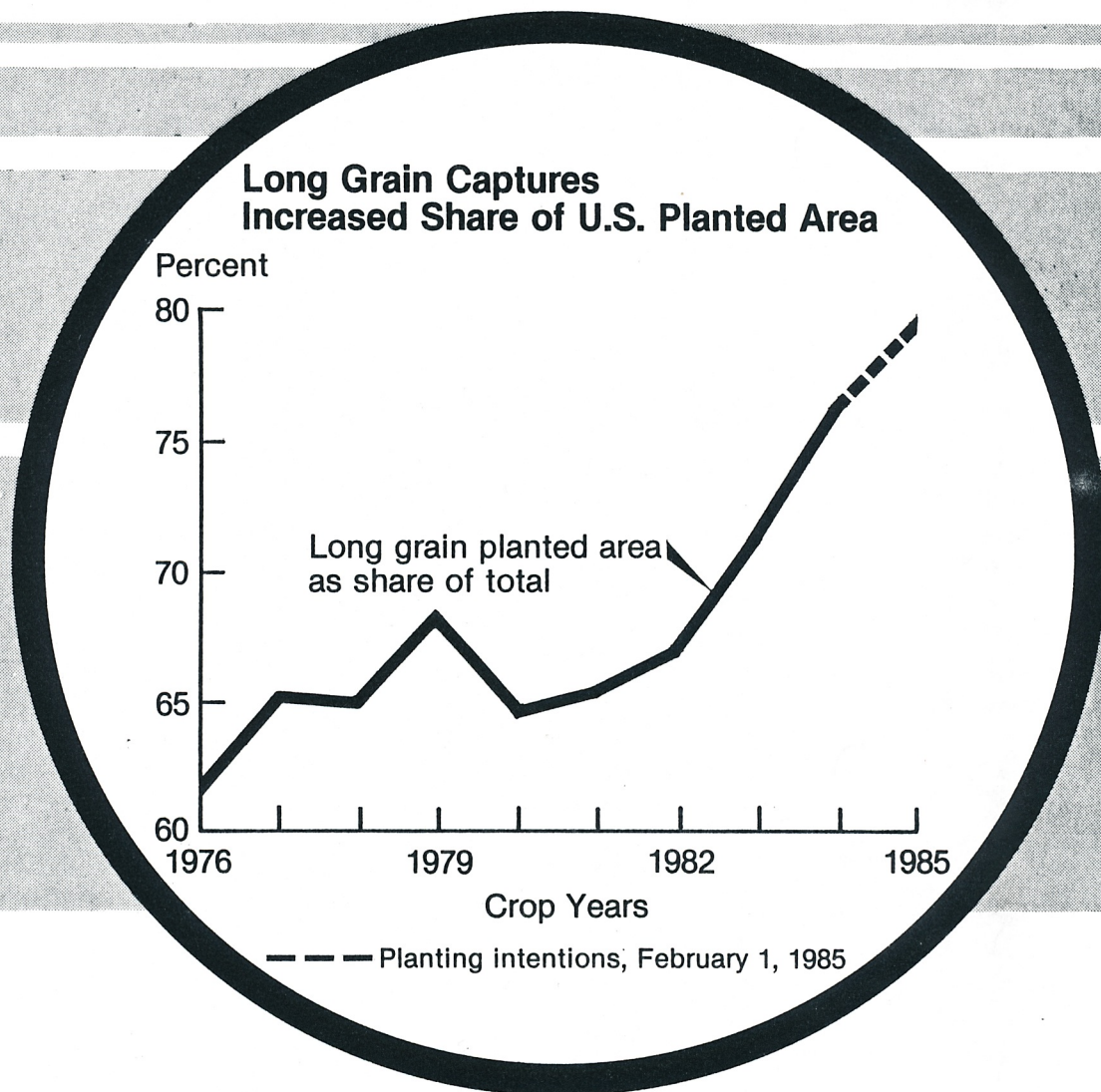


Rice

Outlook and Situation Report



ASIAN RICE ELASTICITIES

Shoichi Ito
Eric J. Wailes
Warren R. Grant 1/

Abstract: Rice supply and demand are generally very price inelastic, but negative income elasticities in Asian rice exporting countries indicate that consumers in those countries are satisfied with current amounts of rice consumption, and that rice consumption decreases as incomes increase. Thus, as incomes in these countries rise, more rice could be available for export, posing an even greater challenge to the U.S. rice industry in the world rice market.

Key words: Asia, rice, elasticity, production, consumption.

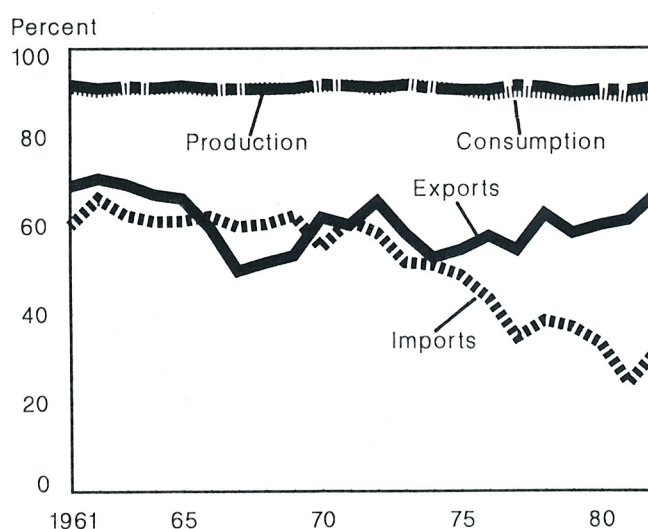
Introduction

The world rice economy has grown significantly over the last two decades. Milled rice production increased by 102 percent, from 155 million metric tons in 1962/63 to 314 million in 1984/85. Asia is a critical component of the world rice economy, with more than 90 percent of world production (fig.2). However, Asia's share of world rice consumption has gradually decreased from 91 percent in 1975/76 to 89 percent in 1981/82. Consequently, a growing share of Asian rice production is available for export. Although there was no substantial growth prior to 1976, total world rice exports rose 56 percent from 8.4 million tons in 1976 to 13.1 million in 1981, before declining to 12.3 million in 1984. Exports by Asia increased 66 percent over this period, from 5 to 8 million tons. Asia's share of world rice exports also grew, from 58 percent in 1976 to over 61 percent in 1981. At the same time, the share of world rice imported by these Asian countries declined substantially (fig. 2).

Using annual data for 1962 through 1981, production and consumption relationships were estimated for eleven countries: Bangladesh, Burma, People's Republic of China (PRC), India, Indonesia, Japan, South Korea, Pakistan, the Philippines, Thailand, and Taiwan. During 1977-81, these countries accounted for 84

1/ Graduate assistant, Department of Agricultural Economics, Texas A&M University, Assistant Professor, Department of Agricultural Economics, University of Arkansas, and Agricultural Economist, Economic Research Service, U.S. Department of Agriculture.

Figure 2
Asian Share of World Production, Consumption, Export, and Imports^{1/}



^{1/} Production and consumption are marketing year data, beginning 1961/62. Exports and imports are calendar year data, beginning 1962.

percent of world rice production and 82 percent of world rice consumption. Results from the analysis provide information on production and consumption elasticities for Asian rice economies. ^{2/} Similar data for the United States (3) are reported for comparison.

In the analyses for production models, government prices were used for Burma, India,

^{2/} Elasticity is the percentage change in one item related to a one-percent change in another item, other variables held constant. For example, a 0.3 price elasticity for yield means that a one-percent increase in price causes yields to increase by 0.3 percent. Short run elasticity, in this paper, refers to the percentage change in one year. Long run elasticity, in contrast, refers to the cumulative percentage change over the adjustment period.

Indonesia, Japan, Pakistan, the Philippines, and Taiwan. Market prices were used for Bangladesh, South Korea, and Thailand. For the consumption models, domestic retail or wholesale prices were used for all countries except PRC and Indonesia. Thailand's export prices were used for these two countries.

Short Run Production Elasticities

Burma, Pakistan, Thailand, and the United States showed no yield response to a change in price. Thus, their price elasticities for yield were estimated at zero. Bangladesh, India, Indonesia, Japan, South Korea, the Philippines, and Taiwan exhibited yield response to a price change, with elasticities ranging from a high of 0.456 in Japan to a low of 0.049 in Bangladesh (table 8). Thus in Japan, a 0.456-percent change in yield was associated with a 1-percent change in price in the same direction, whereas in Bangladesh, a 1-percent change in price elicited only a 0.049-percent change in yield. Subsistence producers in countries like Bangladesh do not respond to price changes as readily as producers in Japan, where government programs and environmental restrictions influence response.

In each country showing statistically significant price responses for both changes in yield and area harvested, the price elasticity for yield was larger than the elasticity for area harvested. Yield response to price was affected indirectly, based on changes in acreage harvested. Acreage increases should have a negative impact on yields because capital and human resources are limited and marginal land is often used for additional acreage. This response was not detected in any of the countries except Japan and Taiwan. The elasticity of yield with respect to harvested acreage ranged from -0.156 in the United States to -0.674 in Taiwan (table 8). Acreage affected yield in those countries that have production limitation programs: Japan, Taiwan, and the United States.

Previous research indicated rice acreage elasticities were very inelastic (1, 2, 5, and 6). Ito's study supports the inelastic character of rice acreage for even more recent periods in Asia. The acreage elasticities reported here are less than 0.1, except for the Philippines (0.116) and Thailand (0.337). In most Asian countries, cropland suitable for rice production traditionally produces rice.

Price elasticities for total production were calculated based on the three preceding types of elasticities. The formula used was:

$$E_{q/p} = E_{yd/p} + E_{a/p} (1 + E_{yd/a})$$

where:

$E_{q/p}$ = price elasticity for production;

$E_{yd/p}$ = price elasticity for yield;

$E_{a/p}$ = price elasticity for area harvested;

$E_{yd/a}$ = area harvested elasticity for yield.

Elasticities, which were not identified statistically, were regarded as zero under the formula. The largest production elasticity for the short run was 0.485 for Japan, followed by 0.447 for South Korea, 0.337 for Thailand, and 0.313 for the Philippines (table 8). Because of the relatively large price elasticities of yield, the production elasticities were relatively large for Japan, South Korea, and the Philippines. However, Thailand's relatively large production elasticity was due to an acreage response to price changes. The production elasticities for other countries remained very inelastic. Elasticity estimates for the United States were similar to these other Asian responses.

Long Run Production Elasticities

No long run yield response to a change in price was detected for most Asian countries. However, Indonesia and the Philippines exhibited lagged response with elasticities at 0.269 and 0.355, respectively (table 9). The cumulative effects of a price change took 2.83 years in Indonesia and 1.8 years in the Philippines.

Adjustments in area harvested to a price change usually take more than 1 year for the full impact to occur. Adjustment periods varied from 1 year in Burma, Indonesia, and the Philippines to 4.81 years in Thailand. However, most long run acreage elasticities were relatively inelastic except for Thailand (1.62).

Long run production elasticities, which were calculated with the same formulas as the short run production elasticities, varied with the country. In Thailand, due to the absence

Table 8.--Short run elasticities of rice yield, area harvested, and production in Asia and the U.S.

Countries	Yield ($E_{yd/p}$)	Acreage effect on yield ($E_{yd/a}$)	Area Harvested ($E_{a/p}$)	Production (1) ($E_{q/p}$)
Bangladesh	.049*	---	.011	.060
Burma	----	---	.043**	.043
India	.156**	---	.027	.183
Indonesia	.094**	----	.074*	.168
Japan	.4568	-.490*	.058**	.485
South Korea	.396**	---	.051*	.447
Pakistan	----	---	.091	.091
Philippines	.197*	---	.116*	.313
Thailand	----	---	.337*	.337
Taiwan	.119*	-.67*	.059	.138
United States	---	-.156*	.125*	.110

* = 5% level significance
 ++ = 10% level significance

$$(1) E_{q/p} = E_{yd/p} + E_{a/p} (1 + E_{y/a})$$

Source: Grant et al., Ito

of a yield response to a price change, the long run acreage elasticity (1.62) was regarded as the long run production elasticity. Japan, South Korea, and the Philippines were near 0.5. India, Indonesia, Pakistan, and Taiwan exhibited a slightly lower price response, while Bangladesh and Burma remained very inelastic. The long run production elasticity for the United States was estimated at 0.311.

Consumption Elasticities

In most Asian countries, rice consumption is influenced by production immediately preceding a given consumption period. Japan and Taiwan are exceptions, in that they have adequate storage facilities. Price elasticities for consumption with respect to domestic prices were very inelastic in this region, ranging from -0.026 in Burma to -0.17 in the Philippines (table 10). Elasticities with respect to the Thai export price were -0.005 for the PRC and -0.046 for Indonesia. The PRC exports rice at the expense of domestic consumers when the world rice price is high. Indonesia, on the other hand, cannot supply domestic consumers with satisfactory amounts

of rice at a reasonable price when the world price is high. The elasticity of the PRC seems almost negligible. However, as the world's largest rice producing and consuming country, changes in its export levels can be dramatic on the world rice market.

No effect of domestic price on demand was found in India, Indonesia, Japan, and Thailand. However, given that rice is a staple food in Asia and that elasticities for other Asian countries are very inelastic, it is assumed that the elasticities for those four countries may also be very inelastic or close to zero. The elasticity of per capita domestic food demand with respect to retail price in the United States was -0.18, slightly higher than the Asian countries. Nevertheless, these elasticities indicate changes in prices have little effect on rice consumption.

Income elasticities were diverse among the countries, ranging from positive to negative. Burma, India, Japan, Pakistan, Thailand, and Taiwan had negative income elasticities (table 10). These six countries are also net rice exporters. Positive income

Table 9.--Long run elasticities of rice yield, area harvested, and production in Asia and the U.S.

Country	Yield			Area harvested			Production ^d
	Adjustment coefficient ^a	Adjustment period ^b (year)	Long run elasticity ^c	Adjustment coefficient ^a	Adjustment period ^b (year)	Long run elasticity ^c	Long run elasticity
Bangladesh	1.000	1.00	.049	.480	2.08	.022	.072
Burma	---	---	---	1.000	1.00	.043	.043
India	1.000	1.00	.156	.452	2.21	.060	.216
Indonesia	.348	2.83	.269	1.000	1.00	.074	.343
Japan	1.000	1.00	.456	.629	1.59	.092	.503
South Korea	1.000	1.00	.396	.722	1.39	.071	.467
Pakistan	---	---	---	.234	4.27	.389	.389
Philippines	.555	1.80	.355	1.000	1.00	.116	.471
Thailand	---	---	---	.208	4.81	1.620	1.620
Taiwan	1.000	1.00	.119	.373	2.68	.1159	.171
United States	---	---	---	.340	2.94	.369	.311

^aAdjustment coefficient is 1 minus the coefficient of the one year lagged dependent variable.

If no lag effect was detected, the coefficient equals 1.

^bAdjustment period is 1 divided by the adjustment coefficient.

^cLongrun elasticity is its shortrun elasticity multiplied by the adjustment period.

^dLongrun production elasticities are calculated the same way as shortrun production elasticities.

For countries where longrun elasticities for yield or area harvested were not detected, the shortrun elasticities are also regarded as longrun elasticities with a one year adjustment period.

Table 10.--Price and income elasticities of rice demand in Asia and the U.S.

Countries	Price elasticities	Income elasticities
Bangladesh	-.028	---
Burma	-.026	-.218*
P.R.C. /	-.005	---
India	---	-.079
Indonesia /	-.046	.308*
Japan	---	-.189*
South Korea	-.169**	.102*
Pakistan	-.139	-.534*
Philippines	-.170	.243*
Thailand	---	-.131*
Taiwan	-.074	-.081**
United States	-.180*	.600*

* = 5% significance level

** = 10% significance level

/ Elasticities with respect to Thai rice export prices.

Source: Grant et al., Ito

elasticities were found for Indonesia, South Korea, and the Philippines. The preponderance of negative income elasticities in Asian countries stood in sharp contrast with the situation in the rest of the world, including the United States, where income elasticities were positive.

Implications for the U.S. Rice Industry

Rice production and consumption elasticities in Asia were very low, indicating

very little price response. This was expected for two reasons.

First, rice production is implicit given the central role of rice in the diet of Asian families. Second, once land is developed for paddy production, it tends to become specialized in that use and substitution of other crops is relatively restricted. Asian governments are more sensitive to prices for rice than other commodities. Most governments have implemented price control policies over domestic rice prices. Inelastic price response in production does not mean production is not increasing. Rather, rice production in Asia has increased substantially in response to subsidies for fertilizers and technological improvements.

Negative income elasticities of demand for rice, particularly in rice exporting countries, indicate that consumers in these countries are relatively satisfied with current levels of rice consumption, and that as their incomes grow, their rice consumption may decrease, supplemented by increased consumption of wheat, meat, and dairy products.

Given these observations, and the fact that Asian rice production has grown rapidly, it is reasonable to believe that Asia has the potential to increase supplies of rice for export. This is particularly evident in the current exporting countries such as Burma, India, Pakistan, PRC, and Thailand, and poses an even greater challenge to the U.S. industry in world rice trade.

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Table II.--Rice (rough equivalent): Supply, disappearance, area, and prices 1/

Item	1981/82	1982/83	1983/84 2/	1984/85 3/
		Million cwt		
Supply				
Beginning stocks, August 1	16.5	49.0	71.5	46.9
Production	182.7	153.6	99.7	136.4
Total 4/	199.6	203.1	171.9	185.0
Disappearance				
Food 5/	42.5	37.3	33.4	38.0
Seed	4.4	3.2	3.9	3.0
Brewers	12.7	13.5	12.4	13.0
Total domestic 6/	68.6	62.9	54.7	59.0
Exports	82.0	68.9	70.3	62.0
Total	150.6	131.8	125.0	121.0
Ending stocks, July 31	49.0	71.5	46.9	64.0
		Million acres		
Area				
Planted	3.83	3.29	2.19	2.80
Harvested	3.79	3.26	2.17	2.78
Allotment	1.80	1.80	---	---
		Pounds per acre		
Yield per harvested acre	4,819	4,710	4,598	4,926
		Dollars per cwt		
Prices				
Received by farmers	9.05	8.11	8.50	8.00-8.60
Loan rate	8.01	8.14	8.14	8.00
Target rate	10.68	10.85	11.40	11.90

1/ Consolidated supply and disappearance of rough and milled rice. Milled-rice data converted to rough-rice basis using annually derived extraction rates as factors. 2/ Preliminary. 3/ Projected. 4/ Includes imports. 5/ Food use includes shipments to U.S. territories. 6/ Includes a residual.