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Ito, Peterson, and Grant (IPG) have recently shown that rice income elasticities are highly negative in many Asian countries and only slightly positive and declining over time in other Asian countries. Their results, if accurate, have obvious and important implications for how Asian governments, international lending agencies, and the CGIAR system should allocate resources in anticipation of weak demand and continued low international prices for rice.

This comment argues that IPG fail to consider the effect on demand for rice of decisions by semisubsistence farmers to produce rice, which leads to downwardly biased time-series estimates of aggregate national income elasticities. That is, demand effects that IPG attribute to trend increases in aggregate per capita income may largely reflect instead (*a*) a concurrent rural to urban migration pattern, (*b*) the decreasing importance over time of aggregate rice production within some Asian countries, and (*c*) a declining share of semisubsistence production within the rice sectors themselves.

Income Elasticities Derived from Expenditure Surveys

A useful starting point for arguing that production and consumption decisions for staple foods cannot be analyzed separately for Asian countries is to note that rice income elasticities derived from expenditure surveys are nearly always positive and in some instances considerably above zero. For example, Timmer and Alderman estimate an aggregate national income elasticity for rice for Indonesia of about 0.4 from household expenditure survey data collected in 1976. Pitt derives an estimate for Bangladesh of about 1.0 for 1973–74, and Trairatvorakul derives an estimate for Thailand of 0.13 for 1975–76 (see Alderman, table 12, for estimates for other countries).[1] The corresponding IPG estimates are 0.19, −0.04, and −0.25 for Indonesia, Bangladesh, and Thailand, respectively, for the survey years cited above.

The same comparison shows a similar result for a developed economy. IPG derive an estimate of −0.71 for the income elasticity of demand for rice in Japan for 1984, where household income averaged about $40,000 per year for a family of four.[2] Intuitively, such a high negative elasticity implies that budgets are so constrained that Japanese households consume rice in large amounts out of rather dire necessity. If incomes double and households reduced rice consumption by 70%,[3] what (calorie dense) foods would these households eat instead which they could not already afford? In table 1 rice expenditure data presented by expenditure group for Japan suggest that higher income groups do not drastically reduce rice consumption as incomes increase.

How does one reconcile declining per capita rice consumption over time with such food expenditure information? Table 2 summarizes rice consumption data, disaggregated by expenditure quartile from food expenditure surveys in six less developed Asian countries. Controlling for urban and rural populations, per capita consumption of rice increases monotonically with income, except for Thailand where the arc income elasticity is close to zero. Comparing rice consumption levels within the same expenditure quartile, rural consumers consume more rice than urban consumers. The most pronounced and consistent difference between urban and rural consumption across income groups occurs for Thailand. IPG estimate that the aggregate income elasticity for rice for Thailand had fallen to −0.44 by 1985.

Explanations for Rural-Urban Demand Patterns

Lower rice consumption in urban versus rural areas has several possible explanations. First is the explanation put forth by IPG (although not in this particular context) that urban incomes are higher and that higher income consumers prefer to substitute more preferred foods for rice. However, this explanation does not go very far in explaining the large differences across urban and rural populations within the same expenditure quartiles indicated in table 2, nor is it supported by the trend in rice consumption across income quartiles, controlling for urban/rural.

Second, assume that two persons with the same set of demand preferences and levels of income and fac-

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[1] The estimate cited for Pitt is for rural households only.

[2] GNP per capita in 1984 was US $10,580 at current prices (World Bank, p. 340–41).

[3] IPG cannot appeal to lower income elasticities closer to zero at, say, a household income of $80,000 because their estimates appear always to become increasingly negative at higher income levels.

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Table 1. Per Capita Rice Expenditures, by Expenditure Group for Japan, 1983

Expenditure Group[a]	Nationwide		Worker's Households	
	Rice Expenditure[b]	Percent of Sample	Rice Expenditure[b]	Percent of Sample
Up to 999	2,032	0.01	1,912	0.00
1,000–1,499	1,764	0.02	1,630	0.01
1,500–1,999	1,772	0.04	1,524	0.02
2,000–2,499	1,647	0 07	1,471	0.05
2,500–2,999	1,593	0.08	1,456	0.07
3,000–3,499	1,482	0.10	1,393	0.10
3,500–3,999	1,532	0.10	1,409	0.11
4,000–4,499	1,522	0.10	1,467	0.11
4,500–4,999	1,587	0.09	1,480	0.10
5,000–5,499	1,578	0.07	1,498	0 08
5,500–5,999	1,660	0.06	1,678	0.07
6,000–6,499	1,786	0.05	1,732	0.06
6,500–6,999	1,747	0.04	1,716	0.05
7,000–7,499	1,598	0.03	1,597	0.05
7,500–7,999	1,643	0.02	1,649	0.03
8,000–8,999	1,692	0.04	1,663	0.04
9,000–9,999	1,688	0.03	1,645	0.03
10,000 and over	1,736	0.05	1,762	0 04

Source Statistics Bureau, Prime Minister's Office, annual report on the family income and expenditure survey, as reported in Food and Agriculture Organization, review of food consumption surveys, 1985

[a] Thousand yen per household per year.

[b] Yen per capita per month

Table 2. Weekly Per Capita Consumption of Milled Rice, By Country, By Expenditure Quartile, By Urban and Rural Populations

Country	Urban or Rural	Expenditure Quartile[a]			
		1	2	3	4
		(kilograms)			
Bangladesh					
	Urban	1.60	1.90	2.15	2 41
	Rural	1.45	1.98	2.51	3.13
India					
	Urban	1.08	1.34	1.36	1 36
	Rural	1.13	1.67	1.91	1.97
Indonesia					
	Urban	1.82	2.10	2.23	
	Rural	1.77	2.56	2.97	
Pakistan					
	Urban	0.15	0.20	0.24	0.29
	Rural	0.22	0.33	0.30	0.37
Sri Lanka					
	Urban	1.30	1.64	1.91	1.96
	Rural	1.63	2.09	2.52	2.88
Thailand					
	Urban	2.17	2.16	2.16	2.22
	Rural	2.92	3.13	3.00	2.89

Data sources (see also Bouis 1989b for other details): Bangladesh *Household Expenditure Survey of Bangladesh 1973–74*, Bangladesh Bureau of Statistics, data are disaggregated by household expenditure quartile instead of per capita expenditure quartile. India *Second Quinquennial Survey on Consumer Expenditure*, undertaken by the Department of Statistics from July 1977 to June 1978 Indonesia. Data are taken from SUSENAS 1981 expenditure surveys, as reported in Rosegrant et al. (1987) Pakistan. *Household Income and Expenditure Survey 1984–85*, conducted by the Federal Bureau of Statistics. Sri Lanka. Data are taken from the *1980/81 Labour Force and Socio-Economic Survey* conducted by the Bureau of Census and Statistics, as cited in Sahn (1984). Thailand. Data taken from the *1975/76 Socioeconomic Survey* conducted by the National Statistics Office, as cited in Trairatvorakul (1984); only calorie intake information is provided for various food groups; a calorie conversion rate of 3,500 calories per kilogram was used to compute rice consumption per kilogram

[a] Tercile in the case of Indonesia.

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ing the same set of prices differ only in the activity levels necessary for earning that income. Energy requirements will be greater for the person engaged in the more active occupation. Under a reasonable set of assumptions (Bouis 1989a, 1990), the more active person will spend more for food than the less active person; more important, his/her diet will be more staple based because staples are relatively inexpensive sources of calories. If rural occupations require a greater energy expenditure than urban occupations, one would expect a priori to observe more staple consumption by rural populations

Third, rice is cheaper to purchase in rural areas, in particular by rice producers themselves. Farmers who grow rice and consume out of own production avoid retailing and other marketing costs in staple purchases. Apart from greater risks associated with growing nonfood crops, such a cost saving may be an important additional incentive for semisubsistence farmers to grow staples. (See Bouis and Haddad 1990a, chaps. 4 and 7, for an analysis of this phenomenon for a specific group of farm households in the Philippines.)

In order to understand structural changes in demand behavior for rice over time in countries where a significant proportion of rice consumption comes from own production (all of the countries studied by IPG would qualify under these criteria at the start of the time-series data used, with the possible exception of Singapore), it is important to study three groups of consumers: (*a*) urban, (*b*) rural rice producers, and (*c*) rural nonrice producers Thus, it is useful to write:

$$(1) \qquad D_N = \theta_U D_U + \theta_{Rr} D_{Rr} + \theta_{Ro} D_{Ro},$$

where D is per capita consumption, θ is proportion of population, N is national total population, U is urban population, R is rural population, r is semisubsistence and commercial rice producers (these households may grow crops in addition to rice), o is producers of crops other than rice (these households grow no rice at all), and

$$(2) \qquad \theta_U + \theta_{Rr} + \theta_{Ro} = 1.$$

Approaching analysis of national aggregate consumption in this way, it is conceivable that significant decreases in aggregate consumption could occur over time if consumption levels differed significantly such that, controlling for income,

$$(3) \qquad D_U < D_{Ro} < D_{Rr}$$

and if there was significant rural to urban migration and/or rice production declined in importance in the rural sector. While increasing per capita incomes are usually associated with structural change in developing economies (i.e., rural to urban migration and a switch from subsistence to commercial agriculture), at some point these processes run their course (e.g., Japan and Taiwan). It then would be misleading to associate further increases in income with the same reduction in consumption of rice.

Correlations between Changes in Per Capita Rice Consumption and Structural Changes

Table 3 ranks the countries cited by IPG by percentage change in per capita rice consumption from 1961–65 to 1981–85.[4] Also given in the table are percentage changes in rice production, agricultural gross domestic product, and total agricultural population, and change in percentage of the population which is urban

The first relationship to note from table 3 is that rice production growth rates in Malaysia, Nepal, and Thailand (which IPG designate as Group I countries, experiencing substantial declines in per capita consumption of rice) were much lower than growth rates in agricultural gross domestic product in these countries. Rice production growth rates in these three countries were at or below the median as compared with rice production growth rates in other countries in South and Southeast Asia. Countries with the highest percentage increases in per capita rice consumption had the highest rice production growth rates, which tended to exceed growth rates for agricultural gross domestic product. Rice production became relatively more important within China and Indonesia, where the increases in per capita consumption of rice were highest

Table 3 also indicates increased urbanization all over Asia. However, the trend in population densities in rural areas exhibited two distinct patterns as this urbanization occurred. Population densities in rural areas declined in Japan, South Korea, and Taiwan. Presumably as this occurred, rice farms increased in size, semisubsistence production gave way to commercial production, and marketed surplus as a percentage of total rice production greatly increased. These changes contrast with increased land pressures and production of rice on smaller operational units in several countries whose agricultural populations increased by 45% or more from the early 1960s to the mid-1980s. If yields had not increased so substantially in most of these countries, marketed surplus (as a percent of total production) likely would have fallen

With the information in table 3 as background, consider the following implicit equation:

$$(4) \qquad \%\Delta D_N = f(\%\Delta RCPRD - \%\Delta AGGDP, \%\Delta AGPOP, \Delta PCURB),$$

where Δ is change, $\%\Delta$ is percentage change, D_N is aggregate national per capita consumption of rice, *RCPRD* is rice production, *AGGDP* is agricultural gross domestic product, *AGPOP* is agricultural population, and *PCURB* is percent of total population which is urban. If $D_{Ro} < D_{Rr}$, then as rice becomes less important in total agricultural production, *ceteris paribus*, national aggregate consumption declines. Because data for D_{Ro}, D_{Rr}, θ_{Ro}, and θ_{Rr} are lacking, $\%\Delta RCPRD - \%\Delta AGGDP$ is a rough proxy (in con-

[4] Singapore and Burma are excluded because of lack of data

Table 3. Percentage Change in Rice Consumption, Rice Production, Agricultural Gross Domestic Product, Agricultural Population, and Change in Percent Urban, by Country, 1961 to 1985

Country	Percent Change in Per Capita Rice Consumption 1961–65 to 1981–85[a]	Percent Change in Total Rice Production 1961 to 1985[b]	Percent Change in Agricultural Gross Domestic Product 1967 to 1986[c]	Percent Change in Agricultural Population 1961 to 1985[d]	Change in Percent Urban[e]
Taiwan	−39	6	45	−24	29
Japan	−29	−8	−3	−66	22
Malaysia	−17	63	127	6	26
Nepal	−17	27	49	69	2
Thailand	−14	77	143	47	17
India	3	63	54	53	6
Bangladesh	1	46	55	61	14
Sri Lanka	4	142	88	49	4
South Korea	5	54	85	−22	29
Philippines	12	102	116	54	11
China	33	160	130	35	12
Indonesia	47	166	133	17	22

[a] Ito, Peterson, and Grant, table 1
[b] IRRI, table 1, adjusted to reflect 20-year growth period
[c] World Bank, 1988 world tables, adjusted to reflect 20-year growth period
[d] IRRI, table 80
[e] IRRI, table 80

junction with *%ΔAGPOP* discussed below) for the percentage change in the contribution of semisubsistence production of rice to total agricultural production. In the regression results presented in table 4, this variable is multiplied by the percent of the population which is rural at the beginning of the period, since the effect of *%ΔRCPRD* − *%ΔAGGDP* on $\Delta\%D_N$ will be greater the larger is the rural sector.

%ΔAGPOP is included as a control for farm size. *Ceteris paribus*, as farm size declines (as *%ΔAGPOP* increases), there is a greater prevalency of low-income rural households producing rice for their subsistence needs, both to increase food security and to avoid paying marketing margins for their rice consumption. Finally, *ΔPCURB* controls for differences between urban and rural consumption of rice. If $D_u < D_{Ro}$, then the expected sign of the coefficient for *ΔPCURB* is negative. However, in most countries average urban incomes are higher than average rural incomes; if rice is not an inferior good, then controlling for production effects on consumption, the expected sign is positive.

The results of estimating (4) are shown in table 4. The rough-and-ready nature of the proxy variables used in the regression estimations, the small sample size, and the lack of variables which account for changes in prices, all provide admittedly compelling reasons for caution in interpreting the correlations shown in table 4. Still, the correlations are strong, have the expected signs, and explain much of the variance across countries. The positive coefficient on *ΔPCURB* suggests that higher income urban house-

Table 4. Results of Estimating Equation (4)

Sample/Variable	*Coefficient	*t*-*statistic
Full sample (12 countries)		
(*%ΔRCPRD*−*%ΔAGGDP*) *%RURAL61*[a]	0.84	4.0
%ΔAGPOP	0.60	3.0
ΔPCURB	2.37	2.6
R^2 = 0.71		
Full sample, excluding Taiwan (11 countries)		
(%ΔRCPRD*−*%ΔAGGDP*) *%RURAL61*[a]	0.83	5.7
%ΔAGPOP	0.57	4.2
ΔPCURB	2.76	4.3
R^2 = 0.84		

Note: Dependent variable is percentage change in per capita consumption of rice, 1961–65 to 1981–85, as cited in table 3, data for all explanatory variables are cited in table 3 also, except for *%RURAL61*.
[a] *%RURAL61* is percent of total population which is rural in 1961 (IRRI, table 80)

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holds do consume more rice than rural households, once production effects on consumption are controlled.

Conclusions

It is beyond the scope of this comment to provide conclusive evidence that the decline in rice consumption in some Asian countries (and increases in others) is largely the result of structural changes in income generation and not to the amount of income that is earned, although the two can be correlated over time. The main benefit from estimating (4) is to show that the aggregate country data at least do not contradict, indeed are very consistent with, two propositions that merit further research—first, rice consumption in Asia does not decline rapidly with income per se, and second, national per capita rice consumption levels have been and in many countries still are closely related to rice production relationships that determine marketed surplus (farm size, irrigation, and road infrastructure, adoption of modern technologies).

In countries where semisubsistence rice production is still important, aggregate national rice consumption may continue to decline as agriculture becomes more commercial and especially as rural population densities decline. However, predicting the existence and rate of such a decline will depend on a much better understanding of the effects of the commercialization process and of reduced work activity levels (which presumably accompany economic development) on demand for specific foods, and for staples in particular.

More specifically, after controlling for income, how much of the difference between urban and rural consumption (shown in table 2) can be explained by (*a*) generally lower food prices in rural areas, (*b*) lower implicit rice prices which rice producers pay for consumption of own-production, and (*c*) by higher work activity levels in rural areas? Are there factors related to expenditure survey techniques that lead to gross overestimates of rice consumption for rural consumers, as compared with urban consumers (Bouis and Haddad 1990b)?

Can supporting evidence be found that the substantial declines in per capita consumption of rice over time in Japan and Taiwan resulted from a decline in semisubsistence rice production? Why has rice consumption not fallen in South Korea, as apparently happened in Japan, Singapore, and Taiwan? Did these substantial declines in consumption in fact not occur in some instances? Are some of the time-series data used by IPG derived from unreliable production and stock information?[5]

Answers to these questions are crucial for planning investments for agricultural research and irrigation. Because of the substantial time lags in realizing investment benefits, if these investments are reduced or delayed because of overly pessimistic demand projections, rice prices may rise unnecessarily with adverse consequences for the poor in Asia, urban and rural, who are net consumers of rice.

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[5] The validity of the 222 kilograms per capita consumption of milled rice cited for Burma for 1981–85 can be questioned on a priori grounds. Such a level of consumption corresponds to a calorie availability of about 2,800 calories per adult equivalent per day, which is about 10% above the recommended intake for the Philippines from all foods. Similarly, the figure of 191 kilograms per capita for Thailand for 1961–65 is quite high.

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