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ELSEVIER

Agricultural Economics 18 (1998) 291–299

AGRICULTURAL ECONOMICS

The effects of expenditure growth and urbanisation on food consumption in East Asia: a note on animal products

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Accepted 11 November 1997

Abstract

Consumption functions for total animal-derived food products were estimated for six East Asian countries. Incorporation of urbanisation was found to make a significant contribution to the functions. The urbanisation elasticities were always positive, indicating that the process of urbanisation had a positive effect on the demand for animal food products. The expenditure elasticities were also positive, but often less than they would be if estimated from consumption functions that excluded the effects of urbanisation. Thus, projections of consumption that ignore the influence of urbanisation may be biased. © 1998 Elsevier Science B.V. All rights reserved.

Keywords: Consumption; Animal products; East Asia; Elasticities; Urbanisation

1. Introduction

While cereal grains still contribute the bulk of the calorie intake in Asian diets, the rapid development of the region is encouraging a shift from these foods to higher value and higher protein foods such as those derived from livestock and fish. Government programmes to promote the domestic production of livestock products have in some instances achieved near self sufficiency, have encouraged rapid growth in imports of feedgrains into Asia, but have also resulted in mixed incentives to producers (Rae, 1992; Rae et al., 1992; Rae and Kasryno, 1993). The future demand for animal products is thus an important concern for policy makers because of its impacts on self-sufficiency, food prices and a nation's trade balance.

Although previous studies have used cross-section data to examine the nature of the demand for animal products within urban-based populations (for example, Teklu and Johnson, 1988) and made comparisons with rural demand (Burney and Akmal, 1991), the issue of how the process of urbanisation impacts on that demand seems to have attracted less attention. Huang and David (1993) attempted to redress this imbalance in this journal with their study of the effects of urbanisation on cereals demands. They estimated an almost-ideal demand system for three food grains in a number of Asian countries, where some of the parameters of the demand system were influenced by the urbanisation process, and concluded that omission of urbanisation from their models provided biased estimates of income effects. Huang and Bouis (1996)

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PII S0169-5150(97)00051-0

looked to household survey evidence from China and Taiwan to illustrate that changes in tastes and lifestyles engendered by urban living provided significant influences on food demand, and also concluded that estimated consumption responses to changes in incomes would be biased should urbanisation effects be ignored.

Food demand patterns are known to change as a country's level of economic development changes (Mitchell and Ingco, 1993). The trend is towards declining consumption of traditional staples (rice and root crops) and increasing consumption of other foods. The latter initially involves increased consumption of nontraditional cereals (wheat products) followed by increased consumption of high-protein foods such as animal products. Since economic development is usually characterised by migration to urban areas as well as higher incomes, these trends accompany the shifting pattern of food consumption. For example, Huang and David (1993) concluded that urbanisation had significantly reduced demand for cereal grains in high income countries such as Japan and Korea, but had consistently increased the demand for wheat. We hypothesise that urbanisation has also had a positive impact on the demand for animal-derived food products.

2. The consumption of animal food products in Asia

Six Asian economies have been chosen for this study. The per capita consumption levels of animal products[1] for these economies are shown in Table 1, along with their shares of the total diet. Over at least the past 25 yr there has been a steady increase in the share of the average diet contributed by animal food products in all these countries, with the exception of the Philippines. Most noticeably, that share has almost trebled in the Republic of Korea and more than doubled in China over the data period. On average over 1990–1995, animal products' share of human diets ranged from a low of 4.4% in Indonesia to a high of 17.7% in Malaysia. The per capita consumption of animal products was also highest in Malaysia and lowest in Indonesia. In the Philippines and Thailand, the consumption of animal products has increased at a rate only a little more than that for all foods, providing little change in animal products' share of the total diet in each country.

In 1994, meat products provided the greatest contribution to animal-based calorie intake in all of the countries. Pork provided the highest proportion of total meat consumption in each country except for Malaysia, where it ranked equal to poultry. In four of the six countries, dairy products accounted for less than 10% of the animal-based calories consumed—the exceptions being Malaysia where the proportion was a little over 22%, and Thailand (11%).

The six Asian economies chosen cover a wide range of per capita expenditure levels and urban population shares. Table 2 gives the average levels of per capita private consumption expenditure[2] and urbanisation, as well as their compound growth rates, over the period 1970–1995. Over this period, both per capita expenditure and urbanisation have trended upwards in all countries, and the growth of the former has exceeded that of urbanisation in each case except for the Philippines. Averaged over 1970–1995, the Republic of Korea showed the highest levels of both per capita expenditure and urbanisation. In China, the average expenditure was lowest and urbanisation second-lowest among this sample of countries.

It was not possible to obtain retail price data for all six countries and for all animal products over the 1970–1995 data period. However, retail price series for the major meats were obtained over the shorter time period 1980–1995. Table 3 indicates the behaviour of meat retail prices in these countries since 1980. In China, meat prices have trended upwards in real terms whereas the trend has been a decline in meat prices in Thailand and the Philippines. Meat prices in Korea suggested cyclical behaviour with peaks in the early 1980s and 1990s, and in Malaysia prices followed a downward trend for much of the 1980s but

[1]Animal food products cover all foods derived from animals, including all meats and offal, dairy products, eggs and fish.

[2]Private consumption expenditure was measured in real terms in national currencies and then expressed in US dollars converted by the purchasing power parity (PPP) exchange rate for 1980 (Pardey and Roseboom, 1989). In a cross-country analysis official exchange rates can be unreliable measures of the purchasing power of a currency (Kravis et al., 1978). PPPs measure the domestic cost of a bundle of goods at its own prices relative to the corresponding cost in dollars of the same bundle in the USA.

Table 1
Consumption of animal products and its share of the total diet

Country	Animal Products (kcal capita^{-1} day^{-1})			All Food (kcal capita^{-1} day^{-1})			Animal products as % share of all food		
	1970–1975	1980–1985	1990–1995	1970–1975	1980–1985	1990–1995	1970–1975	1980–1985	1990–1995
China	128	195	391	2062	2491	2730	6.2	7.8	14.3
Indonesia	57	81	116	1970	2302	2618	2.9	3.5	4.4
R. Korea	147	293	445	2999	3083	3224	4.9	9.5	13.8
Malaysia	308	408	490	2560	2704	2766	12.0	15.1	17.7
Philippines	244	243	318	1836	2190	2369	13.3	11.1	13.4
Thailand	196	205	236	2215	2212	2308	8.9	9.3	10.2

Source: FAOSTAT/PC.

Table 2
Private consumption expenditure and urbanization: mean values and growth 1970–1995

Country	Mean value of		Compound annual growth	
	PCE/capita (1980 US$ PPP)	Urbanization (%)	PCE/capita (%)	Urbanization (%)
China	618	21.9	5.7	2.5
Indonesia	1293	24.9	4.4	3.0
R. Korea	3147	61.0	6.0	2.8
Malaysia	1565	43.8	3.3	1.9
Philippines	2446	41.7	0.6	2.1
Thailand	1632	17.0	4.1	1.5

Sources: FAOSTAT/PC and World Bank (1995, 1996).

Table 3
Average meat retail prices (1990 prices)

Country		1980–1985	1986–1990	1991–1995
China	(Yuan kg^{-1})	4.06	5.57	6.67
Indonesia	(Rupiah kg^{-1})	3215	3502	3802
R. Korea	(Won kg^{-1})	5410	4837	5417
Malaysia	(RM kg^{-1})	5.75	4.95	5.38
Philippines	(Peso kg^{-1})	62.68	62.00	58.37
Thailand	(Baht kg^{-1})	55.15	48.71	46.65

Source: Author's estimates from national sources.

rose up to a peak in 1990. Indonesian meat prices were stable over the 1980–1985 period, but then increased until 1990 since when they have eased somewhat.

3. Models and data

3.1. Model formulation

Because it is known that the proportional response of consumption to a given proportional increase in expenditure typically declines as expenditure rises, it is desirable that the chosen functional form exhibits this characteristic. Two possibilities are the log-inverse and the log–log-inverse functions. The latter function also has the property that it can model an increase in consumption followed by a consumption decline as expenditure rises through time (for example as used by Ito et al. (1989) in their study of Asian rice consumption). Since the consumption of animal products had not appeared to have reached the saturation stage in East Asia, such a function was not required in the present study. Therefore the log-inverse form was used (Eq. (1)).

$$\ln Q_j = \alpha_j + \beta_j(1/X_j) + \gamma_j \ln P_j \qquad (1)$$

where Q_j is per capita consumption in kcal per day in country j, X_j is per capita private consumption expenditure (purchasing power parity) in country j, and P_j is the average meat price per kg in country j.

The effect of urbanisation was added to the model by first expressing the constant term in Eq. (1) as either a linear or nonlinear function of

urbanisation:

$$\alpha_j = a_{0j} + a_{1j}U_j \quad (2a)$$

or

$$\alpha_j = a_{0j} + a_{1j}(1/U_j) \quad (2b)$$

where U_j is the urban population as a percentage of the total population in country j.

The process of urbanisation may also impact on the coefficient of the expenditure variable in Eq. (1), since the impact of urban migration on consumption patterns through time may be influenced by real expenditure levels:

$$\beta_j = b_{0j} + b_{1j}U_j \quad (3a)$$

or

$$\beta_j = b_{0j} + b_{1j}(1/U_j) \quad (3b)$$

On substituting Eqs. (2a) and (3a) or Eqs. (2b) and (3b) into Eq. (1) gives the following pair of equations:

$$\ln Q_j = a_{0j} + a_{1j}U_j + b_{0j}(1/X_j) + b_{1j}(U_j/X_j) + \gamma_j \ln P_j \quad (4a)$$

or

$$\ln Q_j = a_{0j} + a_{1j}(1/U_j) + b_{0j}(1/X_j) + b_{1j}(1/U_j)(1/X_j) + \gamma_j \ln P_j \quad (4b)$$

3.2. The estimation procedure and data

Rather than estimate the functions separately for each country, the cross-section and time-series data were pooled to extend the sample base and dummy variable models were specified. The data set for estimating the consumption functions (4a) and (4b) comprised observations for Q_j, U_j and X_j for six countries covering the period 1970–1995, and on P_j for all countries for the shorter period[3] 1980–1995. The estimation procedure was to first use the 1980–1995 data set to estimate Eqs. (4a) and (4b) but with the restriction that the parameters a_{1j} and b_{1j} each be identical across countries.[4] This allowed information to be obtained on the contribution of the price variable to explaining changes in per person consumption levels (at least over this shorter time period), andon whether the exclusion of this variable was likely to bias estimates of the remaining parameters. Next, the full 1970–1995 data set was used to estimate Eqs. (4a) and (4b) but with the price variable necessarily excluded.

All equations were first estimated by ordinary least squares. In every case, the Durbin–Watson d-statistic was either inconclusive or indicated rejection of the null hypothesis of no positive first-order serial correlation. Also in every case, the Breusch–Pagan–Godfrey test indicated rejection of the null hypothesis of homoscedasticity. Therefore, all equations were estimated by a generalised least squares cross-sectionally heteroscedastic and timewise autoregressive procedure. On the matter of the choice between the linear or nonlinear form of the urbanisation variable, guidance was taken from the comparative R^2 values and the significance levels of the urbanisation variables. This leads to adoption of the nonlinear form as in Eqs. (2b) and (3b).

Data on per capita consumption of animal products and urbanisation proportions were obtained from the Food and Agricultural Organisation's database FAOSTAT/PC. The World Bank publications World Tables and Trends in Developing Countries were the sources of real private consumption expenditure in national currencies, which were converted to purchasing-power-parity measures using the exchange rates of Pardey and Roseboom (1989).

The retail price data were gathered from official national sources. Prices for the major meats (pork, poultry and beef) were obtained for five of the study countries over the time period 1980–1995. For Indonesia, wholesale prices for only pork and poultry were available for the period 1980–1995, but retail prices were available only from 1990. Retail prices for these meats in Indonesia prior to 1990 were estimated from a regression of Indonesian retail prices on wholesale prices. For each country, average retail meat prices were computed as a weighted sum of the individual product prices (in CPI-deflated real terms), using consumption shares (by volume) from FAOSTAT/PC consumption data as weights, and were also converted to a common currency using the purchasing-power-parity exchange rates.

[3]Retail price data for China were unavailable prior to 1980.

[4]Without this restriction, a total of 30 parameters would require to be estimated from just 96 observations.

Table 4
Estimated parameters of the animal products consumption models: 1980–1995

Country (j)	With price variable			Excluding price variable	
	Intercept (a_{0j})	$1/X_j$ (b_{0j})	ln $P_j(\gamma_j)$	Intercept (a_{0j})	$1/X_j$ (b_{0j})
China	7.4(22.84)	−1122.90(7.89)	0.31(2.96)	8.15(46.78)	−1198.30(6.47)
Indonesia	6.88(12.04)	−814.92(3.59)	−0.23(1.20)	6.21(55.20)	−631.41(2.79)
R. Korea	6.85(15.94)	−1862.70(6.92)	0.05(0.32)	6.99(74.94)	−1872.00(6.62)
Malaysia	7.24(46.00)	−818.41(6.45)	0.04(0.39)	7.29(79.67)	−794.61(6.53)
Philippines	9.32(8.21)	−4666.40(3.39)	−0.36(1.05)	7.94(13.32)	−3730.50(2.53)
Thailand	7.61(23.19)	−880.81(4.51)	0.12(0.64)	7.74(34.44)	−725.97(3.42)
Urbanization					
$1/U_j$		−45.98			−45.46
(a_1)		(9.25)			(9.65)
$(1/U_j)(1/X_j)$		18446.00			17036.00
(b_1)		(6.84)			(4.91)
Buse R^2		0.996			0.993

Note: Absolute t-values in parentheses, n=96.

4. Results

Table 4 gives the parameters of Eq. (4b) as well as the parameters of the same equation but with the price variable excluded, estimated from the 1980–1995 data set. Considering first the full equation, only two of the six estimated parameters for the price variable were of the expected negative sign, and only the parameter estimated for China was significant (at the 1% level) but indicated a positive influence of price on consumption. Omission of the price variable from the model reduced the R^2 from 0.996 to 0.993 and produced little change in the size of the majority of the remaining parameters. It is also worth noting at this stage that the urbanisation parameters (a_1 and b_1) in Table 4, and all of the expenditure parameters (b_{0j}) are of the expected sign and are significant at less than the 1% level. On the basis of this information, we proceeded to estimate Eq. (4b) without the price variable, and using the larger sample of data.

The strategy used was to first estimate Eq. (4b) without the $(1/U_j)(1/X_j)$ variable, so that urbanisation was assumed to influence only the intercept of the consumption functions (1). The null hypotheses H_0: $a_{1j}=0$ for all j were then jointly tested. The resulting F-value of 10.15 (6 and 138 degrees of freedom) was significant at the 1% level. Thus, the null hypothesis that all urbanisation parameters a_{1j} were simultaneously equal to zero was rejected.

Next, Eq. (4b) was estimated and the joint null hypothesis tested in this case was H_0: $b_{1j}=0$ for all j.

The resulting F-value of 13.12 (6 and 132 degrees of freedom) was also significant at the 1% level. Thus, the null hypothesis that all urbanisation parameters b_{1j} were simultaneously equal to zero was rejected.

The estimated parameters of Eq. (4b) but without the price variable are presented in Table 5. All parameters in the equations for China, Indonesia, and the Philippines are significant at less than the 1% level, while in the case of Malaysia and Thailand one parameter is significant at the 1% level and one at the 5% level. Overall, 16 of the 24 estimated parameters have significance levels of 5% or less.

Eq. (2b) expressed the intercept terms in the consumption functions (1) as a nonlinear function of urbanisation. For each country, the intercept term (a_{0j}) in Eq. (2b) is positive while the slope coefficient (a_{1j}) is negative. Of the six parameters a_{1j}, three are significant at less than the 1% level, one is significant at less than the 5% level, and one has a 10% significance level. Thus, for each country, over the range of the sample data, increases in urbanisation resulted in the intercept terms of the consumption functions (1) increasing but at a diminishing rate.

Eq. (3b) expressed the slope parameters of the consumption functions (1) as a nonlinear function of urbanisation. For all countries the intercept terms

Table 5
Estimated parameters of the animal products consumption model: 1970 to 95

Country (j)	Intercept (a_{0j})	$1/U_j$ (a_{1j})	$1/X_j$ (b_{0j})	$(1/U_j)(1/X_j)$ (b_{1j})
China	8.09(43.7)	−44.02(6.72)	−1110.70(6.97)	15057.00(7.28)
Indonesia	6.30(35.06)	−41.35(7.87)	−1190.40(3.13)	21777.00(3.94)
R. Korea	7.23(17.01)	−76.85(1.76)	−844.29(0.96)	323.96(0.01)
Malaysia	7.17(17.29)	−43.04(2.10)	−535.61(1.02)	11254.00(0.51)
Philippines	14.75(5.17)	−343.81(3.23)	−21275.00(3.00)	787060.00(3.00)
Thailand	6.12(6.40)	−8.38(0.42)	−1354.40(1.92)	15413.00(0.95)

Note: Absolute t-values in parentheses, Buse R^2=0.989, n=156.

(b_{0j}) in Table 5 are negative and the slope parameters (b_{1j}) are positive. Both these parameters in the equations for China, Indonesia and the Philippines are significant at less than the 1% level. This implied that, over the range of sample data, increasing urbanisation led to the slope coefficients of Eq. (1) becoming more negative, but at a diminishing rate.

Therefore, a common and significant pattern emerged for the six East Asian countries in this study. How urbanisation influences the position and shape of the consumption functions for animal products in these countries is suggested in Fig. 1, where the consumption function estimated for China is reproduced for three levels of urbanisation.[5] Increased urbanisation had a positive effect on the per capita consumption levels of animal products and also, for a given level of expenditure, increased the magnitude of the consumption response to a marginal increase in expenditure.

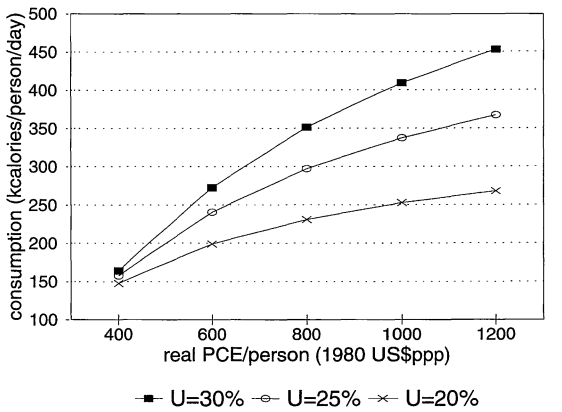

Fig. 1. The animal products consumption function estimated for China.

4.1. Expenditure and urbanisation elasticities

Expenditure and urbanisation elasticities (e_{X_j} and e_{U_j}, respectively) for each country were derived from the derivatives of Eq. (4b) with respect to expenditure and urbanisation, respectively, as follows:

$$\begin{aligned} e_{X_j} &= (\partial Q_j/\partial X_j)(X_j/Q_j) \\ &= -\left(b_{0j} + b_{1j}U_j^{-1}\right)X_j^{-1} \end{aligned} \quad (5)$$

$$\begin{aligned} e_{U_j} &= (\partial Q_j/\partial U_j)(U_j/Q_j) \\ &= -\left(a_{1j} + b_{1j}X_j^{-1}\right)U_j^{-1} \end{aligned} \quad (6)$$

The resulting elasticities, evaluated at the sample mean values of X_j and U_j, are reported in Table 6. Standard errors of the elasticities were computed using the variances and covariances of the relevant parameters of the estimated functions. All of the expenditure elasticities are of the expected positive sign, and those estimated for China and the Philippines are more than twice as large as their standard errors. The expenditure elasticities are all less than unity, with the highest values being 0.99 for the Philippines and 0.68 for China. There would appear to be no pattern, however, relating the level of the elasticities with a country's mean level of either expenditure or urbanisation as might be expected if all country observations lay on an identical consumption function.

[5]Over the data period, the level of urbanization in China ranged from 17% to 30%, and the range of real PCE (PPP) per capita was US$327 to US$1388. Daily consumption ranged from 112 to 501 kcal per capita.

Table 6
Expenditure and urbanization elasticities at sample means

Country	Elasticities(1970–1995 data means)		
	From Eq. (1)	From Eq. (4b)	
	Expenditure	Expenditure	Urbanization
China	0.91(0.08)	0.68(0.14)	0.90(0.33)
Indonesia	0.58(0.09)	0.24(0.16)	0.98(0.22)
R. Korea	0.83(0.03)	0.27(0.28)	1.26(0.65)
Malaysia	0.52(0.06)	0.18(0.11)	0.82(0.25)
Philippines	0.71(0.45)	0.99(0.49)	0.53(0.16)
Thailand	0.20(0.04)	0.28(0.19)	−0.06(0.60)

Note: Figures in parentheses are standard errors of the elasticities.

The hypothesis that the process of urbanisation has had a positive effect on the consumption of animal products is supported by the urbanisation elasticities in Table 6, which are defined as the percentage change in per capita consumption due to a percentage change in the ratio of urban to total population. All are positive and (with the exceptions of Korea and Thailand), are at least twice the value of their standard errors. This elasticity for South Korea is 1.26, but the values for Indonesia, China and Malaysia are also relatively large. Thus in these countries, and also in the Philippines, growth in consumption of animal products appears due not only to increases in expenditure but also to the growing urbanisation of the population. Further, the urbanisation elasticity was greater in magnitude than that for expenditure in all countries except the Philippines and Thailand.

The expenditure elasticities of Table 6 can be compared with those that would have been computed had Eq. (1) been used, in other words if the effects of urbanisation had been ignored. These are given in the second column of Table 6. In four of the six cases they are greater than those estimated from the more complete specification. For the Philippines and Thailand, inclusion of the urbanisation variable increases the magnitude of the expenditure elasticities, although the urbanisation elasticity for Thailand was not significantly different from zero. Therefore, omission of urbanisation variables in animal products consumption models may lead to overestimation of expenditure effects.

It has generally been accepted that as a country's average per capita income rises through time, then income elasticities of demand for food will fall. This relationship requires other things to be equal however, but as development proceeds through time other things are not constant. In particular, the proportion of the population living in urban areas is likely to rise along with average incomes. Eq. (5) indicates that, if urbanisation is held constant, then the expenditure elasticity will indeed fall as per capita expenditures rise. But should both urbanisation and expenditure rise, the behaviour of the expenditure elasticity will be influenced by the relative movement in both these variables.

Fig. 1 gives a clue as to how the expenditure elasticities may behave over time. Increases in both per capita expenditure and urbanisation can be reflected in a movement from the lower left corner to the upper right corner of the graphed consumption function (Fig. 1). It is possible that this could involve a movement through successively higher values of $\partial Q_j/\partial X_j$ since increasing urbanisation has been shown to increase the slopes of the consumption functions. Under these conditions, it is plausible that the expenditure elasticities could have increased, and not decreased, over time with increasing per capita expenditures.

Average values of the expenditure elasticities are given for three successive 5-yr periods in Table 7. At least for Indonesia and the Philippines, the evidence points to increases in the expenditure elasticity over time. From among the sample countries, the growth in urbanisation relative to expenditure growth is strongest in the Philippines and Indonesia (see Table 2). Thus, the relatively strong growth in urbanisation is not only pushing the consumption of animal products on to higher consumption–expenditure functions, but to points on those functions of successively higher marginal propensities to consume.

Finally, Table 7 also includes 5-yr average values of the urbanisation elasticities. Data are not presented for Thailand since the standard error of the urbanisation elasticity was well in excess of the mean value. Again (see Eq. (6)), these elasticities could increase or decrease with growth in both expenditure and urbanisation through time. The data show decreases in the urbanisation elasticities in each country except China.

Table 7
Trends in expenditure and urbanization elasticities through time

Country	Expenditure			Urbanization		
	1980–1985	1985–1990	1990–1995	1980–1985	1985–1990	1990–1995
China	0.71	0.68	0.55	0.79	0.95	1.05
Indonesia	0.22	0.28	0.29	1.04	0.95	0.90
R. Korea	0.31	0.22	0.16	1.26	1.11	0.99
Malaysia	0.17	0.18	0.15	0.83	0.76	0.73
Philippines	0.65	1.66	2.36	0.85	0.58	0.68
Thailand	0.33	0.28	0.22			

5. Conclusions

Urbanisation has been shown to have a significant effect on the consumption of animal products in a sample of East Asian economies. At the mean values of the sample data, the urbanisation elasticities were always positive, indicating that the process of urbanisation has a positive effect on the consumption of animal-derived foods. The expenditure elasticities were also positive, but often less than they would be if estimated from consumption functions that excluded the effects of urbanisation. Thus, omission of urbanisation from animal products consumption functions could lead to upward biases in the expenditure elasticities where the latter measure both the positive influence of expenditures, and of urbanisation, on consumption and when expenditures and urbanisation are positively correlated. Some small-sample evidence suggested that the omission of a price variable from the consumption functions may not have seriously biased the estimates.

As development proceeded in the case study countries, both per capita expenditures and urbanisation trended upwards. In some cases, it was shown that the expenditure elasticities actually increased over time with increasing expenditures, contrary to Engel's law which of course assumed other things unchanged.

Finally, where consumption functions are used to make projections, the inclusion of urbanisation would also allow projections to be conditioned on relative expenditure and urbanisation growth rates different from those observed in the past. If urbanisation was excluded in such applications, projections from functions like (1) may be biased. Should the projected growth rate of urbanisation slow down relative to growth in expenditures, then use of upwardly biased elasticities may result in overstated projections. The converse may hold should the growth in urbanisation be projected to increase relative to expenditure growth. This may have important implications for projections of animal products consumption in countries such as China and Indonesia where urbanisation is still at a relatively early stage, and in Korea where urbanisation has already surpassed levels observed in Japan.

Acknowledgements

The author is grateful to his colleague Robert J. Townsley for helpful comments and assistance.

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