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EFFICIENCY GAINS AND ADJUSTMENT COSTS OF REFORMING THE U.S. RICE PROGRAM †

United States rice exports in 1986 accounted for over 18 percent of the world rice trade. In 1987 U.S. exports are estimated to have captured one-fifth of the world market. If current policies continue, the market share may once again reach the 25 percent share that characterized the early 1980s.

The recent increase in market share is not, unfortunately, the result of an increasingly competitive industry. Declines in the value of the dollar have undoubtedly helped, but improvements in the export picture are due largely to massive government subsidies. For example, in 1986 the world price of rice as estimated by the U.S. Department of Agriculture (USDA) averaged $3.88 per hundredweight (cwt). The average variable costs of production for similar quality grain in the United States, on the other hand, ranged from $6.38 per cwt in California to $8.49 per cwt in Louisiana (Wailes and Holder, 1986).

Total government subsidies to rice growers in 1986 were approximately $915 million. The average rice farm received a deficiency payment of $49,545 and $37,363 in marketing loan certificates (USDA, 1987b, p. 3). Although the 1985 Farm Bill placed a $50,000 cap on deficiency payments, many, if not most, farmers avoided this restriction by dividing farms into multiple entities, each of which was eligible for program benefits (*Washington Riceletter*, 1987).

The significance of the United States in the world rice market and the extent to which U.S. supply is policy-induced suggest that the U.S. rice program may be an important issue during the General Agreement on Trade

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and Tariffs (GATT) negotiations on trade policy initiated in Uruguay. Furthermore, in light of the current emphasis on budget balancing in the U.S. Congress, rice program costs amounting to about one-fifteenth of total commodity program costs may be a domestic issue as well. Estimates presented later in the paper suggest that the static economic or efficiency costs of the 1986 rice program (rather than the budget costs) reached about $350 million. While eliminating price support would save the economy $350 million, discarding all support would almost surely produce a massive contraction of the U.S. rice industry. The social cost of shifting resources from rice to alternative uses is assumed away in the static calculation. Theoretically at least, the adjustment costs of removing price supports as measured by the social value of agricultural production lost during the period of unemployment and underemployment might overwhelm the efficiency gains achieved by cutting domestic rice output. If so, it would be foolish for the United States to negotiate away a domestic farm program in the Uruguay Round or to cut it from the national budget. A method is therefore needed to measure not only the gains from liberalized trade but the domestic adjustment costs as well. Only when these costs are accounted for can one assess the relative merits of liberalizing trade in a given commodity.

After reviewing the nature of U.S. rice production and world markets for the crop, this paper describes traditional methods for assessing the efficiency gains or losses associated with policy changes and proposes a method for estimating the economic cost of displacing labor from a declining sector. The net effect of reducing support to the rice sector will then be evaluated by combining these methodologies. Finally, the paper briefly explores the implications of altering domestic rice policies in conjunction with more liberal rice trade worldwide.

SUPPLY AND DEMAND IN THE U.S. RICE INDUSTRY

U.S. rice production is concentrated in five states: Arkansas, Louisiana, Mississippi, Texas, and California. Although rice accounts for a very small portion of national crop production and export earnings, the commodity is significant to the Mississippi Delta states and to a lesser extent in California and Texas. In 1984 rice made up 0.9 percent of U.S. agricultural commodity cash receipts, but provided 14 percent of such earnings in Arkansas and 12.1 percent in Louisiana (USDA, ERS, 1985b, pp. 90–130). Table 1 shows the importance of rice in producer states.

Rice production is highly mechanized in all five states, but production costs vary considerably from state to state. California is the lowest cost producer at $6.27/cwt for medium grain rice, and Texas and Louisiana are the highest at about $9.00/cwt (Table 2). The difference in cost per bushel between the West Coast and the Gulf Coast results from higher

Table 1.—Cash Receipts from Rice as a Portion of Total Cash Receipts and Portion of Cropped Land in Rice Production
(*Percent*)

State	Receipts 1981	Receipts 1984	Cropped land, 1984
Arkansas	18.8	14.0	16.0
California	2.3	1.8	5.4
Louisiana	16.5	12.1	10.9
Mississippi	6.2	3.1	3.8
Texas	3.2	1.1	1.8
United States	1.2	0.9	—

Source: Receipts from U.S. Department of Agriculture, Economic Research Service, 1985, *Economic Indicators for the Farm Sector: State Financial Summary 1984*, Washington, D.C., pp. 168–73; cropped land from USDA, 1984, *Agricultural Statistics, 1984*, p. 376.

Table 2.—Average Variable Cost of Rice Production by State*
(*Dollars per cwt, rough*)

State	Long grain	Medium grain	Short grain
Arkansas	7.30	6.96	7.23
California	6.38	6.27	5.88
Louisiana	8.49	9.00	n.a.
Mississippi	6.75	n.a.	n.a.
Texas	8.37	10.21	n.a.

Source: Eric Wailes and Shelby Holder, 1986, *A Study of Spatial Organization of the U.S. Rice Industry*, University of Arkansas, Fayetteville, March.

*Calculations presented in this paper assumed medium-grain production in Arkansas and California, and long-grain production in Mississippi, Louisiana, and Texas. This follows the general trend presented in U.S. Department of Agriculture, 1987, *Rice Situation*, RS-49, Washington, D.C., April.

yields achieved in California. This yield differential is due more to natural conditions than differences in farming technique. The budgets from which these costs were derived did not include land costs. Since the opportunity cost of land is higher in California than in Louisiana and Texas, more complete budgets would show higher costs in all states and a smaller spread in production expenses (Monke, Pearson, Akrasanee, 1976).

Elasticities of supply also vary considerably from state to state (Table 3). Grant, Beach, and Lin (1984) found the supply elasticity lowest in Mississippi (0.0887) and highest in California (0.1843). Given different supply elasticities and different average minimum variable costs, the supply response curves for rice must differ from state to state. Chart 1 provides a rough approximation of each state's supply function based on 1986 production, Grant, Beach, and Lin's 1982 elasticities, and average variable costs from Wailes and Holder (1986).

Table 3.—Estimated Supply and Demand Elasticities for U.S. Rice

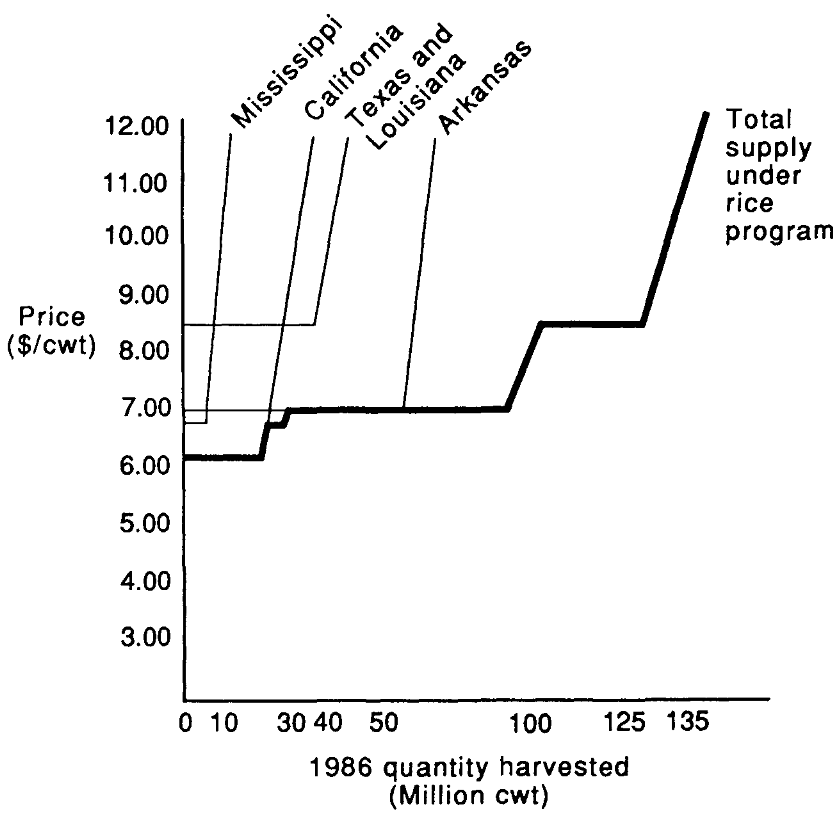
Supply state	Acres planted/ price	Quantity/ price
Arkansas	0.0944	0.0618
California	0.1843	0.1843
Louisiana	0.1407	0.1407
Mississippi	0.0887	0.0887
Texas	0.1465	0.1358
U.S. weighted average	0.1254	0.1101

Demand	Domestic total	Food only	Export
1955[a]	−0.04	—	—
1960[b]	−0.15	—	−8.00
1969[b]	−0.20	—	—
1975[c]	−0.07	—	—
1982[d]	—	−0.18	−3.16

Sources: [a]G.E. Brandow in Warren R. Grant, John Beach, and William Lin, 1984, *Factors Affecting Supply, Demand, and Prices of U.S. Rice*, U.S. Department of Agriculture, ERS, Washington, D.C., October; [b]Leon A. Mears, 1975, "The Political Economy of Rice in the United States," *Food Research Institute Studies*, Vol. 14, No. 4, pp. 319–75; [c]Warren R. Grant and Mack Leath in Grant, Beach, and Lin, op. cit.; [d]Grant, Beach, and Lin, op. cit.

The policy environment in which the elasticities shown above were generated was altered by the 1985 Farm Bill. As far as rice is concerned, the bill aimed at reducing stocks and increasing exports through a marketing loan mechanism. This scheme allowed rice farmers to pay back loans at the world market price thereby making U.S. rice competitive internationally. Regardless of the policy regime, it is likely that rice supply is quite inelastic in the short run and that the own price elasticities are similar to

Chart 1.—Structure of U.S. Rice Supply



Source: Based on elasticities given in Warren R. Grant, John Beach, and William Lin, 1984, *Factors Affecting Supply, Demand, and Prices of U.S. Rice*, U.S. Department of Agriculture, ERS, Washington, D.C., October; average cost data from Michael Cook and Charles Moore, 1986, "The Rice Sector," in Harold Carter, ed., *Impacts of Farm Policy and Technical Change on U.S. and California Agriculture*, Agricultural Issues Center, University of California (Tables 3 and 4); and production data from U.S. Department of Agriculture, 1987, *Rice Situation and Report*, RS-49, Washington, D.C. The curve implies that production ends in a state when price falls below the statewide average variable costs. Since some farms will remain in production at lower prices, this function exaggerates output effects and adjustment costs.

those given by Grant, Beach, and Lin. Regional or state supply curves based on the aforementioned econometric studies are summed horizontally to approximate the national supply function shown in Chart 1. Although the derivation of the curve is somewhat ad hoc, it is sufficiently accurate to provide the basis for an estimate of the efficiency gains likely to be obtained from a reduction in government subsidies.

The Demand for U.S Rice

The United States produces only 1 or 2 percent of world rice output, but it produces up to one-third of all rice moving in international markets. In 1986/87, U.S. exports accounted for 54 percent of disappearance and 60 percent of production. High loan rates resulting in high domestic prices brought the U.S. market share down in recent years, but even with 15 to 20 percent of the world market the United States would still be a "large" country with considerable impact on the thin international rice market (USDA, 1987b, p. 24).

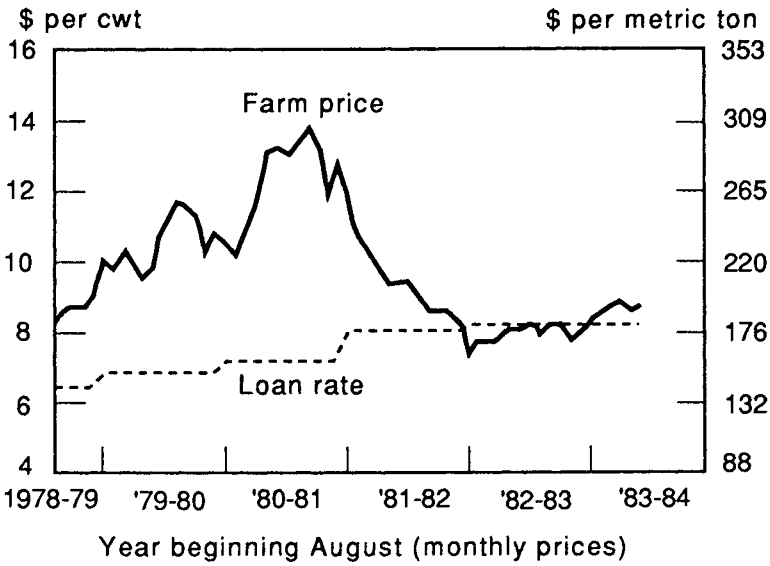
The thinness of the rice market is illustrated by 1985/86 production and trade statistics. In that year, 329 million metric tons (mmt), milled equivalent, were produced worldwide. Only 3.9 percent of this (13 mmt) was traded internationally (USDA, 1987b).[1] The small quantities of rice moving in international markets implies that a production shortfall in any major producer can have enormous impact on international trade. For example, if output in a major rainfed producer such as India had been 15 percent under its actual level because of a monsoon failure, total supplies would have been reduced by 14 mmt, more than the total amount of rice traded internationally in that particular year. A 15 percent deviation in production is not unprecedented in India. India's combined stocks and production were 12 percent lower in the 1982/83 crop year than the year before, but rose 22 percent in the following year. Countries need not turn to the international market to compensate for domestic shortfalls, but rice tends to be imported in erratic and unpredictable amounts. In 1982 India imported 315 thousand mt (milled equivalent); in 1983, 560; and in 1984, 10 (USDA, 1987b).

India is by no means the only source of instability. Much of Asian production is dependent on the monsoon, and vagaries of weather can have a tremendous impact on import demand and the world price. Bad harvests in Asia in 1973 and 1974 sent prices up 261 percent, from \$150/mt to \$542/mt, f.o.b. Bangkok. Chart 2 displays these price instabilities.

The extreme volatility of world rice prices has encouraged many governments to impose price stabilization schemes (Monke and Pearson, 1987). Paradoxically, such domestic stabilization measures reduce the elasticity of the import demand function for rice and exacerbate international price fluctuations. In stabilizing domestic prices, governments export price instability, which in turn increases the costs of stabilization programs (McCalla and Josling, 1985). For example, an exogenous shock to production (monsoon

[1] Rice is the staple food in most producing countries, and production is devoted primarily for domestic consumption. Even in Thailand, whose exports account for 30 percent of world trade, only 22 percent of production was exported in 1985/86.

Chart 2.—Rough Rice Farm Prices and Loan Rates



Source: U.S. Department of Agriculture, 1987, *Rice Situation and Outlook Report*, RS-43, Washington, D.C.

failure), may cause the world price of rice to increase. If consumers are insulated from price instability via some government program, their demand will not fall in response to rising world prices. These consumers will introduce an element of demand side inflation to the supply-led price increase. Similarly, if producers in a rice-exporting country are guaranteed a minimum price, then they will not voluntarily curtail production when world prices fall below that floor. Should technical change improve production in Asia such that import demand and world prices fall, these protected growers will maintain high levels of production for export, thereby accelerating the decline in world prices.

Ideally, if rice farming were profitable on average but subject to periods of negative net revenues, the social problems of adjustment would be handled by making financial assistance available to farmers in "bad" years and collecting debts in "good" years. (Bad and good years in this case obviously correspond to strong and weak global harvests.) In such a scheme, savings would adjust to stabilize incomes and factors, such as labor, would not have to be adjusted unnecessarily.

From the perspective of economic efficiency, policies that intervene in the commodity market itself are inappropriate. But if such second-best outcomes are deemed essential, the appropriate intervention strategy would try to stabilize output around long-term price trends. Admittedly, the thinness of the market and the prevalence of interventions by many other governments make it difficult to establish a trend price and project it into the future with any accuracy (Monke and Pearson, 1987). Nevertheless, it seems reasonably clear that the trend price is much less than $11.66/cwt, last year's U.S. target price for rice. The roots of U.S. policy must be found elsewhere (Chart 2).

The U.S. Rice Program

U.S. rice policy uses target prices, loan rates, and marketing loan rates to manipulate prices received by farmers, and land set-asides to restrict production. The *target price* ensures a floor price to producers for income support. This price, $11.66/cwt in 1987 and $11.90/cwt in 1986, never appears in the market. But the U.S. government stands ready to pay participating farmers the difference between the market price and the target price as a "deficiency payment." To be eligible for deficiency payments in 1987, farmers were required to set aside 35 percent of their land. While set-asides have contributed to a 40 percent reduction of rice acreage since 1981, yield increases have kept production from falling appreciably.

The second price mechanism is the *loan rate.* This is the price at which the Commodity Credit Corporation (CCC) values a farmer's crop when making non-recourse loans. Should the market price be below the loan rate ($6.84/cwt in 1987, $7.20/cwt in 1986), the farmer may turn over his crop to the CCC, essentially selling it at the loan rate (USDA, ERS, 1987b). This policy has two implications. First, if world prices remain below the loan rate in consecutive years, the government acquires vast and costly stocks. Second, since the United States is a major factor in the world rice market, the loan rate may become the price floor for all producers. Other rice exporters are thereby subsidized and consumers are taxed.

Marketing loan rates were established in 1985 in order to reduce U.S. rice stocks and consumer prices. Under this mechanism farmers are paid the difference between the loan rate and the world price, as announced every Tuesday at 3:00 p.m. by the Secretary of Agriculture, in the form of a marketing certificate. These certificates may be used to repay CCC loans as long as the world price is greater than one half of the loan rate. Marketing loan certificates are exempt from the $250,000 per farm payment cap (USDA, ERS, 1987a).

Because marketing loans are paid at the farm gate rather than at the border, they are technically not export subsidies. Arguably, the U.S. rice program is entirely domestic. Nonetheless, these rice policies do affect world trade. While the basic loan rate held the world price up in the early 1980s, the marketing loan system is probably depressing the world price now by stimulating U.S. exports.

U.S. Rice Policy Alternatives

Restricting itself to the three price mechanisms currently in use, the United States has numerous options for policy reform. Three relevant options are (1) to remove all price support; (2) to remove the marketing loan and loan rate and lower the target price; and (3) to remove the target price but maintain the loan rate and marketing loan. From an efficiency perspective, removing the target price while maintaining the loan rate price and the marketing loan has the same effect as removing the loan rate and marketing loan programs and lowering the target price to the level of the former loan rate. Hence only two alternative policies will be contrasted with maintaining the 1987 program.[2]

The marketing loan most closely resembles orthodox trade policy and is likely to be subject to more criticism from other rice exporters than the target and loan rate prices. However, it should be noted that eliminating the marketing loan while maintaining the loan rate and the target price would not reduce budget costs, but would promote stock accumulation. Production would not be affected, but consumer prices would rise. This argument has been used repeatedly to defend the policy. While the marketing loan should not be removed in isolation, it may be beneficial to eliminate the program in conjunction with other policy changes as suggested in option (2) above.

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[2] Other policy options would be to (a) remove the marketing loan but maintain the target price and loan rate; (b) remove the marketing loan and loan rate but maintain the target price; (c) remove the target price and the marketing loan but maintain the loan rate; (d) remove the loan rate but maintain its target price and marketing loan; (e) remove the target price and the loan rate but maintain the marketing loan; and (f) maintain the current policies. Option (a) is discussed in the text. Assuming that the marketing loan is based on the "true" world price and that there is no effective cap on deficiency payments, option (b) would have no efficiency impact. Option (c) would reduce government payments, production, and producer and consumer surplus by the same amount as policies (2) and (3) in the text. However, like option (a), this policy would make the government responsible for costly surplus stocks. Since the marketing loan is meaningless without a loan rate for reference, options (d) and (e) are meaningless. Thus the only relevant options are variations of those considered in the text. The form of the policies could be altered by not only varying the degree of subsidization but by changing mandatory set-asides or other compliance restrictions.

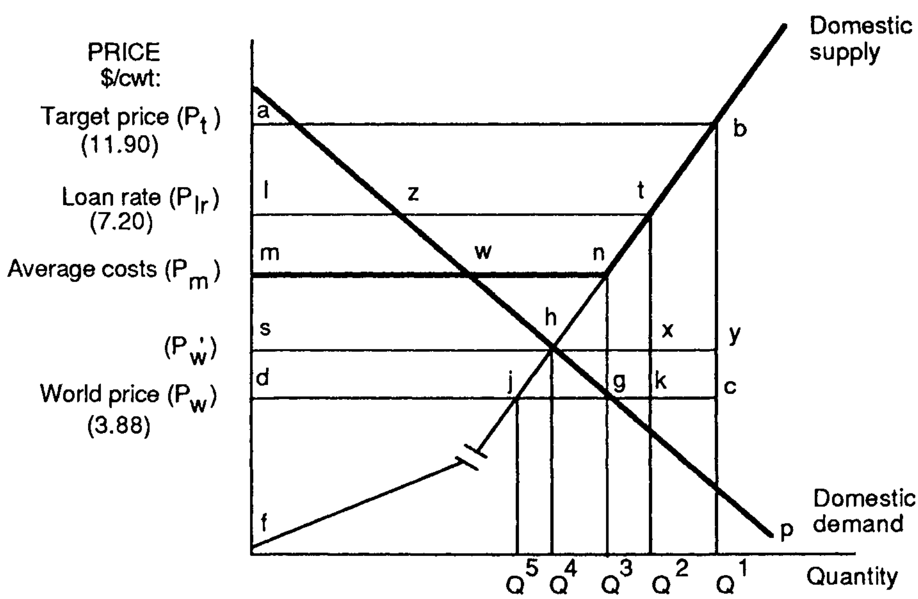
QUANTIFYING THE NET SOCIAL BENEFITS OF RICE POLICY OPTIONS

The social gain (or loss) of liberalization may be understood as the present value of the efficiency gains of liberalized trade minus the loss of productive output over the transition period (Bale, 1976, p. 245; Jenkins and Montmarquette, 1979; Baldwin and Mutti, 1973).

Estimating Static Efficiency Gains and Losses

Efficiency gains from removing the subsidy can be estimated by simply subtracting the consumer and producer losses from the budget savings (Johnson, 1960, pp. 327–34; Baldwin and Mutti, 1973, pp. 156–57; Cline et al., 1978, pp. 39–44). This procedure can be clarified with the aid of a partial equilibrium diagram (Chart 3).

Chart 3.—Partial Equilibrium Analysis of U.S. Rice Policy



Initial (1986) policy

Budget cost: abcd
Producer surplus: abnm
Consumer surplus: agd

In Chart 3, if government subsidies are giving farmers price P_t per cwt while the world price at which rice is eventually sold is P_w, the budget cost of the policy would be abcd or $(P_t - P_w)(Q_1)$.

Given the supply curve fb, the producer surplus under subsidization is abf. If price supports were removed, the price would fall to P_w. Under a small country assumption, production would fall from Q_1 to Q_5, and producer surplus would contract by $abjd$ or $(P_t - P_w)(Q_1) - .5(Q_1 - Q_5)(P_t - P_w)$. A reduction in supply in a large country will result in a higher world price (P'_w) thus reducing the change in price and the production response. Such a result would clearly alter the above equation. Although the United States is a large country in the rice market, this dynamic effect on the consumer side is unlikely to affect the producer surplus. The national supply curve for rice probably looks more like mnb than fb. This curve reflects the fact that when prices fall below the variable costs of production, P_m, supply drops to nothing. This minimum production price may exceed the prevailing world price, as in Chart 3. Assuming a linear supply curve, the producer surplus lost becomes $abnm$ or $[(P_t - P_m)Q_3 + .5(Q_1 - Q_3)(P_t - P_m)]$. Under these conditions, the increase in world price associated with the decline in production will not affect the calculation of producer surplus loss as long as the new world price is below the average variable cost of production in the United States. As shown previously, at 1986 production costs and world prices, rice farming would be unprofitable on average in every state even if world prices increased 50 percent in response to declining U.S. production.

Estimates of the difference between the producer surplus loss and the budget savings (*mnbcd*, the static production efficiency gain) will vary depending on the assumed elasticity of supply and minimum production price. Since supply elasticities are a function of existing policies and technologies, even recent estimates must be treated skeptically. Accordingly, production efficiency gains were evaluated under various assumptions regarding supply elasticity. Producers were disaggregated by state so that differences in elasticity and average variable costs could be accounted for. The formula used to estimate production efficiency gains by state was:

$$.5(P_t - P_m)(\triangle Q) + (P_m - P_w)(Q), \qquad (1)$$

where

$$\begin{aligned} P_t &= \text{the 1986 target price (\$11.90/cwt);} \\ P_m &= \text{the minimum production price or the} \\ &\quad \text{average variable cost of production;} \\ \triangle Q &= \text{the reduction in output associated with} \\ &\quad \text{the price fall from } P_t \text{ to } P_m; \\ P_w &= \text{is the world price, (\$3.88/cwt); and} \\ Q &= \text{the amount of production under the rice} \\ &\quad \text{program (94 percent of total 1986 output).} \end{aligned}$$

The large country effect is relevant for rice consumers. If the world price increased to P_w' in response to supply changes, consumption would fall from Q_3 to Q_4 and consumer surplus would contract by the trapezoid *shgd*:

$$.5(P_w' - P_w)(\triangle C) + Q_4(P_w' - P_w) \tag{2}$$

where

$$\begin{aligned} \triangle C &= \text{the change in consumption associated with the} \\ &\quad \text{price increase from } P_w \text{ to } P_w',\ Q_3 \rightarrow Q_4 \text{ in Chart 3.} \end{aligned}$$

The net social benefits in the absence of adjustment costs would therefore be the production efficiency gain (summed over each state) minus the consumer surplus loss, or the area of the chart:

$$abcd - abnm - shgd = mnbcghs$$

or,

$$.5(Q_1 - Q_3)(P_t - P_m) + (P_m - P_w)(Q_1) - [.5(Q_3 - Q_4)$$

$$(P_w' - P_w) + Q_4(P_w' - P_w)]. \tag{3}$$

Measuring Social Costs of Adjustment

Estimates of the adjustment cost cannot be taken directly from the partial equilibrium model. Furthermore, methods for measuring this value are not as well established as those for calculating the gains from subsidy removal. Adjustment cost measurement generally considers the loss associated with transferring labor inputs to new productive employment.

Capital losses are usually ignored as sunk costs; they are private but not social losses.

In an early attempt to compare adjustment costs with gains from liberalization, Baldwin and Mutti (1973) quantified labor adjustment costs by multiplying an estimate of the number of workers displaced by their gross weekly wage times the average duration of unemployment discounted over the duration of unemployment. This assumes that the gross wage equals the marginal social value of labor. (A similar method was used in Cline et al., 1978.)

Bale (1976) revised this method noting that the marginal social value of labor in an industry may differ from the gross wage if subsidies to the output of that industry are transferred into input subsidies or if the labor is unionized. Accordingly, he estimated the social cost of labor displacement as the average gross wage received by displaced workers once re-employed times the duration of their unemployment. Since labor is assumed to be re-employed at its marginal social value, adjustment losses do not extend beyond the period of unemployment.

More recent models (Jenkins and Montmarquette, 1979; Evans, Glenday, and Jenkins, 1980) are also based on a lost income analysis, but consider the social losses incurred if labor is re-employed at a lower level of productivity than in the pre-displacement situation. They compare the social value of labor output before the lay-offs with the social value of labor output after the lay-offs. A simplified version of their estimate of the social value of labor before displacement (I') is:

$$I' = A'P'W' \tag{4}$$

The symbol P' equals the labor hours spent at gross wage W'. A' represents an adjustment term which relates the social value of labor to its market valuation. If union power has won laborers a wage 30 percent greater than their marginal social value, this term would be 0.7.

The value of labor after displacement, I, is:

$$I = AP_tW_t, \tag{5}$$

where A is the adjustment term in the new industry; W_t is the new gross wage; and P_t is the amount of labor re-employed at time t. While some workers may retire from the labor force completely, they would only do so if the value of their time in retirement were as great as the value of their time at work. Therefore, retired workers can be aggregated with the rest of the labor force when calculating their social value (Jenkins and Marquette, 1979, p. 345).[3]

[3] While this method includes adjustment costs incurred after the initial period

The following analysis relies on the simplified version of the Jenkins model. In calculating the social value of labor in rice production before displacement ($A'P'W'$) the average annual wage for field labor by region as reported by the National Agricultural Statistics Service is used to estimate W' (USDA, 1986). P' is deduced from 1985 labor input coefficients and 1986 rice production.[4] Table 4 shows that during the 1980 to 1985 period, when rice acreage fell by 40 percent, labor input coefficients remained stable. Thus it seems safe to assume constant labor input coefficients over the adjustment period. It is assumed that there are no imperfections in the labor market and that any subsidy rents accrue to management not to labor. Therefore, A' for rice labor is set at unity. In estimating the value of labor in rice milling it was assumed that the 35 mills operating in the United States fit the specifications of the generic large mill described in Holder, Morrison, and Traylor (1974). Wages in milling are taken from the same study and inflated by the wage index reported by the International Monetary Fund (1986b).

Mill wages in California are typically about 70 percent higher than in the South (USDA, ERS, 1974, p. 26; Cook and Moore, 1986). Cook and Moore suggest that this is due to the stronger labor unions in California. It may also be that mill workers in California are more productive than their southern counterparts. Consequently alternative estimates are given for the social value of Californian mill labor. First it is assumed that the social wage equals the gross wage. Then results are given assuming that the social wage in California is the same as the gross wage in the South. The second calculation implies that the gross wage is greater than the social value of labor, or that the A term in the adjustment cost equation is less than unity for California mill workers.

The generic 1974 mill assumption probably overestimates the labor intensity of current milling operations and thus biases upwards the costs of adjustment. Similarly, since labor is more expensive in California than in the South, California mills may be more capital intensive than those in the model; if this is the case these calculations overstate the quantity of displaced labor.

In assessing the social value of labor after displacement, AP_tW_t, it is assumed that as land moves out of rice into alternative crops, a portion of the displaced labor is immediately absorbed in the production of the new

of unemployment, it ignores the loss of firm-specific human capital investments. That is, the loss associated with investments in human capital made with an expected pay-out period extending beyond the time of displacement. Such investments may be considered sunk, therefore not relevant to evaluations of social losses.

[4] Labor input coefficients are calculated from figures given in USDA, ABS, 1986 and USDA, ERS, 1985.

Table 4.—Labor Inputs in Rice and Alternative Crops

	Rice, 1980	Rice, 1984/85	Soybeans, 1984/85	Safflower, 1984/85
National				
Wage ($/hr)[a]	3.60	4.32	4.32	4.32
Cost ($/acre)[b]	31.39	36.08	11.47	n.a.
Use (hr/acre)	8.72	8.35	2.66	n.a.
Arkansas (Non-Delta)				
Wage ($/hr)	3.38	3.88	3.88	n.a.
Cost ($/acre)	32.41	36.57	12.02	n.a.
Use (hr/acre)	9.59	9.43	3.10	n.a.
California				
Wage ($/hr)	4.51	5.47	n.a.	5.47
Cost ($/acre)	30.92	34.98	n.a.	8.81[c]
Use (hr/acre)	6.86	6.40	n.a.	1.71
Delta				
Wage ($/hr)	3.38	3.88	3.88	n.a.
Cost ($/acre)	27.68	29.11	12.02	n.a.
Use (hr/acre)	8.19	7.50	3.10	n.a.
Texas				
Wage ($/hr)	3.45	4.46	4.46	n.a.
Cost ($/acre)	33.06	41.24	n.a.	n.a.
Use (hr/acre)	9.58	9.24	3.10[c]	n.a.

Sources: [a] U.S. Department of Agriculture, 1986, Agricultural Statistics Board, National Agriculture Statistics Service, *Farm Labor*, February, Washington, D.C.; [b]USDA, 1985, Economic Research Service, *Economic Indicators of the Farm Sector: Costs of Production, 1984*; [c]Leon A. Mears, 1976, "The Domestic Resource Costs of Rice Production in the United States," *Food Research Institute Studies*, Vol. 15, No. 2, pp. 139–75.

crops. Mears (1976) suggests that the alternative crops are soybeans in the South and safflower in California. The rate of labor absorption in these crops is given by the labor input coefficients shown in Table 4.

Average periods of unemployment for the rest of the displaced workers would depend on the general rates of unemployment and personal characteristics of the worker, such as age, sex, and previous work experience. In the absence of such data scenarios are presented with the remainder of the displaced labor unemployed for one year and for 31 weeks (the average unemployment duration for trade displaced workers in Bale, 1976). These workers are assumed to be re-employed at the legislated minimum wage and to receive real wage increases of 10 percent each year for a fixed period after re-employment. The minimum wage assumption holds incomes at the lowest likely level for the posited unemployment durations. Given the skill level of these workers, such low wage rates are unlikely to be in equilibrium. Thus, 10 percent annual wage increases are added to the model. This income pattern resembles that found by Jenkins and Montmarquette (1979) for displaced Canadian aircraft workers. After six years the wages of re-employed labor are greater than wages in farming, but lower than the average manufacturing wage.[5] The adjustment term A is assumed to be unity and the value of labor production is assessed annually for six years ($t = 1...6$). The adjustment costs as depicted here would actually decrease in the seventh year even if real wages stabilized in year six. If the average duration of unemployment is assumed to be 52 weeks, this turning point in adjustment is reached one year later. The incomes of displaced Californian rice workers, however, could not reach their pre-displacement levels. The summation of AP_tW_t is compared with the social value of labor in the rice industry over a six-year period, assuming that the real social value of labor kept in rice production remains constant over the period. The adjustment cost is estimated as:

$$A'P'W' - AP_tW_t. \tag{6}$$

This calculation of the social cost of labor displacement neglects the costs incurred in relocation and retraining of labor. Such costs can be tacked on in an ad hoc fashion, but will be ignored for the present. It could be argued that the low wage upon reemployment reflects a period of on-the-job training and thus the formula captures at least part of the retooling costs. This proposition, however, requires empirical support.

Finally, the proposed assessment method ignores any effect the displaced rice workers have on the general economy. This follows an implicit small firm assumption that seems valid on the national level.[6] In the short run, however, the regional and local effects of industry contractions may be substantial. If local markets for services and consumer goods contract as incomes in the rice sector fall, recession could easily sweep through rice-oriented regions. This would be especially likely in the areas with the least diversified agricultural sectors and high cost rice production like Louisiana and the Gulf Coast. In these areas, the general economy effects might outweigh the direct costs of labor displacement.

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[5] After six years on this wage-tenure schedule, the real wage of re-employed workers would be \$5.46 per hour or \$5.11 per hour if unemployed for 52 weeks. Average hourly wages in manufacturing in 1983 were as follows (in dollars per hour): Arkansas, \$7.05; California, \$9.52; Louisiana, \$9.72; Mississippi, \$6.70; and Texas, \$8.86 (USDL, 1986, p. 273).

[6] Jenkins and Kuo (1978) present a model including these general equilibrium effects.

However, over the medium run, the nature of the economy-wide repercussions is not clear. For example, a shift away from rice might stimulate other labor using industries and foster growth. This is roughly the pattern experienced in areas of the northeast United States as the textiles industry declined. Whether or not a similar dynamic would occur in Louisiana or Arkansas if the rice sector waned is beyond the scope of this paper.

EVALUATING RICE POLICY OPTIONS

Static efficiency gains from the removal of subsidies are derived by subtracting the value of lost consumer surplus (*shgd* in Chart 3) from efficiency gained in production. The size of the consumer surplus loss will depend on the assumed elasticity of domestic demand and the price effect of an output reduction. Two scenarios are presented below.

Option I: Removing All Price Supports

The production efficiency gain formula was evaluated three times using: (1) elasticities given in Grant, Beach, and Lin, 1984 (Table 3); (2) an elasticity of 0.05 for all states; and (3) an elasticity of 0.20 for all states. Solutions varied from \$401 to \$421 million with \$410 million as a best guess. Table 5 gives results by state and calculations under different elasticities. For estimating efficiency effects, a domestic elasticity of demand of −0.20 and a world price increase of 40 percent are taken as best guesses. This implies a consumer loss of about \$98 million. Other estimates of consumer surplus lost are presented in Table 6. The static efficiency gain before adjustment costs would be \$312 million under these assumptions.

The adjustment cost associated with this policy is assessed by evaluating the social cost of labor displacement formula over a six-year period. Given the 1986 production and 1985 labor input coefficients, completely ending U.S. rice production would release 19.6 million annual labor hours. An additional 9.2 million annual labor hours would be displaced when closing the 35 generic large mills. (Each mill was assumed to run 120 hours per week and 143.9 million cwt per year.) Based on these calculations a total of 28.8 million labor hours (about 15,000 full-time jobs) was used in the rice industry in 1986 and would be released under Option 1. Distinguishing farm wages by state and milling wage by duty, the total social value of this labor, $A'P'W'$, was approximately \$140 million (or \$138.5 million if the marginal social value of California milling labor is assumed equal to the gross wage in southern mills).

To evaluate the productivity of this labor if displaced, the amount of labor immediately absorbed in soybean and safflower production must be estimated. It is assumed that 95 percent of the released rice acreage is

Table 5.—Domestic Effects of Removing All U.S. Rice Price Support: Production Efficiency Gains

State	Elasticity of supply (cwt/price)	Variable costs, P_m ($/cwt)	Quantity under program, Q^a (1,000 cwt)	Output effect, $\triangle Q^b$ (1,000 cwt)	Value of gain[c] ($1,000)
Arkansas	0.06	6.96	58,040.80	1,409.00	173,556.20
California	0.18	6.27	26,063.40	2,152.80	43,789.90
Louisiana	0.14	8.49	18,217.20	732.33	85,412.10
Mississippi	0.09	6.75	10.050.50	389.01	29,962.90
Texas	0.14	8.37	16,979.20	692.75	77,629.10
Total					410,380.20

State	Elasticity of supply (cwt/price)	Value of gain ($1,000)	Elasticity of supply (cwt/price)	Value of gain ($1,000)
Arkansas[d]	0.2	181,359.80	0.05	173,119.60
California	0.2	44,276.10	0.05	39,608.40
Louisiana	0.2	85,946.30	0.05	84,609.20
Mississippi	0.2	31,187.00	0.05	29,518.00
Texas	0.2	78,204.60	0.05	76,856.00
Total		420,276.80		403,711.20

Sources: Elasticities from Warren R. Grant, John Beach, and William Lin, 1984, *Factors Affecting Supply, Demand, and Prices of U.S. Rice*, U.S. Department of Agriculture, ERS, Washington, D.C., October (1982 estimates); variable costs from Eric Wailes and Shelby Holder, 1986, *A Study of Spatial Organization of the U.S. Rice Industry*, University of Arkansas, Fayetteville, March. Prices and quantities are from U.S. Department of Agriculture, 1987, *Rice Situation and Outlook Report*, RS-49, Washington, D.C.

[a]Rice under program equals 94 percent of production in each state. In 1986 participation nationwide was 94 percent. By imposing this on each state, the author may have overstated participation in low cost areas such as California and underestimated participation in Texas and Louisiana.

[b]Derived from elasticities in Warren R. Grant, John Beach, and William Lin, op. cit., 1986 target price − variable costs, and Q.

[c]Value of gain $= .5(\triangle Q)(P_t - P_m) + Q(P_m - P_w)$, where P_t = target price = $11.90/*cwt*; P_w = world price = $3.88/*cwt*.

[d]Includes Missouri.

suitable for soybeans or safflower and the remaining 5 percent must be retired. (Since most of the poorer rice acreage has already been set aside, this arbitrary estimate might not be far off.) Assuming the labor input coefficients of these crops remain at their 1985 levels, soybeans and safflower could absorb about 6.7 million man-hours, leaving approximately 22.0 million annual man-hours for further adjustment. The labor absorbed in alternative crops is assumed to receive the same wage as when employed in rice production. After the given period of unemployment, the residual displaced workers are employed at wages described above. Under these circumstances and a 31-week average duration of unemployment, labor's income in the first year after displacement is about $56 million, over $83 million less than it would be if kept in the rice industry. By the end of the sixth year after displacement the total value of lost employment is $142 million ($135 million if one adjusts the California mill worker's wage). If initial periods of unemployment are assumed to last 52 weeks, the value of foregone labor becomes $299 million ($292 million if one adjusts the California wage).

These values are estimates of the loss of productive output over a six-year period. The static gains from the first year of subsidy removal which induced this adjustment exceed the highest cost estimate by only a low margin. However, it would be more appropriate to compare the present value of the static gains after six years with the adjustment cost over the same period. As a simple estimate of the benefits through time, the efficiency gain in the first year can be discounted over the period of interest. Discounting at 5 percent, the six-year gain is $1,590.5 million.[7] Under this estimate, adjustment costs could be absorbed even if substantial allowances are made for relocation and retooling. This value represents the savings from restructuring the rice program relative to maintaining the 1986 support levels through 1993. The 1985 Farm Bill allows the target price to drop from $11.90/cwt to $11.30 in 1988, $10.95 in 1989, and $10.71 in 1990. Reducing the target price would lower the budgetary and economic costs of the program and reduce the relative gains of subsidy removal.

Under the assumed wage/tenure profile, the total adjustment costs of displacement will decrease after the sixth year. (If wages stabilized after the sixth year the total adjustment costs would drop to zero within 18 years.)[8] While the six-year time horizon may be more relevant to policy makers,

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[7] This method of establishing dynamic efficiency gains is a very conservative version of the method used in Cline et al. (1978). Implicit is the assumption that the gains would be the same each year.

[8] In the sixth year, total wage receipts are $8 million greater than the predisplacement earnings. If real labor revenues maintain this margin for an 18-year period the total wage loss of a given 31-week unemployment duration, $142 million, would be recovered. If unemployment durations were 52 weeks, then the

Table 6.—Domestic Effects of Removing All Rice Price Support: Consumer Surplus Loss*

Demand elasticity	Consumer surplus loss (millions)
World price effect of 5 percent:	
−0.05	12.71
−0.15	12.68
−0.20	12.66
−0.25	12.65
World price effect of 10 percent:	
−0.05	26.06
−0.15	25.93
−0.20	25.87
−0.25	25.80
World price effect of 20 percent:	
−0.05	51.33
−0.15	50.82
−0.20	50.56
−0.25	50.30
World price effect of 40 percent:	
−0.05	100.82
−0.15	98.78
−0.20	97.78
−0.25	96.75

*Consumer surplus loss = $(\triangle C)(\triangle P_w)(.5) + (C')(\triangle P_w)$, where $\triangle C$ = change in consumption derived above; $\triangle P_w$ = change in world price; and C' = 67 million $-\triangle C$, new consumption level.

the dynamic gains from subsidy removal are more closely approximated by discounting over an infinite time horizon. At a 5 percent discount rate these dynamic gains reach over $6 billion, clearly dwarfing any adjustment costs.

Option II: Reducing the Target Price

Reducing the target price to $7.20/cwt would damage but not destroy the U.S. rice industry. Production would probably stop in Texas and Louisiana where production costs are highest, but Arkansas, California, and Mississippi would continue to produce. The estimate of the social gains as-

wage loss of $299 million would be recovered after 37 years. These wage scenarios indicate that individual workers may not recover their lost incomes even if support removal is economically efficient.

sociated with this policy must reflect the impact of the large country price effect on budget costs. Since the proposed policy pays the difference between the world price and \$7.20/cwt, increases in the world price in the wake of output reductions reduce program costs. The formula for evaluating the production efficiency gain (budget savings minus producer surplus loss) is:

$$0.5(\triangle Q)(\triangle P) + (\triangle Q)(7.20 - P_w) + (P'_w - P_w)(Q'),$$

where

$\triangle Q$ = the change in production associated with the fall in prices received by farmers;
$\triangle P$ = producer price reduction, \$11.90 – \$7.20 = \$4.70/cwt;
P_w = the world price before the policy change, \$3.88/cwt;
P'_w = the world price after the policy change; and
Q' = the quantity produced under the new policy.

This area is represented by *bcdsxt* in Chart 3.

The efficiency gains depends on the supply and demand elasticities and on the large country price effect assumed. Supply elasticities given in Grant, Beach, and Lin (1984) imply an output reduction of 42 million cwt rough. This is equivalent to 1.37 million metric tons (mmt) milled or 12 percent of 1986/87 world trade. The effect this would have on the world market price for rice is a matter of speculation. It seems plausible that removing 12 percent of traded rice from the market could produce a 20 percent increase in the world price. This implies that over the range considered, prices increase by about \$8.00/mt milled rice for every 0.5 mmt of milled rice removed from trade, or equivalently, prices increase by \$0.25/cwt rough rice when availability drops by 14 million cwt. Given this price effect, the production efficiency gain from reducing subsidization is \$254.9 million. Assuming a demand elasticity of −0.20, the consumer loss is \$50.6 million. This leaves a static social efficiency gain, gross of adjustment costs of \$204.3 million.[9] As is clear from Chart 3, a large world price response increases both the consumer surplus loss and the production efficiency gain. Given these off-setting effects, assuming different world price responses does not significantly alter the results.

[9] In Chart 3, these values are represented as follows: budget savings, $abdc - ltxs$; producer surplus loss, *abtl*; consumer surplus loss, *shgd*; static efficiency gain, *bcghxt*; and production decline, $Q_1 - Q_2$.

Table 7.—Efficiency Gains of Reducing Support Prices to \$7.20/cwt (Excluding Adjustment Costs): Four Scenarios
(*Gains in million dollars*)

World price response (percent)	Elasticity of demand	Gains after one year	Gains after six years[a]	Gains over infinite time span[a]
20	−0.20	204.6	1,090.4	4,092.2
40	−0.20	208.7	1,112.2	4,174.0
5	−0.25	193.8	1,033.1	3,876.9
40	−0.05	206.6	1,101.5	4,132.9

Sources: Calculated with supply elasticities given in Warren R. Grant, John Beach, and William Lin, 1984, *Factors Affecting Supply, Demand, and Prices of U.S. Rice*, U.S. Department of Agriculture, ERS Staff Report, Washington, D.C., October.

[a]Discounted at 5 percent annually.

The implied labor adjustment costs will depend on supply elasticities as well as unemployment durations and wage rates. Estimates of man-hours released are based on Grant, Beach, and Lin's supply elasticities and an elasticity of 0.20 in each state. These elasticities refer to price responses of acreage planted in rice. Depending on the elasticity, estimates of annual man-hours released ranged from 13.0 to 12.5 million. The social value of this labor, after adjusting the California wage downward, varies from \$66.8 to \$64.1 million. Making the same assumptions regarding re-employment as in the previous section, the lowest cost scenario (31 week unemployment period and Grant, Beach, and Lin's elasticities) results in a productivity loss of \$82.1 million over six years. Assuming 52 weeks of unemployment and higher supply elasticities the value of the loss is \$121 million. Adjustment costs begin to decline after the sixth year. The static gains from trade again surpass the loss in the productivity of displaced workers over a six-year period. Discounted over six years, the gains grow to just over \$1 billion and are greater than \$4 billion if discounted over an infinite time horizon.

Comparing the two policy options in Table 8, it is clear that in both cases the adjustment costs are insignificant compared with the discounted value of the efficiency gains. Under the first policy option, the efficiency gain over a six-year time span reaches a value of \$1.5 billion while the labor adjustment cost peaks at \$300 million. The relative gains from the second option are slightly less: a \$1 billion efficiency gain and a \$100 million adjustment loss. Admittedly, these estimates are based on fairly crude assumptions regarding the characteristics of the rice supply curve. Nonetheless, the net effect of reducing subsidization is unambiguously positive.

Table 8.—Summary of Effects of Alternative Policies
(*Million dollars*)

	Efficiency gains	Adjustment costs	Net gains
Removal of Price Support[a]			
31-week unemployment			
Year 1	312.6	83.5	229.1
Year 6	1,591.5	142.0	1,449.6
52-week unemployment			
Year 1	312.6	112.4	200.2
Year 2	1,591.5	298.5	1,293.1
Reduction of Price Support[b]			
31-week unemployment			
Year 1	204.6	41.6	163.0
Year 2	1,090.5	82.1	1,008.3
52-week unemployment			
Year 1	204.6	57.5	149.9
Year 6	1,090.5	121.3	969.2

Sources: [a]Based on elasticities from Warren R. Grant, John Beach, and William Lin, 1984, *Factors Affecting Supply, Demand, and Prices of U.S. Rice*, U.S. Department of Agriculture, ERS, Washington, D.C., October; 40 percent world price effect, and elasticity of demand of −0.20. [b]Based on a 20 percent world price effect and −0.20 elasticity of demand.

THE UNITED STATES, RICE, AND THE URUGUAY ROUNDS

From this analysis, it is apparent that the dynamic efficiency gains of removing rice support outweigh the likely adjustment costs. However, the single commodity approach of this paper ignores one purpose of multinational trade negotiations. While a single commodity perspective is in keeping with U.S. domestic policy, trade liberalization undertaken in the GATT is often on a multilateral, multicommodity basis. The trade-expanding effects of multicommodity trade negotiations should result in accelerated growth in a nation's efficient industries which implies reduced unemployment rates and lower adjustment costs for workers displaced from declining industries. Astute participation in the Uruguay Round may be the best adjustment assistance the United States could offer the rice industry. Even if farmers could not shift easily into the growing service sector, unemployed workers in general would benefit from faster economic growth.

Discussion of unilateral policy reform also ignores potential gains by multinational reforms of single commodity policies. If multinational trade negotiations improved access to rice markets in Japan, Africa, and the Middle East, one would expect demand-induced increases in the world price for rice. Higher world prices would lessen the costs of a reduced subsidy policy (Option II), but cause a consumer surplus loss. However, the consumer loss would be less than the budget gain as long as domestic consumption remains below domestic production. For a price increase from P_w to P'_w, this difference is represented by the area *hxkg* in Chart 3. If the new foreign demand raised the world price above the minimum production price for U.S. farmers (say to *Plr*), the net effect of removing all subsidies would be altered. The higher prices would induce a larger consumer surplus loss than that described in the Option I scenario (area *lzgd* rather than *shgd*). But the unemployment effects and producer surplus loss associated with policy reform would be reduced. The net gain, given increased foreign demand, becomes the budget savings minus a greater consumer surplus loss than when overseas markets do not open minus a smaller producer surplus loss and a lower adjustment cost. The adjustment cost is lower because domestic rice production and employment are profitable with higher world prices. In Chart 3 the efficiency gain, given a demand led world price increase to *Plr*, is *btzgc* minus the cost of adjusting the labor employed in producing $(Q_1 - Q_2)$. It is not clear whether the salvaged producer surplus and employment would outweigh the lost consumer surplus associated with the higher world price. However, it is certain that the unicommodity approach overestimates the labor adjustment problem and that this problem could be reduced through internationally coordinated policy reform.

CONCLUSION

The United States is currently pressuring Japan to liberalize its rice importation policies. However, considering the degree of government involvement in the industry and the significance of the United States in the international rice market, American negotiators may find themselves under fire when trade talks turn to rice.

Rice exporters lose when U.S. production is artificially enhanced. Thailand is the largest exporter, but other losers include Burma, China, Pakistan, Uruguay, Australia and the European Economic Community (USDA, ERS, 1987b, pp. 22–24). These exporters are likely to pressure the United States regarding the marketing loan policy. Since this policy does resemble an export subsidy, their complaints about this approach would have some basis in GATT codes. However, removing the marketing loan without altering the loan rates and target prices would increase U.S. budget costs and consumer prices. Other policy reforms could benefit both competing rice exporters and the U.S. economy. The most direct of these reforms might be simply to reduce subsidization by lowering the target price. While such action would be likely to displace some American labor, the efficiency gains to the economy could be expected to dwarf the costs of adjusting the labor market to the new conditions. Likely increases in consumer prices which may follow the reduction in U.S. supply would also be slight compared to gains through more economic allocation of resources. Net gains will obviously be greatest when policies are undertaken to reduce the negative effects of worker displacement.

Steps to promote growth and reemployment could be taken within multinational trade negotiations. Even if progress cannot be made in the context of the Multinational Trade Negotiations, a unilateral liberalization of U.S. rice policy would bring benefits far outweighing the costs of labor adjustment and higher consumer prices.

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