.510 | - | -0.453 | **-0.420** | -0.568 | -0.631 | - | - | -0.645 |
| Gansu | -0.410 | - | - | - | - | - | -0.689 | - | -0.028 | - | - |
| Qinghai | -0.321 | -0.685 | - | - | -0.146 | **-0.773** | -0.499 | -0.925 | -0.873 | 0.362 | - |
| Ningxia | -0.334 | -0.488 | -0.399 | - | -0.197 | - | -0.608 | -0.710 | - | - | - |
| Xinjiang | -0.068 | -0.570 | -0.512 | -0.751 | - | **-0.885** | -0.488 | -0.845 | - | - | - |

Note: To clearly show the difference in demand for each livestock product across regions, this table only keeps those regions whose estimates are significant from national average.

[a] Including fresh milk and milk product consumption (e.g., milk powder and cheese).

[1] In 1998, the Center for Chinese Agricultural Policy, Chinese Academy of Agricultural Sciences and the Department of Agricultural and Resource Economics, University of California in Davis conducted a household field survey. They found that the portion of pork consumed away from home was nearly 20 percent and the portions for beef and mutton were even higher (25 and 39 percent, respectively).

[2] The South includes Yunnan, Guizhou, Sichuan, Guangdong, Guangxi, and Hunan, and the West includes Shaanxi, Gansu, Qinghai, Ningxia Xinjiang, Neimeng and Shanxi.

[3] This data collection commenced in 1997 and involved the Center for Chinese Agricultural Policy of Chinese Academy of Agricultural Sciences (CCAP), the Center for Agricultural and Rural Development, Iowa State University (CARD), and Department of Agricultural and Resource Economics, University of California in Davis (UCD).

[4] Unlike other meat consumption, fresh milk and milk powder was less likely to be consumed out of the home. In fact, based on CCAP's field survey, the portion of dairy products consumed out of the home was less than 5 percent for urban households by 2000 and this proportion was almost zero for rural households. So in this paper, we directly used HIES's data in generating dairy products expenditure share.

[5] As stated earlier, for example, most people from western regions consume more ruminant meat, but they consume less pork. Those from the south and southeast, however, consume more pork meat, but they consumed less ruminant meat.

[6] Wald statistics were employed to test whether or not the expenditure structure changed between the 1980s and the 1990s. These two Wald statistics were 37.03 and 113.76 for urban and rural economies respectively.

[7] Such as Liaoning, Jilin, Heilongjiang, Inner Mongolia, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang and Tibet

[8] Such as Shanghai, Jiangsu, Shandong and Guizhou.