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FORECASTING GOVERNMENT RESPONSES TO CHANGING ECONOMIC CONDITIONS IN REGIONAL COMMODITY TRADE MODELS

Karl D. Skold and William H. Meyers

It is often the case that regional trade models have static assumptions about government policy imbedded in domestic market models and in commodity price linkages across countries. This may be satisfactory when the purpose is to evaluate the impacts of changing certain of these policies or trade barriers. However, when such a model is used for forecasting, it may not be realistic to hold government policies or trade barriers constant as market conditions changes.

The purpose of this paper is to develop an approach to modeling government behavior as it affects the transmission of commodity prices from one country to another. The method is tested empirically and compared to the more simplified static assumptions employed in many current trade models.

A theoretical model is first developed which incorporates a government response function in a standard price linkage relationship. The model is then tested empirically with countries that have different kinds of internal pricing policies or trade policies. The performance of these models are then compared to standard price transmission models where government behavior is static.

Analytical Methods

Standard price linkages in multi-country models often take the form for the ith country:

$$PD_i = PW * e_i + T_i \qquad \text{or}$$

$$PD_i = a_o + a_1 (PW * e_i) + a_2 T_i$$

where

e is the exchange rate
PD is the domestic price
PW is the world price in the numeraire currency

T is a spatial differential (transport cost, etc.) or a policy factor (tax or subsidy) or some combination.

Since the 1979 article by Bredahl, Meyers, and Collins, it has been well accepted that the price transmission elasticities [$E_{Pi} = (dPD_i/dPW) * (PW/PD_i)$] imbedded in such relationships are critical parameters in determining the elasticity of demand for U.S. exports. More fundamentally, the E_{Pi} are central in determining the relative movements of market prices and quantities in response to external shocks. When relationships of this type

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are used in a forecast, it is implicity assumed that everything contained in T_i is invariant with respect to market conditions.

A country with a fixed internal price (PD^*_i) protected by an EC-type variable levy (V_i) would usually be represented as follows:

$$V_i = PD^*_i - PW * e_i \quad \text{and} \quad PD_i = PW * e_i + V_i$$

In this case, $E_{Pi} = 0$, since $dPD^*_i/dPW = 0$. In this case, PD^*_i would be assumed invariant with respect to world market conditions.

If, instead, the price policies are themselves influenced by country market conditions, price transmission elasticities would tend to be higher, world price variability lower, and U.S. export demand elasticities higher. Take the extreme case of the EC-type policy. If $PD^*_i = f(PW * e_i)$, then $E_{Pi} > 0$. In the more general case, if an endogenous policy component (TZ_i) is identified and separated from the exogenous margin T^*_i such that

$$PD_i = PW^* e_i + T_i + TZ_i$$

$$TZ_i = Z_i(PW * e_i) \qquad Z'_i > 0$$

then

$$E_{Pi} = (1 + Z_i') \frac{PW * e_i}{PD_i} > \frac{PW * e_i}{PD_i}$$

These are plausible specifications, since a country's desire or ability to protect a specific price intervention can be affected by changes in market conditions. Other market or policy factors could also influence TZ_i.

Several price relationships of this type are hypothesized and tested for major wheat exporters and one importer. World prices, carryover stocks, and program budgets are the variables used in various specifications to measure expected endogenous policy effects. The empirical models combine the two relationships above into one equation. The price responsiveness of Argentina, Australia, Canada, the European Community, and Japan are examined. A brief description of each region's price policy is given, and is followed by estimates of the region's price linkage equations. From these results, the revised price representations are compared with standard form price linkage equations in a world wheat trade model.

Selected Country Policies and Price Linkages

Argentine Price Policy

Agriculture policy plays a pivotal role in the Argentine economy. Agricultural policy is important because of the dominance of agriculture in the economy. In 1982, agriculture's share of the total value of exports was 73 percent. The dependency on agriculture has remained high even after a continual push for industrialization and a regressive policy toward agriculture. The agricultural sector is relied upon for foreign exchange, fiscal revenue, and capital to support the industrialization objectives.

The primary instruments used in agricultural policy are export taxes, exchange rate manipulation, and tariffs on imported inputs. Also, consumer prices are subsidized to enhance industrialization objectives. The government has set minimum producer support prices, but these fixed prices often have an inconsequential effect. In most years, producers sell their commodities at open market prices and not at the support price levels. The support prices are typically below the open market price and are essentially meaningless because "about 80 percent of the time official wheat price announcements came after the beginning of the May planting season" (Mielke). Also, the producer prices were not always adjusted for the reoccurring rapid inflation in the interim between announcement and harvest. Producers were allowed to sell on the open market, except during 1973 to 1975 when the Peronists briefly regained power. In 1977 a new price policy was announced. Producers were guaranteed 80 to 85 percent of the export price. This was instituted to prevent exporters from gaining excess rents by under bidding on the domestic market (Mielke). Nevertheless, the price signals between the export and farm prices remain distorted with the combination of exchange rate policies and export taxes.

The frequent exchange rate regime changes are not detailed and are exogenous in the model, since they are strongly influenced by factors outside of agriculture. The export tax on agricultural products has the most direct effect on the producer price in general, and the transmission of the world prices to the wheat sector in particular. Export taxes are a primary source of revenue for the government. One quarter of overall tax revenue is derived from these taxes (World Bank). Export taxes are traditionally higher for unprocessed bulk commodities such as wheat, and have been a depressing influence on the producer price. When the military government regained power in 1976, export taxes were abolished as a means of returning the economy to a more competitive atmosphere. The taxes on agricultural exports were reinstituted in 1981 as the fiscal deficit sharply increased, and as a means of controlling inflation.

Argentine Price Linkages

In equation 1.1, the U.S. Gulf Port price multiplied by the peso-dollar exchange rate and deflated by the Argentine wholesale price index, (WHPOBU9*NIMEUAR)/WPI80AR, is linked to the real Argentine fob export price, WHPXEARR. An additional zero-one dummy variable, DM180, is included for the 1980 crop. In the price linkage equations that follow, t-statistics are in parentheses under the coefficients, and elasticities are in brackets.

$$\underset{(1.1)}{\text{WHPXEARR}} = \underset{(0.76)}{35.76} + \underset{\substack{(10.1)\\[0.92]}}{0.865} * (\text{WHPOBU9*NIMEUAR})/\text{WPI80AR} + \underset{(1.49)}{58.8} * \text{DM180}$$

R-SQUARE = 0.90
D.W. = 2.20

As depicted in equation 1.2, the Argentine farm price, WHPFMARR, is a function of the Argentine export price, the export tax, WHTAXAR, and two zero-one dummy variables. The export tax reduces the farm price as intermediaries pass on tax increases to the producers. The dummy variable, DM17376, is for the years 1973 to 1976, and represents the policy change when the Peronists regained power. The second dummy variable, DM181, is for the 1981 crop, when export taxes were reinstituted.

(1.2) WHPFMARR = 41.07 + 0.78 * WHPXEARR - 1.65 * WHTAXAR
(0.89) (7.53) (-2.84)
[1.08] [-0.07]

- 196.7 * DM17376 + 80.64 * DM181
(-7.89) (3.88)

R-SQUARE = 0.92
D.W. = 2.54

The export tax rate, WHTAXAR, is directly related to the government deficit as a percent of gross domestic product, NAGDFARP. As the government deficit increases, export taxes are raised to achieve higher revenue levels. Also a zero-one dummy variable is included from 1977 onwards since in many of these years the export tax was abolished. There was no significant effect on the export tax of changes in export market prices.

(1.3) WHTAXAR = 11.69 + 1.92 * NAGDFARP - 25.3 * DM1S77
(5.90) (7.74) (10.2)
[0.86]

R-SQUARE = 0.90
D.W. = 1.79

Australian Price Policy

The Australian Wheat Board (AWB) is essentially the sole marketing channel for all wheat sold beyond the farm gate in Australia. The AWB with a near monopoly over wheat sales and transfers effectively discriminates between domestic and international markets. The AWB does so to stabilize producer and consumer prices, and to "maximize returns from export sales" (Perkins et al.). The AWB provides a price guarantee for domestic producers, and administers the consumer price for both food and feed uses. The control over prices protects producers and consumers from the vagaries of the international marketplace.

The AWB assures producers a return termed the guarantee price, which since 1974 has been called the stabilization price. Before 1968, the guarantee price was adjusted annually based on changes in the cost of production. This earlier formula included depreciation, interest, and imputed labor costs. After 1968, the guarantee price was realigned to reflect world market conditions, and was then adjusted with changes in cash production costs. When export prices began to surge disproportionately above the guarantee price in the early 1970s, the cost-based adjustment formula was abandoned. In 1974, the stabilization price replaced the guarantee price, and was adjusted to reflect changes in the world wheat market. The stabilization

and guarantee prices have the same price assurance for producers, but have different price adjustment mechanisms. The adjustment scheme adopted by the AWB for the stabilization price is depicted in equation 2.1 (Hefford).

$$(2.1)\quad SP(t) = SP(t-1) + \frac{(EXP(t)-((EXP(t-1)+SP(t-1))/2}{4}$$

Where: SP(t) = stabilization price in year t
EXP(t) = average export price in year t

As depicted above, the current stabilization price is the previous year's stabilization price plus a partial adjustment factor that incorporates changes of the average export price in relation to an average of the previous period's export and stabilization prices. Thus, changes in the export market were directly reflected in movements of the stabilization price. More lately, the producer guarantee price has been set to approximate 95 percent of the average net returns from the two previous years (International Wheat Council). The guarantee price, initially was assured on only the first 100 million bushels exported (Hefford). This level was increased as exports increased, and then abandoned with the introduction of the stabilization price. Then, the price guarantee applied to all exports.

Producers also receive payments from the pooled sales of the AWB. The AWB combines the payments from the domestic and export sales in a pool tied to the particular crop, the receipts of which are kept until all payments have been received. After which the pool's payments are distributed based on the producer's deliveries to the AWB in that crop year. The final payment from the pool's proceeds may arrive several seasons later due to export credit sales and unsold stocks in storage. Thus, the producer receives the initial payment for a particular crop, but must wait for the final payment as the AWB collects the proceeds. Nevertheless, the producer is assured the guarantee or stabilization price when the initial and final payment total is below the stabilization price.

Australian Price Linkage Equations

As laid forth in equation 2.2, the Australian export price, WHPOBAU, is linked to the U.S. export price denominated in Australian dollars, WHPOBU9/NIMEUAU. The AWB seeks to maximize returns from export sales, but must maintain competitive quotes "thereby avoiding the possibility of retaliatory discounting...or loss of market share" (Perkins et al.). Thus, the relationship between the Australian and U.S. export prices is close. However, since the AWB has sole control over export transactions, some price manipulation may take place. The second explanatory variable is beginning wheat stocks, WHCOTAU.1. This latter variable is negatively related to the export price, because the AWB presumably discounts the export price in order to remove excessive stocks.

(2.2) WHPOBAU = 16.16 + 1.12 * (WHPOBU9/NIMEUAU)
(1.12) (10.76)
[0.97]

- 4.03 * WHCOTAU.1
(-1.99)
[-0.46]

R-SQUARE = 0.91
D.W. = 1.21

The Australian export price in turn is linked to the farm price, WHPFMAU, in equation 2.3. The farm price is a combination of initial and guarantee prices, and final pool payments, depending on market conditions. As outlined previously, producers receive payments for past crops as the AWB receives full payment for the pooled grain. Thus, the final payment timing combined with the changes in export and guarantee relationships prohibits the use of a simple aggregate policy price as the producer price. The lagged export price is used because the initial price is set before the marketing year. Also, the lagged export price is used to capture the effects of the lag in the final payment structure, and the partial adjustment formulas used to capture international market conditions in setting the guarantee price. Also, the lagged consumer price index, CPIAU.1, is included to incorporate the initial guarantee price-setting decisions based on changes in the farm cost structure. The consumer price index, while not ideal, provides a proxy for the influence of cost increases which have had direct effects on the guarantee price, and also influence the setting of the home consumption price. Therefore, the lagged explanatory variables capture the administered nature of the domestic price structure, and the delays in the receipt of the final payment. Both variables have a positive influence as would be expected from the policy discussion presented previously.

(2.3) WHPFMAU = - 191.26 + 28.86 * WHPOBAU.1
(-0.18) (2.77)
[0.35]

+ 115.96 * CPIAU.1
(5.53)
[0.75]

R-SQUARE = 0.91
D.W. = 1.71

Canadian Price Policy

Canadian wheat is primarily marketed through the Canadian Wheat Board (CWB). The CWB, a government entity, attempts to "market as much grain as possible at the best price" and "to ensure that each grain producer gets his fair share of the available markets each year" (Canadian Wheat Board). The CWB attains these objectives by controlling the flow of grain among the provinces, and the sales of wheat internationally, as well as setting prices for Canadian grain on domestic and international markets.

In the domestic market, the price of wheat marketed through the CWB is determined by a price pool. Producers are paid an initial payment or basic price at the time of delivery of the grain. The initial price is set in March before planting begins. The initial price is the same for all producers, no matter when the grain is marketed during the crop year (with adjustments for internal transportation cost and grade differentials). The CWB then sells the grain domestically and on the international market. Proceeds of the sales, less operation, distribution, and handling costs less initial payments, are distributed to producers according to their initial deliveries. This final payment is announced in the first calendar quarter following the close of the market year. Final payments are typically received soon after the final payment is established.

The price policy of initial price payment supplemented with a final payment from the CWB's marketing proceeds remained essentially intact until 1973. In 1973, producers were allowed to bypass the CWB in their sales of feed wheat and barley in the prairie provinces. The following year producers were allowed to sell feed wheat between western and eastern provinces. Wheat is principally produced in western Canada, and flows to the grain deficit regions of eastern Canada for domestic use and export, and to the Pacific coast for export. The prices of feed wheat received in these transactions, not through the CWB, are termed "offboard prices".

The CWB is the sole marketer of Canadian wheat in the international market. The CWB either enters in direct negotiation with purchasers, or sells through private grain trading companies. The CWB sets a daily asking price for the various grades and port locations. The asking price is determined by considering competitors' grain prices, subsidies of grain by exporting and importing nations, supplies of exportable grains, variations in freight rates, foreign exchange movements, and various other factors (Moncrieff et al.). However, the asking price is typically not the transaction price. The asking price "simply sets the price level at which negotiations may begin" (Gilmour and Fawcett). Nevertheless, the true transaction price for exported wheat is not public information, thus a unit-value price is used as an approximation. The unit value price is defined as the gross value of export sales divided by the volume of export sales. The unit-value price incorporates the grades, varieties, and locational differences of the exported wheat in the approximation of an average export price of Canadian wheat.

Canadian wheat sells at a premium on the export market because of its high protein. Thus, the Canadian export price is typically above the U.S. export price. The margin between these two prices depends upon supply and demand conditions, as well as relative changes in exchange rates and transportation costs. The Canadian export price has a direct influence on the final payments producers receive. The CWB attempts to maximize the net returns for producers, and thus must consider both short-term gains and long-tern pricing objectives. Raising prices substantially in shortage years may reduce demand in the long-run as purchasers find other sources of supply.

Canadian Price Linkage Equations

The Canadian wheat prices, both CWB and offboard, are linked to the U.S. export price. The Canadian unit-value export price, WHPXECA, the initial price, WHGPICA, and final payments, and WHGPFCA and the offboard price (prairie basis), WHPOBCA, are determined endogenously in the Canadian

subsector of the model. In equation 3.1, the unit-value export price is linked to the U.S. export price denominated in Canadian dollars, WHPOBU9*NIMEUCA. Also included as an explanatory variable is the ratio of lagged U.S. wheat ending stocks to total production, (WHCOTU9.1/WHSPRU9.1). This latter variable is hypothesized to have a negative sign because as more carry-over stocks remain in the market, the premium for Canadian wheat is assumed to decline. The CWB is forced to reduce their asking price and, thus, their transaction price in the international market, because purchasers can more easily substitute lower quality wheat in their consumption plans.

(3.1) WHPXECA = 31.2 + 1.02 * (WHPOBU9*NIMEUCA)
(1.8) (16.47)
[0.97]

- 60.25 * (WHCOTU9.1/WHSPRU9.1)
(-2.25)
[-0.19]

R-SQUARE = 0.97
D.W. = 1.72

The initial price, equation 3.2, made on sales to the CWB is a function of the lagged initial price, WHGPICA.1, the lagged U.S. Gulf export price denominated in Canadian dollars, WHPOBU9.1*NIMEUCA.1, and a zero-one dummy variable for the 1974 crop. The lagged dependent variable is included because the initial payment is an administered price that is set to stabilize producers' returns. The lagged U.S. export price is included to capture the influence of market forces at the time the initial price is set. The dummy variable is included to account for the policy shift in allowing feed wheat to be sold to the eastern provinces.

(3.2) WHGPICA = 0.82 + 0.67 * WHGPICA.1
(0.12) (4.59)
[0.67]

+ 0.30 * (WHPOBU9.1*NIMEUCA.1) + 25.79 * DM174
(3.00) (2.14)
[0.39]

R-SQUARE = 0.96
D.W. = 2.14

The final payment, equation 3.3, is simply a function of the lagged export price, WHPXECA.1, and the initial payment, WHPGPICA. The explanatory variable is lagged because of the delay in the final payment. The initial payment has a negative influence since larger prepayments will invariably decrease the later final payment.

(3.3) WHGPFCA = 4.39 + 0.79 * WHPXECA.1 - 0.88 * WHPGPICA
(0.67) (8.44) (-6.53)
[39.3] [-3.69]

R-SQUARE = 0.84
D.W. = 1.57

In equation 3.4, the offboard price, the price for feed wheat not sold through the CWB, is a function of the Canadian export price, WHPXECA, lagged ending Canadian wheat stocks, WHCOTCA.1, and the offboard price of barley, BAPOBCA1. The export price is expected to have a positive influence on the offboard price since it is a competing use. Lagged ending stocks is expected to have a negative effect on the offboard wheat price because more available supplies will invariably depress the domestic offboard price. The barley offboard price is hypothesized to have a positive effect since barley is a competing feed crop.

(3.4) WHPOBCA = 23.3 + 0.32 * WHPXECA - 1.05 * WHCOTCA.1
(2.53) (5.02) (-2.89)
[0.51] [-0.16]

+ 0.50 * BAPOBCA1
(3.53)
[0.40]

R-SQUARE = 0.99
D.W. = 2.59

The European Community Price Policy

The Community's Common Agricultural Policy (CAP) is one of the principal links of an economically integrated Europe. The objectives of CAP were laid forth in the Treaty of Rome (1957), and have provided the basis for the protection measures applied to the cereal and feed grain sectors in particular, and the entire agricultural sector in general (nearly 90 percent of the Community's agricultural output is regulated by CAP). From the outset, the objectives of CAP were to increase agricultural productivity, to increase the standard of living of the agricultural producer, stabilize markets, and to assure a dependable supply at reasonable prices to consumers. This amalgam of objectives has been principally reached through fixed guaranteed prices for domestic producers above market clearing levels. Imports are constrained through levies that cause imports to be priced at or above domestically produced commodities. Surpluses are disposed of in the international market through export subsidies.

The cereals were the first agricultural commodities brought under the fold of CAP protection. The cereal prices were unified in 1967. Three policy prices provide the basic framework for the support structure. The policy prices are the target, threshold, and intervention prices. The target price is the market price that is deemed an appropriate return for producers. It is based on the projected price in the most grain deficit producing region, Duisberg, West Germany. The target price is not actively supported, but rather provides a guideline in setting the threshold and intervention prices.

The threshold price is the minimum import price (basis Rotterdam). The threshold price is set so that the selling price of imported grain is the target price in Duisberg, West Germany. This essentially prevents domestically produced commodities from being undercut by imports. In normal market years, the threshold price is the ceiling for domestically produced grains. When domestic prices rise above the threshold price, imports become feasible, and thus pressure the domestic price downward. The difference

between the lowest standardized import price and the threshold price is the variable levy. The variable levy is set daily, and provides revenues to support the CAP expenditures on rural development, and export restitutions (see Harris et al., 1983, for details).

The intervention price is the guaranteed price for domestically produced cereals. The intervention price provides the price floor on the domestic market. Government agencies are obligated to buy at the intervention price, thus domestic market prices rarely fall below the intervention level. However, the prices producers receive are adjusted for quality, handling, and transportation costs. In recent years, producer receipts have also been reduced by coresponsibility levies designed to reduce program costs. The grain sold to government agencies at the intervention level are sold either on the domestic or international markets. The grain is sold on the domestic market when the domestic price rises above the intervention level. For internationally sold grain, an export restitution is paid, since the intervention price is typically above the world market level. Export restitutions are a major expenditure in the CAP budget.

The target, threshold, and intervention prices are politically administered prices. They are annually set by representatives of each member state in the Council of Ministers. The prices are set in an omnibus package that guides CAP structural policies and guidelines. An unanimous vote determines the approved omnibus CAP policy for the upcoming year. Under the unanimous decision structure, all members must agree to the price structure for all commodities.

Various considerations enter the price setting process. Since the policy prices are set in a conglomerate fashion, member countries with interests for specific crops will press for more favorable treatment for these specific commodities. Other countries will acquiesce in order to achieve higher rates of support for their local crops. With this political decision framework as a backdrop, as the price policy has evolved, the goals at the inception of the Community have focused on the disparity between urban and rural incomes. The price setting goal has increased price supports to "bring the average incomes of those engaged in agriculture into line with incomes of comparable occupational groups" (Koester).

The price setting policy has also come under some recent pressure from increasing expenditures. The European Agricultural Guidance and Guarantee Fund, the budget that finances CAP expenditures, is restricted to be within its "own resources." The own resources for CAP expenditures are raised from import duties and levies, and a value-added tax applied on all member states. The imposition of the own resources budget constraint has affected price policy since the levels of the threshold and intervention prices are directly linked to CAP income (levies) and expenditures (export restitutions). The CAP budget can be viewed as a political cost (Von Witzke). The budget is especially relevant in the wheat sector, because of the costly restitutions required to dispose of the excess supply of wheat.

European Community Price Linkages

The intervention price, WHPIEO, is the policy price used to determine the threshold price, WHPTHEO. The target price is not considered because it is

not actively supported, and does not enter the European Community subsector of the model. The intervention price is chosen as the focal policy price, because it is closely related to the price producers receive and provides the support floor in the price structure. The intervention price linkage equation is given below in equation 4.1.

(4.1) WHPIEOR = 8.18 + 0.60 * (WHPOBU9.1*NIMEUEO.1)/WPIE9
(9.77) (3.76)
[0.29]

- 0.97 * WHYDEO.1 - 0.34 * (EAGGF.1/ECGDP.1)
(-3.91) (-3.15)
[-1.01] [-0.52]

+ 0.62 * DM179
(2.03)

R-SQUARE = 0.94
D.W. = 1.19

The real intervention price, WHPIEOR, deflated by a wholesale price index for the European Community, is a function of the lagged U.S. Gulf export price, denominated in ECUs and deflated by the EC wholesale price index, (WHPOBU9.1*NIMEUEO.1)/WPIE9, the lagged wheat yield, WHYDEO.1, and the ratio of the lagged expenditures in the guarantee fund to the Community's gross domestic product (GDP), (EAGGF.1/ECGDP.1). The guarantee section is the part of the CAP budget for market support measures. The lagged U.S. Gulf export price is included as a proxy of the forecast of the current world price. The lagged yield has a negative effect, because productivity increases reduce the need for increased support. The ratio of the guarantee section expenditures to GDP is a proxy for the own resources budget constraint. As CAP expenditures grow faster than overall income, there is pressure to reduce the price support level.

The Community's expenditures on the guarantee section are endogenously determined in equation 4.2. The guarantee fund, EAGGF, is a function of the intervention price and the threshold price. The intervention price has a negative effect on the guarantee fund, since as the intervention price is increased, export restitutions will increase. The threshold price has a positive influence, because increases in the threshold price increase CAP revenues from the variable levies. A equal increase in the intervention and threshold price increases guarantee fund.

(4.2) EAGGF = -3410.76 - 305.328 * WHPIEO + 325.96 * WHPTHEO
(-3.05) (-4,57) (5.60)
[-9.34] [10.1]

+ 1917.88 * DM179
(1.94)

R-SQUARE = 0.9
D.W. = 1.03

The threshold price is a function of the intervention price and a dummy variable, DM16771 (equal to 1 through 1971, then zero). The dummy variable is included to account for the expanding margin between the threshold and intervention price that occurred when the EC became a net exporter.

(4.3) WHPTHEO = -2.66 + 1.11 * WHPIEO - 6.19 * DM16771
(-0.46) (45.3) (-2.06)
[1.02]

R-SQUARE = 0.99
D.W. =0.61

Japanese Price Policy

The market intervention measures conducted by the Japanese government in the domestic wheat market are closely linked to the market conditions in the domestic rice market. Rice remains the predominant crop, both in terms of production volume and as a staple in the Japanese diet. Wheat, a close substitute, is directly affected by the policies pursued in the rice market.

The origin of the current policies in the rice and wheat markets can be found in the enactment of the Staple Food Control Act of 1942. This law provided the mandate for the government's stringent control over the procurement and distribution of staple commodities. The staple commodities include barley, potatoes, and other cereals, as well as rice and wheat. The government was instituted as the sole purchaser of domestically produced staple commodities and of imported products, as well as the distributor of these products to the consumer. The rigid control over the staple commodities was a response to post-war shortages, and the need for rational distribution procedures. As industrial and agricultural production revived many of the commodities' controls were relaxed, except in the rice and wheat markets. The effects of the price and structural policies in the rice and wheat sectors remain a major concern in the formation of agricultural policy.

The government is the sole purchaser of wheat from domestic producers (since 1976 domestic producers can sell their wheat production on the open market, however, the government's purchase price is typically above the domestic market price). The government's purchase price is above world market price levels, and thus provides both income support, and an incentive for increased production. The government sells both domestically produced and imported wheat at the resale price to domestic intermediaries. In the case of wheat, the domestic intermediaries are primarily millers. The resale price is below the purchase price, and typically above the import price.

Wheat imports are controlled by a quota that is annually set based on estimates of domestic needs. Import licenses are distributed to importers as a means of allocating the rights to import under the quota. The government is the sole purchaser of the imported wheat. Thus when the import price of wheat is below the resale price, substantial revenues can be gained in the

importation of wheat. The resale price has remained above the import price, except during the large price increases during the early 1970s. The rents gained during the importation of wheat finance the losses from rice and wheat purchased on the domestic market and resold at the lower resale price.

The resale price is set so as not to exceed a ceiling price. The ceiling price in turn is determined by past retail prices of wheat flour, disposable income, and wheat processing and distribution costs (Japan Flour Millers Association). Along with the ceiling price, other factors enter in the determination of the resale price. The resale price is set to stabilize consumers' expenditures, thus changes in the cost of living are taken into account. Also, the price of rice is considered in the price-setting decision. For example, when rice surpluses persisted, the resale price of wheat was increased to discourage wheat consumption, and to encourage increased rice consumption. The price of imported wheat, as was the case in the 1970s, also plays a factor in the determination of the resale price because of the implications on the treasury. If the resale price is below the import price, the costs of imports can be prohibitive, and if the resale price is above the import price, substantial rents can be captured. The purchase price of wheat has minimal influence in the determination of the resale price because of small proportion of total wheat food use originating from domestic production.

Japanese Price Linkage Equations

The price linkage equations for Japan consist of three equations. In equation 5.1, the U.S. Gulf port price converted to Yen, WHPOBU9 * NIMEUJP, is linked to the Japanese cif import price, WHPJPU9Y.

(5.1) WHPJPU9Y = - 3.29 + 1.29 * (WHPBOU9*NIMEUJP)/1000
(2.29) (31.6)
[1.08]

R-SQUARE = 0.99
D.W. = 1.24

As depicted in equation 5.2, the wheat resale price, WHRPJP is a function of the import price and an index of wage earnings, WAGEJP. The import price affects the cost of imported wheat, and thus influences the resale price. The wage earning index is included to capture the ability of consumers to shoulder a consumer price increase. As wages increased, the government would be more willing to increase the consumers' cost of wheat.

(5.2) WHRPJP = 19.03 + 0.10 * WHPJPU9Y + 0.37 * WAGEJP
(0.44) (12.7) (12.7)
[0.08] [0.52]

R-SQUARE = 0.96
D.W. = 2.12

In equation 5.3, the purchase price, WHPPJP, is a function of the resale price, WHRPJP, rice ending stocks, RISTKJP, and a zero-one dummy variable for the 1976 crop. The resale price has a positive influence on the purchase price because the government can increase the purchase price and still not increase expenditures on the support program. Rice ending stocks also have a positive effect on the purchase price because as rice is in excess supply, the government will invariably increase the purchase price of wheat to encourage

domestic production. The dummy variable is included to account for the implementation of the subsidies to producers for growing wheat in paddy fields.

(5.3) WHPPJP = - 95.96 + 4.16 * WHRPJP + 0.0043 * RISTKJP
(6.23) (15.9) (2.47)
[1.74] [0.15]

- 35.56 * DM176
(2.73)

R-SQUARE = 0.96
D.W. = 2.00

Comparison to Standard Price Transmission Models

The revised price linkage equations were inserted into the CARD/FAPRI world wheat model which initially had standard price linkage representations. The revised price linkage equations change the model's structure by introducing different rates of price transmission among the modeled regions. Changes in the U.S. Gulf port price is the primary means of relaying changes in world market conditions throughout the model. Thus, changes in the rate of price transmission will directly affect the behavioral responses of the regional subsectors. In Table 1, a comparison is made of the original and revised models' price transmission elasticities. The elasticities were calculated using 1984 values.

Argentina exhibits considerably more price transmission. In the original model, the price transmission to the Argentine farm price was 0.31. The price transmission elasticities for the export and farm price in the revised model are 1.01 and 1.15 respectively. Price changes are perfectly passed on to producers, but the farm price remains lower than the export price because of the export tax. The effect of the export tax causes the price transmission elasticity to be higher for the farm price than the export price. The revised model imposes a more responsive price structure on Argentina.

The price transmission of Australia for the revised model is quite similar to the original model. The higher export price elasticity of 1.43 in the revised model suggests that the AWB undercuts the U.S. in the marketplace, even more so than is suggested by the original model's transmission elasticity. The rate of transmission to the farm price is lower in the revised version, because the farm price is determined by both the changing cost structure of Australia and the export price. Nevertheless, the Australian wheat sector is competitive in both representations of the model.

Canada remains competitively priced in the international wheat market as suggested by the high degree of price responsiveness in their export and policy price structure. The export price elasticity of 0.90 in the revised model illustrates Canada's ability to mark-up the price of their premium exported grain. The differences in the price transmission to the farm level are primarily because of the differing lag structures in determining the final payment price. The original model used a two year lag from export price determination to final payment, while the revised model used a one year lag assumption. The dramatic difference between the rate of transmission in the

off board price is a result of inclusion of the offboard barley price in the specification of the revised model's offboard price equation. This does not substancially affect the model's structure, because the offboard price only enters the stock equation, a minor component of total use.

The most substantial change is in the price transmission of the European Community. In the original model the policy prices of the EC were exogenous. The revised model incorporates the U.S. gulf port price in determination of the intervention price, and thus threshold price. The revised model makes the EC responsive to world market conditions. However, the response of the EC is lagged because the previous year's U.S. gulf port price is used as an explantory variable in the intervention price equation. Nevertheless, the revised model's results suggest that the EC responds to market conditions in the setting of policy prices both directly in the form of the U.S. Gulf port price, and indirectly as a response to CAP budgetary pressures.

The price transmission of Japan demonstrates that the import price is quite responsive. However, the resale price's responsiveness is unchanged in the revised model. The purchase price, or producer price, has a higher elasticity than the resale price because it is substantially larger in value. The revised model's results correspond to the original version's in illustrating the highly protective nature of the Japanese import policy.

The revised price linkage equations create a different behavioral representation of the world wheat economy. In the original model, market conditions influenced the setting of the various policy prices through the current market price. The revised version introduces both additional variables that represent past market conditions, and economic forces exogenous to the world wheat sector, in the setting of export, consumer, and producer prices in the model's regions. The introduction of wheat market variables in the price determination equations impose different behavorial and dynamic relationships in the model.

Canada and Australia use marketing boards as means of maximizing the returns to their producers on export sales. The revised model's results suggest that market conditions influence their export pricing behavior. For the Canadian case, the carryover stock position of the U.S. affects their ability to price substantially above the U.S. gulf port price. The Australian carryover stocks have a negative effect on the export price, indicating the AWB's desire to limit excessive stocks because of limited storage capabilities.

The EC's policy prices are determined by the lagged yield and the ratio of guarantee fund expeditures to the GDP of the EC in addition to the U.S. Gulf port price. The inclusion of the lagged yield demonstates that price-setting decisions are directly affected by productivity conditions of the EC, and thus wheat market variables beyond the price level. The guarantee fund expeditures are affected by the intervention and threshold prices, which in turn are influenced by the U.S. Gulf port price. Thus, the wheat market affects the price determination of the EC in several indirect ways.

The price behavior of the regions is also affected by economic forces exogenous to the wheat sector. The Argentine export tax is not influenced by wheat market conditions, but rather fiscal expeditures in relation to GDP. Also, the Japanese resale and purchase prices are influenced by variables

Table 1. Price Transmission Elasticities Comparison Evaluated at 1984 Values

Region	U.S. Gulf Port Price	
	Original	Revised
Argentina		
WHPXEARR - Export Price	N/A	1.01
WHPFMARR - Farm Price	0.31	1.15
Australia		
WHPOBAU - Export Price	1.12	1.43
WHPFMAU - Farm Price	0.68	0.47
Canada		
WHPXECA - Export Price	1.20	0.90
WHPOBCA - Offboard Price	1.24	0.48
WHPGPICA - Initial Price	0.75	0.34
WHPFPCA - Final Payment	3.20	6.63
WHPFMCA - Farm Price	1.01	1.12
European Community		
WHPIEOR - Intervention Price	0.00	0.38
WHPTHEO - Threshold Price	0.00	0.37
Japan		
WHPJPU9Y - Import Price	N/A	1.03
WHRPJP - Resale Price	0.26	0.26
WHPPJP - Purchase Price	N/A	0.41

exogenous to the wheat sector. The resale price is positively influenced by the wage earnings index, suggesting that the price-setting decision is influenced by consumers' income gains. The purchase price is affected by the level of rice carry-over stocks, and thus is influenced indirectly by policy decisions in other markets.

The effect of changes in the behavioral assumptions of the model are demonstated by an exogenous shock of the U.S. wheat yield in 1980. The U.S. wheat yield was decreased by 10 percent. The 1981 actual values and percent changes from the actual values for the original and revised versions are presented in Table 2. The effect of the decline of the U.S. yield in 1980 is examined by comparing 1981 simulations of the original and revised models with 1981 actual values of several key variables.

The effects of the yield shock on the original and revised models are significantly different. The effect on the U.S. Gulf port price is less pronounced in the revised version, because in general competing exporters were more responsive to price changes. U.S. exports decline more in the revised version because of the expansion of Argentine and EC exports. The value of U.S. exports increases in the original model and decreases slightly in the revised model. Thus, the implied elasticity of U.S. wheat exports shifts from being inelastic (-0.8) to being elastic (-1.3).

Argentina and the EC demonstrate a qreater resposiveness to the U.S. price increase in the revised version, and thus expand exports. This is particularly true for the EC, since in the original model the EC was totally unresponsive to market conditions. The other major exporters, Australia and Canada, exhibit essentially the same initial response becuase the price transmission rates were similar between the two models. Japanese imports also remain unchanged for the same reason.

Summary

The revised price linkages provide a means of incorporating the behavior of government in a regional trade model. The price linkage equations allow for both the market effects internal to the wheat market, and economic forces exogenous to the wheat sector to affect the price determination in the modeled regions. The inclusion of the revised price linkage equations provides a more realistic picture of the world wheat ecomomy, and thus enhances the model's reliability in policy analysis and in forecasting.

Table 2. Effect of 10 percent U.S. yield reduction in 1980 - original vs. revised model 1981 simulation values

Region	1981 Simulation - Percent Change From Actual		
	Actual Value	Original	Revised
United States			
Gulf Port Price ($/MT)	173.00	7.31	5.07
Net Exports (M/MT)	48.20	-5.84	-6.52
Value of Exports (Mil $)	8338.60	1.89	-0.92
Elasticity of Export Demand		-0.80	-1.29
Other Regions Net Exports (M/T)			
Argentina	3.64	2.93	5.94
Australia	11.01	0.18	0.00
Canada	18.45	2.79	1.97
European Community	10.93	0.00	4.29
Japan	-5.42	-0.18	0.00

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