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Impact of Japanese Rice and Wheat Policy on Trade*

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Abstract

Jabara, Cathy L, and William T. Coyle (USDA) - Impact of Japanese Rice and Wheat Policy on Trade. The interaction between Japanese rice and wheat policy and the impact on trade is analysed through estimation of an annual, econometric model describing production, consumption, and trade. Simulation results indicate recent policies designed to reduce surplus rice stocks decrease wheat imports,but rice production and consumption are not balanced.

Impact of Japanese Rice and Wheat Policy on Trade

The objective of Japanese agricultural policy since the early 1960's has been to increase farm incomes by raising the farm price of rice, the country's principal agricultural crop, while at the same time maintaining affordable consumer prices. These objectives were accomplished through the two-tiered pricing scheme administered by the Japanese Food Agency, the principal purchaser and seller of rice and its close substitute wheat, in which producer support prices were maintained at higher levels than the consumer equivalent. In recent years, however, the accumulation of rice surpluses has forced Japans policy makers to implement major changes in rice policy. These policy changes include payments to producers to divert paddy land to production of priority crops such as wheat, soybeans, and barley; adjustment in the wholesale (resale) prices of rice and wheat to favor rice consumption; adjustment in producer support prices to favor production of crops other than rice.; and disposal of accumulated surplus rice stocks by subsidizing rice for export and for domestic use as feed.

Each aspect of Japan's rice policy has a potential impact on U.S. agricultural trade with Japan, a major market for U.S. agricultural exports, or on U.S. trade with third countries. Increased production of wheat in Japan will compete directly with wheat imports. Exports of surplus rice could affect the volume of U.S. rice exports to third countries. Subsidized use of rice in formula feed production will displace corn and/or sorghum imports on a near one-to-one basis.

Previous studies of Japanese agriculture have analyzed the social costs of agricultural programs (Bale and Greenshields) or analyzed the impact of a change in the resale wheat price on Japanese wheat imports (Greenshields). The purpose of this study is to provide a more comprehensive framework for analysis of Japanese agricultural policies by considering explicitly the interaction of Japanese rice and wheat policies. An econometric model of the Japanese rice and wheat sectors is estimated and the model is used to simulate the initial impact of changes in producer support and resale prices of rice and wheat and an increase in the paddy land diversion payment on rice stock levels, rice exports, and wheat trade.

Conceptual Model

An annual, econometric model is estimated and used to analyze the interaction between Japanese rice and wheat policies and their impact on trade. The model describes production, consumption, and trade in both commodities. Prices for rice and wheat in Japan are regulated at all levels - producer, wholesale, and retail - and are therefore not simultaneously determined in the model solution. 1/

Figure 1 illustrates the interrelationships of the rice and wheat markets described by the model. 2/ Panels (a) - (c) describe the impact of Japanese pricing policies on wheat trade. The S and D schedules in panel (a) of figure 1 represent supply and demand for rice. By fixing producer (PPR) and consumer (PR) prices above the market clearing levels, the government generates surplus rice stocks equal to the distance $Q_0 - Q_3$. The imbalance between production and consumption can be reduced, say, to $Q_1 - Q_2$, by lowering PPR, by offering diversion payments to rice producers (which shift the supply curve leftward to S'), and/or by reducing

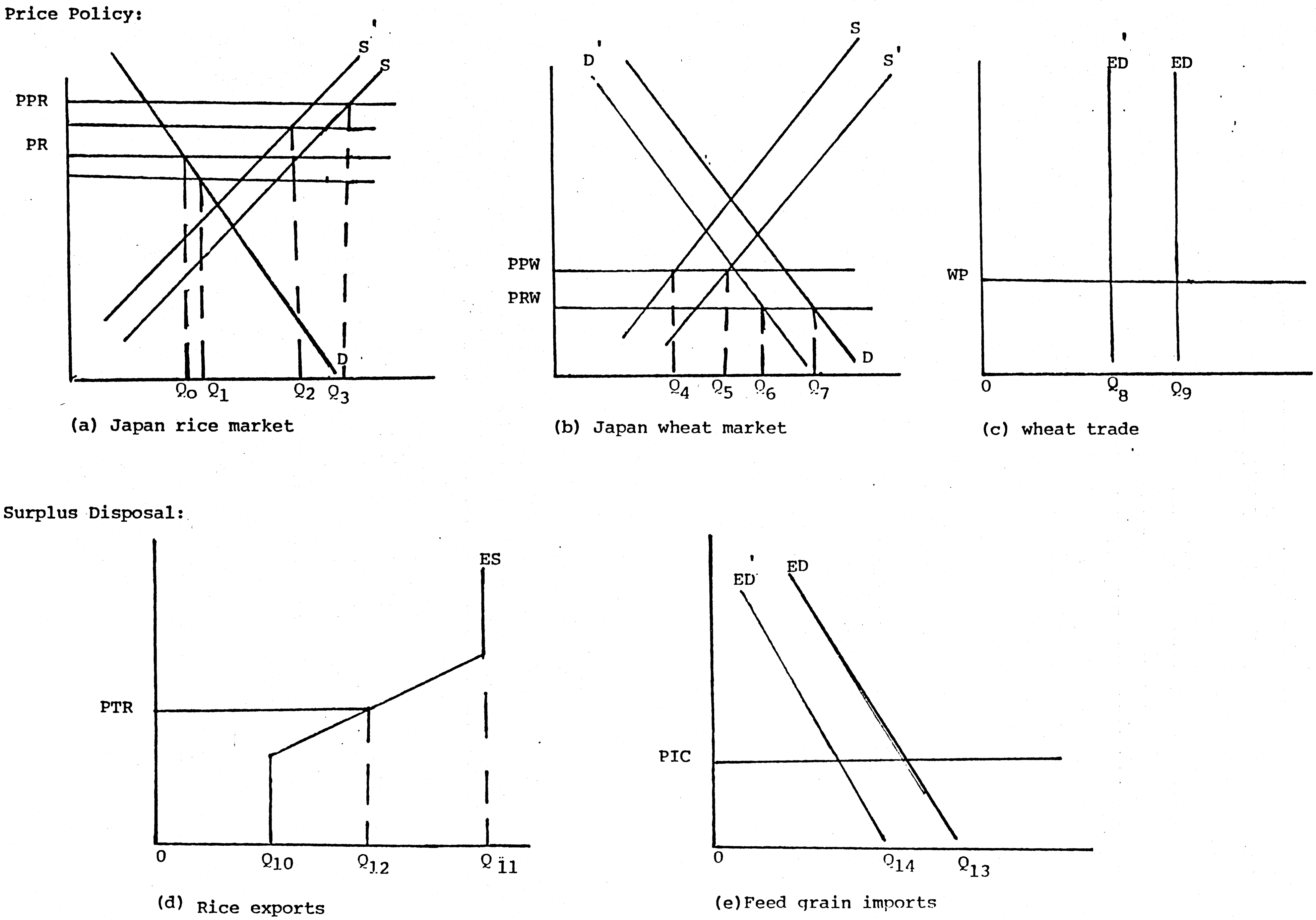

Figure 1. Trade impacts of Japanese rice and wheat policy.

PR to encourage consumption of rice. These price changes generate corresponding shifts in the supply and demand for wheat (S' and D'), a substitute for rice in production and in consumption, based upon the cross - price relationships between the two commodities (panel b). As a result of the policies, wheat imports decline from $0 - Q_9$ to $0 - Q_8$.

Trade effects of the Japanese surplus disposal program are represented in panels (d) and (e) of figure 1. In panel (d), the excess supply curve of rice has zero slope at Q_{10}, which represents the minimum annual level of exports required by the disposal program, but at some point is upward sloping to represent the opportunity cost of rice in terms of feed value. At the world rice price level represented by PTR, rice exports equal the distance $0 - Q_{12}$ and rice stocks used in formula feed are equal to $Q_{11} - Q_{12}$. Feed grain imports decline from $0 - Q_{13}$ to $0 - Q_{14}$ (panel e).

Econometric Results

The empirical model is comprised of 11 equations of which 9 are behavioral and estimated with ordinary least squares (OLS). Because prices and quantities are not simultaneously determined, the model can be solved recursively. Therefore OLS estimation yields consistent and unbiased estimates of the parameters. The presence of lagged dependent variables on the righthand side of several equations may lead to estimation difficulties in that OLS is no longer a consistent estimator. However, Dhrymes (p. 401) notes that the difference between OLS and more complicated estimation procedures is not large in certain small sample situations.

Equations 1-6 are specified to show the interrelationship of

Table 1. OLS estimates of structural equations, Japanese wheat and rice sector model, 1960-77.

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1. $QDW_t = .06185 - .00555\ Y_t - .00014\ \frac{PRW_t}{PRR_t}$

(15.069) (-2.1201) (-4.3740)
(-.1653) (-.1746)

$\bar{R}^2$ = .83; DW = 2.30; N = 17

2. $\Delta WS_t = 1790.33 - 1.0707\ WS_{t-1} - 2.0054\ EXR + 395.75\ D1$

(4.5089) (-5.5538) (-2.4739) (4.3568)
(-22.15) (-12.78)

$\bar{R}^2$ = .68; DW = 1.65; N = 17

3. $QDR_t = .17133 - .02902\ Y - .00010\ \frac{PR_t}{PN_t} - .00018\ PF_t$

(48.552) (-4.8683) (-3.5054) (-2.1138)
(-.2357) (-.0839) (-.1057)

$\bar{R}^2$ = .98; DW = 1.40; N = 17

average

4. $AW_t = 562.03 + .5562\ AW_{t-1} + .00118\ PPW_{t-1} - 2.9814\ MAN - .00162\ PPR_{t-1}$

(1.8316) (2.1437) (1.7940) (-1.3421) (-3.1356)
(.6115) (.4202) (-.7042) (-1.1539)

$\bar{R}^2$ = .99; DW = 1.30; N = 17

5. $AR_t = 835.56 + .7377\ AR_{t-1} + 391.31\ PPR_{t-1} - .00259\ PPW_{t-1} - .59826\ DV_t - 450.59\ PPV_{t-1} +$

(1.6435) (4.8283) (2.4065) (-1.8196) (-7.3679) (-3.6279)
(.7456) (.1225) (-.0926) (-.0454) (-.1344)

$5.4655\ MAN$

(1.6859)
(.1305)

$\bar{R}^2$ = .99; DW = 2.90; N = 17

yield

6. $YDR_t = 5.2755 - .00061\ AR_t + .88935\ PPR_{t-1} - .41389\ D2$

(5.6209) (-2.6225) (2.6408) (-2.7094)
(-.4356) (.2002)

$\bar{R}^2$ = .69; DW = 1.20; N = 17

ex.

7. $REX_t = -102.94 + .06591\ RS_{t-1} + 83.899\ \left(\frac{D3*PTR_{t-1}}{PIC_{t-1}}\right) - 226.543\ D1$

-1.0376) (4.6780) (2.9356) (-3.3159)
(1.2693)

$\bar{R}^2$ = .95; DW = 2.30; N = 9

8. $PRW_t = 25886 - .25301\ WP_t - 1.2377\ RS_{t-1} + 40242\ CPI_t$

(10.086) (-3.4478) (-4.1993) (11.518)
(-.2018) (-.1598) (.7017)

$\bar{R}^2$ = .91; DW = 1.42; N = 17

9. $PR_t = 9510.8 + 198023\ CPI_t$

(-.6207) (10.317)
(1.079)

$\bar{R}^2$ = .96; DW = 1.52; N = 17

10. $MW_t = QDW_t * POP + \Delta WS_t - AW_t * YW_t$

11. $\Delta RS_t = QDR_t * POP + REX_t + RF_t - AR_t * YDR_t$

Notes:

1) T - Values reported below estimated coefficient.
2) Elasticities reported in parentheses below T - values.

Table 2: Variable definitions for Japanese wheat and rice sector model.[1/]

Endogenous Variables

QDW_t = per capita Japanese consumption of wheat, 1000 MT,

WS_t = end of period wheat stocks, 1000 MT,

QDR_t = per capita Japanese consumption of rice, brown basis, 1000 MT,

AW_t = acreage planted in wheat, 1000 Hectares,

AR_t = acreage planted in rice, 1000 Hectares,

YDR_t = yield of rice, 1000 MT/Hectare.

REX_t = Japanese net rice exports, 1000 MT,

MW_t = Japanese wheat imports, 1000 MT,

RS_t = Japanese end of period rice stocks, 1000 MT,

PR_t = government resale price of rice, yen per ton,

PRW_t = government resale price of wheat, yen per ton,

Predetermined Variables

Y_t = per capita Japanese income, deflated by the consumer price index, (CPI_t),

RF_t = rice stocks diverted to feed, 1000 MT, 1970/71 - 1973/74,

WP_t = c.i.f. import price of wheat, yen per ton,

PRR_t = retail price of rice, deflated by CPI_t, 1975/76 = 1000, yen per ton,

EXR = U.S. $ - yen exchange rate, yen per dollar,

D1 = dummy variable representing policy of Japanese government to hold larger stocks, 1975/76 - 1977/78 = 1, = 0 all other years,

PN_t = retail price of dried wheat noodles, deflated by CPI, 1975/76 = 1000, yen per Kg.,

PF_t = retail price index for fish, 1975/76 = 1000, deflated by CPI,

PPW_t [2/] = wheat support price, yen per ton,

PPR_t = support price for rice, yen per ton,

DV_t = payments to producers for production of wheat and other priority crops on paddy land, yen per Hectare,

MAN = index of wages in manufacturing sector, 1975/76 = 1000, deflated by CPI,

PPV_t = index of prices received for vegetables, 1975/76 = 1000,

D2 = dummy variable representing low rice yields not attributable to economic variables, = 1 in 1971/72 and 1976/77, = 0 all other years,

PTR_t = Thai rice export price, $ per ton,

PIC_t = Japanese c.i.f. import price of corn, $ per ton,

D3 = Variable representing surplus disposal prigram, 1970/71 - 1973/74 = 1, -0 other years.

1/ All variables on Japanese fiscal year basis, April - March.

2/ PPW, DV_t, and PPR (equation 4) are deflated by an index of prices paid by producers (PPI), 1975/76 = 1000. PPR and PPV are deflated by the index of prices paid for fertilizer (PFI), 1975/76 = 1000.

the rice and wheat sectors with producer and resale prices of rice and wheat set by the government. Equations 7-9 are policy reaction functions which relate government behavior in the rice export market and in setting the resale prices of rice and wheat to economic and policy variables. The model specification assumes that wheat stocks are desired, whereas rice stocks are determined through a market clearing identity (equation 11). Wheat imports are determined as a residual in equation 10. Feed use of rice (RF_t) in previous diversion programs (1970/71 - 1973/74) is treated as exogenous due to lack of sufficient observations.

Equations 1 and 3 are reduced form demand equations in that they are derived from a consumer demand function, a supply function for the intermediate marketing sector, and a market clearing identity. Negative income elasticities indicate that both rice and wheat are inferior goods in Japan. These results are not surprising as a negative income elasticity of demand for wheat was also obtained by Greenshields and a negative income elasticity for rice was also obtained by Rojko, et. al. 3/ The results of equation 2, which relates government - held wheat stocks to economic and policy variables, indicate that the exchange rate, the level of last years wheat stocks, and storage capacity are important variables determining current wheat stocks and wheat imports. World wheat prices did not appear to be significantly related to wheat stock demand.

Equations 4-6 are expressed as functions of lagged producer prices because the government support prices are not announced until after the decisions to plant the crops have been made. The estimated price elasticities indicate that wheat acreage is more responsive to price changes than is rice acreage. The coefficient of MAN in equation 6, although not statistically significant, indicates a negative relationship between wheat production and wages received in the maunfacturing sector, whereas rice acreage is positively related. 4/

The results of equation 5 also indicate that rice diversion payments (DV_t), initiated since 1969, have been an important factor in reducing rice acreage. DV_t, however, was not significantly related to wheat acreage and this variable was dropped from equation 4. This relationship is expected to change in the future with increases in diversion payments which make wheat production more competitive with rice production (Coyle). A yield equation for wheat was not estimated because yields appear to have remained fairly stable over the estimation period.

The coefficient of PTR/PIC in equation 7 indicates that during the previous disposal program, 1970/71 - 1973/74, the volume of rice allocated to export and feed use was partly determined by relative prices of rice and imported feed. The level of last years rice stocks, a proxy for the cost of storage, is positively related to rice exports. Equations 8 and 9 indicate that resale prices of rice and wheat are significantly determined by the consumer price index in Japan. Equation 8 also indicates a negative relationship between the world price of wheat (WP_t) and the resale wheat price, PRW_t. This relationship is due to the government maintaining high wheat despite declines in the world wheat price since 1974.

Simulation Results

Equations 1-7 and 10-11 are used to analyze the impact of exogenous increases in the resale and producer prices of wheat on Japanese rice stocks and wheat trade. The model is solved for the initial (one year) impact of the price changes. The impact of price changes on rice exports is shown in year 2 because current price changes affect rice exports in the following period.

The base year chosen is 1973 because that is the last year for which data is available in which Japan was administering a surplus disposal as well as a diversion program. Since Japan is currently administering a 5 - year surplus disposal program and a 10 - year diversion program, it is believed that current conditions are similar to that earlier period.

The simulated impact of the price changes are summarized in table 3. Simulation I presents the impact of an 11.0 percent increase in the relative resale price of wheat to rice and a 2.4 percent increase in the producer price of wheat relative to rice.5/ This resale price increase was effective February 1980, and the producer price increase went into effect for the 1979/80 crop year. The results of simulation I indicate an initial decline in wheat imports of 1.1 percent from the 1973 base. Rice consumption and production are not brought into balance from these price changes although current rice stocks decline 1.3 percent from the 1973 base level. This results in a decline in rice exports in the following period of 6.9 percent.

Simulation II presents the results of increasing the rice diversion payment 33.1 percent to the new level announced for the 1978/79 crop year in addition to the changes introduced in simulation I. The increase in the diversion payment results in a reduction in rice production of 2.5 percent, although rice production and consumption are still not brought into balance. Rice stocks decline 8.1 percent from the 1973 base and rice exports 13.6 percent in the following period. The impact of diversion payments on wheat production is not evaluated in this simulation. However, it would be expected that part of the land taken out of rice production will be diverted to wheat production in the future.

Table 3 - - Comparison of actual 1973 values with solution values for 1973 and simulation results.

Variable	Actual 1973	Solution 1973	Simulation I[a] value	Simulation I[a] % Δ	Simulation II[c] value	Simulation II[c] % Δ
Wheat consumption	5584	5497	5446	-1.0	5446	-1.0
Wheat stocks	1110	1143	1143	0.0	1143	0.0
Rice consumption	12077	11881	11920	.3	11920	.3
Wheat production	202	192	200	4.1	200	4.1
Rice area	2622	2678	2671	-.3	2570	-4.0
Rice yield	4.633	4.628	4.632	.1	4.693	1.4
Rice Production	12149	12396	12374	-.2	12065	-2.5
Rice exports	392	418	389[b]	-6.9[b]	368[b]	-13.6[b]
Rice stocks	4095	4512	4452	-1.3	4144	-8.1
Wheat imports	5353	5278	5219	-1.1	5219	-1.1

a/ Increase in the relative wheat to rice resale price of 11 percent and on increase in the relative wheat to rice producer price of 2.4 percent.

b/ Change realized in period following the price changes (t+1).

c/ Increase in rice diversion payment from 400,000 yen per hectare to 550,000 yen per hectare in addition to price changes in simulation I.

Conclusions

This paper has analyzed the interaction of Japanese rice and wheat policies and the impact on trade. The results of the 1973 econometric model simulation indicate that the initial impact of recent adjustments in Japanese resale and producer prices of rice and wheat results in a decline in wheat imports and a decline in rice exports from the 1973 base year. However, these price changes are not sufficient to bring rice production and consumption into balance. This suggests that further price changes will be required or that Japan will continue to export rice to alleviate its rice surplus problem.

1. Lattimore and Zwart endogenized the Japanese wheat resale price by expressing it as a function of the world wheat price, the consumer price index, and the exchange rate.

2. Implicit in the analysis is the small country assumption, i.e., it is assumed that the volume of Japan's trade does not affect world market prices.

3. Bale and Greenshields obtained positive income elasticities, however, their dependent variables were not on a per capita basis.

4. Increases in the manufacturing wage rate have encouraged the long run decline in wheat production in Japan because farm laborers work off the farm instead of cultivating double crop wheat with rice.

5. The increase in the wheat noodle price in equation 1 was limited to .3 of the increase in the wheat resale price.

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