INCORPORATING POLICY RESPONSE FUNCTIONS INTO STRUCTURAL ECONOMETRIC COMMODITY MODELS

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While increasing use is being made of econometric models in the policy formulation process, there is concurrently a questioning of the realism of these models and the role of applied econometricians in providing policy advice. The concerns may be divided into two broad themes, although both are part of the more general problem of model specification. First, there is a recognition that in markets where the level of government intervention is high, not enough of this public sector activity is reflected in the model structures. Second, there is the criticism of Lucas and others that conventional techniques of evaluating policy alternatives using econometric models are deficient in that they do not allow decision-makers' views about the relationships between policy variables and endogenous variables to vary with or adapt to changing values of these policy variables. Hence, a simple comparison of the simulated values of endogenous variables is not a reliable test of the effects of alternative policies, since the real world results are a combination of changes brought about both by policy initiatives and by changes in the underlying structure, while the model captures only the first effect.

The objective of this paper is to develop a structural econometric model specification which incorporates public sector activity and allows the participants in the market being studied to react to changes in the policy variables in which they have an interest. The theoretical and empirical analysis relates to the evaluation of policy alternatives in the world markets for rapeseed, soybeans and their products (Griffith). These markets have relatively low levels of government intervention, so if the approach appears appropriate for these commodities it should be more so for more highly regulated markets.

ENDOGENOUS PUBLIC SECTOR BEHAVIOUR

The proposition that changes in public sector behaviour (changes in government policies) have measurable and significant impacts on private sector decision makers is well documented in the literature. In econometric analyses this type of impact is typically incorporated into the model by the specification of exogenous government policy variables. The presumption is that these policies are determined "outside the system" and therefore that there is no interaction between economic activity in the market being modelled and the levels of policies applied to that market. An increasing number of commentators argue that in many circumstances this presumption is incorrect, and that public sector behaviour should be included endogenously.

The notion of endogenous public sector behaviour (policy reaction or response functions) is not new. Over 20 years ago Downs set out the arguments that government actions in some areas, particularly the area of economic policy-making, are the direct result of the magnitude and/or variability of economic variables having wide-ranging impacts on society - national income, unemployment rate, inflation rate, balance of payments, foreign exchange reserves, etc. In a Keynesian economy the assumption is that governments act rationally to attempt to maximise social welfare by stimulating, stabilizing or somehow influencing these state variables by policy action. If it is not agreed that complete altruism or rationality are motives of government, Downs (p. 137) provides more general and more compelling reasoning "...political parties in a democracy formulate policy strictly as a means of gaining votes", i.e. they form policies and serve interest groups solely to gain and maintain office. Thus in choosing and implementing policies, governments must account for those variables which voters deem important - wages, prices, unemployment, disposable income, taxes, etc. In either case then, the government policy reaction function is based on considerations which include at least some major economic variables.

More recently, Brock and Magee developed a theoretical framework which demonstrates that reaction functions of individual politicians represent equilibria between positions on issues and the resources these positions generate. Thus taxes, subsidies and other politically determined "pork-barrel" variables, which are usually treated as exogenous, are explicitly endogenous and consistent with simultaneous equilibrium in economic markets. Heidhues has discussed the motives of agricultural trade policy makers in a number of countries. Lindbeck points out that approaches to evaluating behaviour in the private sector must treat explicitly instabilities and imperfections in both market and political-administrative systems.[1] Similarly, Rausser and Stonehouse (p. 888) contend in their analysis of the Canadian dairy industry that market intervention requires a structural specification including behavioural equations for both producers, private markets, and the regulatory agency. They argue the regulatory agencies respond to changing market conditions, including producers' responses to policy variables, by continually adjusting the policy instruments at their disposal.

It is apparent that the concept of endogenous government behaviour is reasonably well accepted and that public sector activity can be reflected in model structures in a manner which acknowledges the feedback relationships between the institutional (or political) and market environments. Further, there is beginning to appear a sizeable empirical literature on the incorporation of policy response or reaction functions into econometric commodity models. For example, Brainard demonstrates that agricultural policy cycles in Czechoslovakia can be explained by an economic model; Rausser and Freebairn estimate policy preference functions for use in setting U.S. beef import quotas; and Lattimore and Schuh, and Lattimore, Schuh and Thompson, provide some evidence of the rationality of Brazilian policy makers in setting the magnitude of the distortion between world and domestic prices of beef and corn. Abbott (1979a, 1979b) in his analysis of world wheat and feed grain trade argues that with depleted stocks, adjustments in net exports by the major traders must come out of extremely inelastic domestic consumption markets, and the prices faced in domestic and world markets would tend to become unstable. Under these conditions the free market model may be insufficient to find the response of a country's net import demand to changes in world prices, since importing countries will tend to implement trade policies to maintain stability in their domestic economies by divorcing internal prices from world prices. The method that Abbott employs to account for these circumstances is to specify trade functions as endogenous policy reaction functions, i.e. domestic and international prices are separated by standard devices such as tariffs or quotas, but the extent to which these devices are used is determined endogenously by the economic environment of the period under consideration. Lattimore and Zwart employ a similar method of analysing world wheat trade, Gulliver et al. use such a scheme for analysing Brazil soybean and product export policies, while Rausser and Stonehouse adapt the method to domestic policies and analyse Canadian dairy supply response.

Thompson (p. 15) however concludes his review of some of these studies by suggesting "Much more work is needed in this direction (policy distortions endogenously determined) in the future to improve the specification of present trade models".

Zwart and Meilke also indicate that it is necessary for researchers to incorporate the relationships between world markets and individual domestic agricultural policies into econometric commodity models if the problems of these markets are to be better evaluated. Finally, Lattimore and Schuh (p. 15) find their results encouraging and suggest "...that further research in this area might prove fruitful".

PRIVATE AND PUBLIC SECTOR PARAMETER INSTABILITY

Most econometric policy evaluations are conducted within a theoretical framework loosely termed, after Tinbergen, "the theory of economic policy". The essence of this framework is that there exists a fixed parameter vector, estimated from past data, which transforms changes in predetermined variables into changes in endogenous variables. After Lucas, let an economy or market in time period t be described by a vector Y(t) of endogenous variables, a vector X(t) of exogenous variables and a vector E(t) of temporally independent, identically distributed residuals. The motion of the economy is then determined (generally) by a difference equation

$$Y(t) = f\left[Y(t-1), X(t), E(t)\right], \qquad (1)$$

the distribution of E(t), and a description of the temporal behaviour of X(t).[2] The function f is taken to be fixed but not directly known, so the task of econometricians is to estimate f, or in practice, the values of the fixed parameter vector Θ in

$$f\left[Y(t-1), X(t), E(t)\right] = F\left[Y(t-1), X(t), \Theta, E(t)\right], \qquad (2)$$

where F is specified in advance. The central assumption of this theory is that once F and Θ are approximately known, they remain stable to changes in X(t).

With knowledge of F and Θ, forecasting Y(t+i) is simply a matter of inserting forecasted X(t+i) values into F. Policy evaluation is similarly straightforward, where a "policy" is a particular specification of present and future values of some components of X(t). With the remaining X(t) components forecast in the normal manner, the stochastic behaviour of f from the present on is then precisely specified as moments of well-defined random variables. The effects of various policies are readily ascertained by comparing the various, resultant, endogenous variable values.[3]

Within this framework the variance of short run forecasts tends to zero with the variance of E(t), and as the latter becomes small so also does the variance of estimated behaviour of Y(t) conditional on values of X(t). Thus forecasting accuracy in the short run implies reliability of longer run policy evaluation.

<u>Is This Model Realistic?</u>

In $$Y(t) = F\left[Y(t-1),\ X(t),\ \Theta,\ E(t)\right], \qquad (3)$$

the essential proposition is, as stated above, that the structure of the system (F, Θ) does not vary with the choice of X(t). However, to assume stability of (F, Θ) under alternate policy rules is to assume that agents' views about the behaviour of exogenous variables are invariant under changes in the true behaviour of these variables.

Lucas (p. 25) suggests that "Everything we know about dynamic economic theory indicates that this presumption is unjustified". Since the structure of the model depends on the optimal decision rules of economic agents, which depend in turn on the expected future behaviour of relevant variables, including those under the control of policy-makers, and since these expected values in turn will vary with changes in the true behaviour of the policy path, one is forced to conclude that the structure (F, Θ) depends on the policy sequence $X(t)$. Gordon, while critical of Lucas in other respects, agrees that this interpretation is correct.

Empirical evidence also points to the parameter vector Θ "drifting" in the face of changes in the series decision makers are attempting to forecast. For example, Weaver has found that parameters of estimated wheat acreage response functions change under different acreage control policy regimes. Gallagher's results support this view. Many econometric forecasting agencies also routinely revise intercept estimates as the economic environment changes. This may be done informally by observing patterns of recent residuals, or formally by applying "adaptive regression" methods (see Cooley and Prescott, 1973a, 1973b). It is argued that it is likely that the drift in Θ which these adaptive models describe, reflects, at least in part, the adaptation of the decision rules of agents to their environment. Since this drift will in most instances be relatively slow, use of adaptive methods can quite markedly improve the short-term forecasting abilities of econometric models. For longer term forecasting and policy simulations, ignoring the systematic sources of drift will however lead to large and unpredictable errors.

Now while it is well recognized that policy response functions should be included in policy models and that private sector parameters will vary as policies vary, it seems to us that an additional and related point has been largely ignored. This is that policy response functions by their very nature must contain variable parameters, since policy makers respond to variations in the constraints under which their optimization decisions are made (Maddala).

For example, Lindbeck argues that the constrained optimization of the criterion function of public sector decision makers will induce instability into public sector policy decisions as the relevant constraints change (i.e. as elements of the economic environment change). This instability will be amplified by shorter term electibility considerations which may not be explicitly recognized in the long run criterion function. There are then instabilities in political-administrative systems and these should be accounted for in the policy response functions representing such systems. In an econometric context this means that there is likely to be parameter instability in the public sector just as there is in the private sector.

Alternative Representations

For policy analysis, an improvement in model specification relating to the link between the decision rules of market participants (private and public) and the economic environment in which they make these decisions is necessary. Further, the simple adaptations which work well in short-term forecasting cannot be expected to perform well for long run policy evaluation.

For example, in the adaptive regression model, the parameter vector Θ is viewed as a purely random variable following the random walk

$$\Theta(t) = \Theta(t-1) + n(t), \tag{4}$$

where n(t) is a sequence of independent, identically distributed random variables. However, since the random walk scheme is stochastic by definition, a small standard error of short-run forecasts is totally consistent with infinite variance of the long-run operating characteristics, and therefore, policy responses, of the model.

An alternative is the time varying parameter procedure, where the parameter vector Θ is assumed to vary systematically with time. Thus

$$\Theta(t) = a + b(\text{time}) + n(t) \tag{5}$$

and

$$Y(t) = F\left[Y(t-1),\ X(t),\ \Theta(t),\ E(t)\right] \tag{6}$$

The problem with this approach is, of course, that the relationship between the parameter vector and time is usually specified to be monotonically increasing or decreasing. Thus, this method may be quite appropriate for situations where, for example, technological change occurs at a relatively constant rate, or changes in taste and/or substitution patterns are smoothly changing over time and always in the same direction, but it also will lead to large errors when these changes are not linearly time dependent (Singh et al.).

A third suggestion is to let policy variables be viewed as stochastically disturbed but known functions of the economic environment, i.e.

$$X(t)' = G\left[Y(t), \lambda, n(t)\right], \tag{7}$$

where G is known, λ is a fixed parameter vector, and $n(t)$ is a vector of disturbances. This function (7) is then a policy reaction function, and it effectively endogenizes policy-maker's behaviour. Then the remainder of the economy follows

$$Y(t) = F\left[Y(t-1), X(t), X(t)', \Theta(\lambda), E(t)\right], \tag{8}$$

where the behavioural parameters Θ are allowed to vary systematically with the parameters λ governing policy variables. The econometric problem in this context is that of estimating $\Theta(\lambda)$.

In a model of this type, a change in policy is viewed more as a change in the function (7) generating the values of the policy variables at particular times, i.e. a change in the parameter vector λ, than as a change in the policy variable values themselves. Thus, a change in policy affects the behaviour of the system in three stages - first by modifying the behavioural parameters λ governing the policy rule; second by altering the time series behaviour of X(t)' ; and third by the resultant changes in the endogenous variables Y(t).

Problems with these Representations

To take full account of the criticisms of econometric policy evaluation methods, a rehabilitation must therefore contain two major components - the specification of policy response functions which allow better prediction of public sector behaviour, and the recognition of rational responses of economic agents which allow better prediction of private sector response to changes in public sector policy rules, and public sector response to the economic environment.[4]

The previous discussion indicates that the concept of endogenous government behaviour is well accepted in terms of institutional realities. The discussion above reaffirms this belief and provides additional justification in the context of dynamic economic theory. Even so there are at least two major problems with incorporating these concepts into econometric commodity models.

The first problem relates to whether these types of functions (7) can be estimated. If the types of policy changes being studied have occurred within the sample period and their timing is announced and known by econometricians, their effect on Y(t) can be evaluated by estimating (7), substituting into (8), and then simulating for various values of λ. If however, these changes occurred gradually or erratically, leading agents to adapt their behaviour haphazardly, it may be impossible to obtain estimates of the relationship between Θ and λ from past data (Lucas), Further, if the policy under consideration was not applied during the sample period, it may be extremely difficult to estimate the impacts of such a policy in a reaction function. For example, a problem may arise in attempting to evaluate stabilization policies in a market that was previously highly unstable.

Conversely though, estimation of behavioural shifts as a distributed lag on shifts in policy rules, or by time-varying methods, may be feasible if agents react gradually but systematically to the alteration in their circumstances. And, even if econometric estimation of the policy reaction functions are impossible or unreliable, there may be some cases where shifts in parameter values can be deduced on theoretical grounds and hence integrated into the standard structural model (equation 8).

The second problem concerns the form that the reaction function should take. As an example of such a function for a macroeconomic policy authority, Gordon suggests that the authority has some long term desired or target value for a specific policy variable, $X(t)^*$, but deviates from it in the short term in response to deviations in say national income $Y(t)$ from its target value $Y(t)^*$, i.e.

$$X(t) = X(t)^* + a\left[Y(t) - Y(t)^*\right] + \mu(t).^{5} \qquad (9)$$

The estimated value for $X(t)$ can then simply be substituted into (8), and one type of policy to be evaluated might be a reduction in the size of a.

It seems however, that this type of function (equation 9) may be more appropriately specified. By endogenizing the policy decision process it provides a more correct structural specification and hence a better representation of reality, but the approach is still inadequate since it relies on fixed parameter vectors.

As argued above, policy reaction functions are likely to be characterised by variable rather than fixed parameters. Further, although there is certain to be some random instability generated by the activities of the public sector, it is inconsistent to argue for rational behaviour in one sector of the economy (private sector) and irrational behaviour in another sector (public sector). Thus if public policy-makers are regarded as at least partly rational, their behaviour would seem to be better characterised using econometric techniques that allow for systematic, and perhaps random, coefficient variation (Ward and Myers).

A possible solution then is to specify the <u>relative</u> rather than the <u>absolute</u> difference between actual and desired policy values as being dependent on deviations in national income from target levels, i.e. if

$$X(t) = b(t)\, X(t)^* + \gamma(t) \qquad (10)$$

and

$$b(t) = c + d\left[Y(t) - Y(t)^*\right] + \delta(t) \qquad (11)$$

then

$$X(t) = \{c + d\left[Y(t) - Y(t)^*\right] + \delta(t)\}\, X(t)^* + \gamma(t) \qquad (12)$$

This reaction function theoretically can be estimated and used to determine the impact of policy changes on Y(t).[6] In this case a possible policy might be a reduction in d. This specification allows the policy decision rules to be endogenous and to be adaptable to changing economic circumstances.

Since our primary interest in this paper lies with the specification and estimation of endogenous policy response functions, we are not concerned for the present with the problem of private sector parameter instability. It should be noted anyway that this source of instability cannot be totally avoided with present econometric techniques (Friedman). Stonehouse and Rausser (p. 11) summarize these concerns: "This source of parameter instability can only be avoided by reasonably accurate measurements of expectation formation patterns and dynamic responses; a dubious hope at best".[7] This will be especially true if circumstances dictate that it may be impossible to obtain estimates of the relationships between Θ and λ from past data.

In any case, it seems reasonable to assume that much of this instability can be avoided by the prior accounting for some of it using a variable parameter specification for the coefficients in the policy response functions. The parameters in the private sector behavioural equations therefore may be more precisely estimated because of the inclusion of endogenous policy response functions and a decrease in specification error, and as well some of the instability generated by public sector activities is avoided.

A POLICY RESPONSE FUNCTION APPROACH TO POLICY EVALUATION IN THE WORLD MARKET FOR RAPESEED, SOYBEANS AND THEIR PRODUCTS

A recent study (Griffith) considered the impacts of various domestic and trade policies on the world market for rapeseed, soybeans and their products, and particularly, on economic activity in the Canadian rapeseed sector. This section of the paper integrates the previous discussion on the techniques of policy evaluation with the institutional and market characteristics of the world oilseed complex.

The discussion contained in previous sections may be generalized with the assistance of Figures 1 and 2. With no policy intervention and an otherwise competitive market, price relationships within and between exporting and importing regions may be represented by a set of simple identities. Price is assumed to be determined in the wholesale market of the exporting region (PWX), and all other prices relate to PWX. For example, as depicted in Figure 1,

$$PFX = PWX - HCX, \tag{13}$$

$$PXX = PWX + FOB, \tag{14}$$

$$PMM = PXX + CIF, \tag{15}$$

$$PWM = (PMM * EXR) + DCM, \tag{16}$$

$$PFM = PWM - HCM. \tag{17}$$

These identities are of course those that would be specified for a spatial equilibrium model - prices between two points in space, time or form are equal, after all transfer costs are accounted for, if there is product movement between these points.

Figure 1 about here

However, if governments intervene in these markets by domestic agricultural and/or trade policies, these simple identities no longer hold. In some cases the accommodation required is small: in the import case of specific or ad valorem tariffs, the relevant identity (16) would be respectively

$$PWM = (PMM * EXR) + T + DCM, \quad (18)$$

or

$$PWM = (PMM * EXR)\ (1 + t) + DCM, \quad (19)$$

where T is the specific tariff and t is the ad valorem tariff. This type of specification assumes no terms of trade effects.

In many cases though, governments choose to partially or wholly insulate domestic prices from the world market. Some examples of partial insulation are the minimum import price schemes that Japan and the U.K. (before it joined the E.E.C.) adopted for some products. In these cases domestic prices may adjust to world market prices in the long term, but in the short run there are limits to the extent that domestic prices will respond to conditions in the world market. A price linkage model which corresponds to this type of policy behaviour would be a partial adjustment identity,

$$PWM = a\ (PMM * EXR) + b\ PWM\text{-}1. \quad (20)$$

In this situation domestic price responds partially to the world price through the coefficient a, and partially to past domestic prices through the coefficient b, where $0 \leq (a,b) < 1$.

Some examples of near complete insulation are a constant import quota determined from growth in domestic demand, as used up until recently for some products by Japan, and the variable import levy system employed within the E.E.C. Common Agricultural Policy (CAP). As Abbott (1979a, p. 24) points out "In a world in which self-sufficiency and protection of domestic agriculture are important policy goals, this (equation 20) may be a considerably more reasonable assumption that what is used in the spatial equilibrium framework. In developing countries, where food riots may result from sudden increases in food prices, domestic price stability may in fact be a requirement". In this situation, the value of a will be close to zero and the value of b will be close to unity. Similar arguments apply to the linkages between domestic farm and wholesale prices - identities (13) and (17), and between wholesale and export prices - identities (14) and (15). All these considerations are represented in Figure 2.

Figure 2 about here

The price linkage relationships must therefore be generalized to incorporate the way these policy rules are implemented if the linkages between prices are to be clearly understood and useful for forecasting and policy evaluation purposes. Further, since the mix of policy options will probably be different in different circumstances, it seems unlikely that simple expressions will be sufficient to capture the structural detail required.

In deriving a more general specification of price linkages in the presence of intervention, we make use of the ideas suggested earlier and implemented in part by Abbott and others, i.e. specify a typical structural econometric model to explain variations in endogenous variables, but allow many of the policy variables affecting them to be endogenous and to change in response to changes in the economic environment. Some of the policy variables relevant for this study are discussed below.

Domestic Price Support Policies

In an exporting region price support measures are typically guaranteed minimum prices set and announced at the beginning of the crop year or before. These guaranteed prices are typically below expected market prices but are used as a stop-loss measure to provide a floor in case of sudden and unexpected market price falls. Some examples are the U.S. loan rates for soybeans and corn and the first advance payments made to Canadian and Australian wheat producers.

An expected high domestic production and/or a high level of opening stocks relative to demand will tend to depress prices received (PXX and hence PWX), so the level of price support given to producers would likely decrease. High levels of net farm income in the recent past will likely induce governments to support farm prices at higher levels, especially if support levels are related by formula to past prices and costs. If the domestic inflation rate is high, there is an inducement for the government to increase the level of support with the objective of stimulating output and lowering future food prices. Finally, where explicit producer price stabilization policies are in effect, current producer support prices will be some function of past support prices.[8]

The Abbott approach would specify

$$PSX(t) - PWX^*(t) = f\,[\text{domestic production and stocks}^*(t), \text{world production and stocks}^*(t), CPI^*(t), \text{net farm income } (t-1), PSX(t-1)], \quad (21)$$

or more generally,

$$PSX(t) = f\,[PWX^*(t), PSX(t-1), \text{domestic supply}^*(t), \text{world supply}^*(t), CPI^*(t), \text{net farm income } (t-1)], \quad (22)$$

where PSX(t) = producer support price for period t, and * is an expectations operator. Thus, the first advance given by the Canadian Wheat Board would be a function of expected export prices, past producer prices, expected domestic and foreign supply in relation to expected demand, expected inflation, and previous net farm income. The expression for PSX is then substituted into the structural equations explaining acreage and/or output. Notice that this formulation of the policy reaction function is at least partially independent of the form of the support measures adopted, and thus less reliant on the identification and measurement of explicit program variables.

However, recognizing the validity of the arguments outlined earlier, procedures similar in concept to equations (10), (11) and (12) need to be incorporated. Without sacrificing the economic reasoning, equation (22) can be written as

$$PSX(t) = b(t)\ PWX^{*}(t) + \gamma(t), \tag{23}$$ [9]

where

$$b(t) = f\left[PSX(t-1),\ \text{domestic supply}^{*}(t),\ \text{world supply}^{*}(t),\ CPI^{*}(t),\ \text{net farm income}\ (t-1)\right]. \tag{24}$$

The expression for b(t) is substituted into (23), estimated, and then PSX(t) is substituted into the acreage or production equations. This formulation therefore endogenizes the policy response mechanism and allows it to adapt systematically to alterations in the economic environment. It is also, as with (22), largely independent of the form of the support measures adopted.

Much the same type of formulation would apply to farm support policies in importing regions. In these cases, the support level is generally set above expected market prices and the difference made up by deficiency payments. Examples are the treatment of rapeseed under the CAP and the treatment of rapeseed and soybeans in Japan. The only difference is that some of the signs on the explanatory variables change and their values may be larger since b(t) would be greater than unity instead of less than unity.

Export Subsidization Policies

Many of the arguments that apply to domestic farm price supports are equally valid for explaining export subsidization policies. In addition, the decision to implement such policies at a particular level may be related to the current balance of payments situation, the holdings of foreign exchange reserves, and the exchange rate. For example, governments may wish to encourage export sales when the current account is weak, when reserves are falling, or when the currency is appreciating against the currencies of its principal trading partners. Thus,

$$PMM(t) = b(t)\, PWX(t) + \gamma(t) \tag{25}$$

and

$$\begin{aligned} b(t) = f\Big[&\text{domestic supply }(t), \text{ world supply }(t), \\ &BOP(t), \text{ reserves}(t), \text{ exchange rates}(t), \\ &PMM(t-1)\Big]. \end{aligned} \tag{26}$$

This expression for PMM (or PXX) is then used as a price linkage function or substituted into structural equations explaining export supply or export demand if these are specified.

A similar type of expression would be appropriate for the case of export restriction policies, but more importance would be placed on the ability to satisfy domestic demand and the price level that this would entail. Export quota or embargo variables and inflation variables would be necessary inclusions.

Import Restriction Policies

In importing regions the decision to partially or wholly insulate the domestic market from the world market will depend in part on the existing tariff structure and in part on the actual or potential use of non-tariff measures. As mentioned above, if only fixed tariffs are used the simple identities (18) and (19) will be sufficient to specify the price linkages.

However, when variable tariffs or levies, or any of a host of non-tariff measures, are used to protect the domestic market, these simple identities are insufficient. For example, the importing country facing a foreign exchange constraint may be unwilling to maintain a low domestic price that will stimulate the demand for imports. The level of domestic production may affect the level chosen for a controlled domestic price so that in bad years a higher price will be allowed than in good years. In countries where stocks are held the level of these stocks may also be a factor, and a depreciating exchange rate can induce policy makers to reduce the gap between domestic and world prices since the world price is rising in local currency terms. Finally, the quantities of food aid received may not be additional imports but instead substitutes for commercial imports which would otherwise have been purchased. So, when aid receipts are large, governments may be willing to maintain higher domestic prices since total consumption will not be reduced to that implied by the domestic price elasticity of demand.

The effects of tariff and non-tariff barriers impeding entry into an import market may, therefore, be specified as

$$PWM(t) = b(t)\ PMM(t) + \gamma(t) \tag{27}$$

and

$$b(t) = f\left[\text{tariffs}(t),\ \text{domestic production}(t),\ \text{domestic stocks}(t),\ \text{reserves}(t),\ \text{exchange rate}(t),\ CPI(t),\ AID(t),\ PWM(T-1)\right]. \tag{28}$$

This expression for PWM is then used as a price linkage function or substituted into structural equations explaining domestic and import demand if these are specified. The effect of the tariff is explicit, while the effects of non-tariff import measures are implicit and are evident through causal variables rather than through direct, explicit factors.[10] Thus, the effects of tariff changes may be modelled directly by changing the value of the tariff variables, but the effects of non-tariff import measure changes have to be modelled by altering the responsiveness of b(t) to the variables in (28).

EMPIRICAL ANALYSIS

Model Specification

The theoretical considerations outlined above are incorporated into a structural econometric model of the world markets for rapeseed, soybeans and their products (Griffith, Griffith and Meilke). The model contains some 150 behavioural equations, market-clearing conditions, and technical and accounting identities, representing six commodity markets (rapeseed, rapeoil, rapemeal, soybeans, soyoil and soymeal) and six regions (Canada, Japan, E.E.C., U.S., Brazil and an aggregate Rest of World). The standard Houck partitioning of an oilseed model into a recursive supply block and simultaneous seed, oil and meal blocks is employed, but a number of important extensions and modifications are incorporated. For present purposes, the relevant inclusions are endogenous policy response functions which determine in many regions the links between domestic and world prices. Seed, oil and meal blocks for each oilseed in each region contain an explicit price linkage function connecting the domestic seed, oil and meal prices to the "world price". In Brazil and Japan these price linkages are specified as in equations (25)-(26) and (27)-(28) respectively. Where support prices are used at the farm level (Japan, E.E.C., Brazil and the U.S.), policy response equations are also estimated which link these support prices to the market prices within that region (equation 23). The "world price" is determined by global market clearing conditions for rapeseed and soybeans and their oil and meal derivatives. These conditions are based on trade volumes. Net imports or exports of seed, oil or meal in any region are determined by market clearing conditions within each region.

The model is therefore comprehensive in its coverage of products and regions and flexible in the way in which policy variables are incorporated. As such, the specification provides the capability for evaluating a large number of different types of domestic and trade policy alternatives.

In this paper only the estimates for the policy response functions are presented, with a full account of the complete model specification, estimation and validation being given in Griffith and Meilke.

Policy Response Function Estimates

The policy response functions linking support and market determined farm prices, and domestic and world wholesale prices, are estimated using OLS over the period 1958/59 to 1976/77, although some series are shorter because of data limitations.[11] The data used in the estimation are described in full in Griffith and Meilke.

In the estimated equations described below, data availability and degrees of freedom problems preclude a detailed specification of policy response functions such as those outlined in equations (24), (26) and (28). However a further generalization of these restricted response functions is made by specifying a variable intercept parameter.

Thus as an example, take a simplified version of the Japanese soyoil domestic-world price linkage function. The conventional fixed parameter form is

$$PWSOJP(t) = a + b\,(PESOWD)(t) + c(BOPJP)(t) \qquad (29)$$

The corresponding variable parameter form is

$$PWSOJP(t) = a(t) + b(t)(PESOWD)(t)$$

where
$$a(t) = \alpha + \beta\,(BOPJP)(t)$$
$$b(t) = \gamma + \delta\,(BOPJP)(t)$$

or
$$PWSOJP(t) = \alpha + \beta\,(BOPJP)(t) + \gamma\,(PESOWD)(t) + \delta\,(PESOWD * BOPJP)(t) \quad (30)$$

Thus the fixed parameter form is a special case of the variable parameter form. Further, it is possible to test the variable parameter hypothesis by testing whether δ is significantly different from zero.

(a) Farm Support - Market Price Linkage Functions

The guaranteed or support prices for rapeseed and soybeans are specified to be a function of the lagged market price (+), lagged input cost index (+), lagged dependent variable (+), and other explicit explanatory variables where appropriate (+ or -). Thus, the relationship between the market price and the support price is hypothesized to be affected by factors which influence the net returns to rapeseed and soybean production - predominately the cost of production. A lagged dependent variable is included to capture the expressed desire for a relatively stable support price. The import price of soybeans is used as an explanatory variable for the Japan rapeseed support price, since the legislation for the guaranteed price defines a close correspondence with activity in markets for related products. Finally, 1974-75 is dummied out of the SOYLOAN relationship as there was no loan rate program in operation that year.

Table 1 about here

-market

The results of estimating the guaranteed/price linkage functions are presented in Tables 1 and 2 for fixed and variable parameter estimates respectively. In the fixed parameter format, all regressions track the sample period well and display generally sound statistical properties. Over 93 per cent of the variation in the dependent variables is explained by the independent variable set, and there are no significant autocorrelation problems. The SEE's represent between 4 and 12 per cent of the value of the means of the dependent variables. The estimated coefficients all have the correct signs, have t values near unity or greater, and generate elasticities which indicate that the responsiveness of support prices is generally inelastic. The exception is the long run elasticities for the input cost index which in most cases are highly elastic.

Table 2 about here

In the variable parameter form (Table 2), the general picture remains the same although some differences are evident. The E.E.C. equation has a substantially reduced $\bar{R}^2$ value (compared to the fixed parameter form), an approximately double standard error, and a significant positive autocorrelation problem. The cause of these effects is the omission of a lagged dependent variable due to its coefficient value consistently exceeding unity. All other equations have similar goodness of fit and other statistical criteria to the fixed parameter case.

In terms of the explanatory variables included, the hypothesis of parameter variation cannot be rejected for the Japan, E.E.C. and Brazil equations, while some parameter variation is evident in the U.S. equation in that while both fixed and variable parameters of the cost index cannot be included, the variable parameter form is consistently more significant than the fixed parameter form. The estimated coefficients are much more elastic than their fixed parameter equivalents, with the cost index having the major effects and the fixed and variable price terms tending to have offsetting effects. The market price variable is now significant in all regions, but the lagged dependent variables for the E.E.C. and Brazil fail to attain acceptable levels of significance. Finally, attempts to include the level of stock overhang as an explanatory variable in the SOYLOAN function did not succeed in either fixed or variable parameter versions.

Comparing the two estimation approaches, the variable parameter format appears to do marginally better in terms of $\bar{R}^2$ for the Japan, U.S. and Brazil functions while the fixed parameter format performs best for the E.E.C. rapeseed support price equation.

(b) Wholesale Domestic-World Price Linkage Functions

The domestic wholesale prices for rapeseed, soybeans and their products in Japan, and soybeans and its products in Brazil, are specified to be dependent on the world equilibrium price (+), freight rates, tariffs where applicable (+), macroeconomic policy indicators and lagged dependent variables (+). The world price is converted to domestic currency by the appropriate exchange rate, and in the Japanese rapeoil and soyoil functions, the tariff is included in the world price term. The sign of the freight rate variable will depend on whether the region is an importer (+) or exporter (-). Exogenous macroeconomic policy indicators (merchandise trade balance and foreign exchange reserves) are included in these price links to help determine the extent to which the gap between world and domestic prices is varied by the two governments in response to changes in the macroeconomic environment of the respective regions. Lagged dependent variables are also included in the oil price links of those two regions to capture the expressed intent of stable domestic oil prices. The Brazil soybean price link contains a minor exception in that there is no published Brazilian wholesale soybean price - hence the farm price is the only market-determined domestic price.

Table 3 about here

The results of estimating these world-domestic wholesale price linkages are presented in Tables 3,4 and 5. The Japanese rapeseed and product functions (Table 3) all track the sample period well and in general display sound statistical properties. Greater than 83 per cent of the variation in the dependent variables is explained by the independent variable sets, there is no significant autocorrelation, and the standard errors represent between 6 and 15 per cent of the dependent variable mean values. The world price variables all have positive signs, large t values and estimated coefficients which indicate for rapeoil an elasticity near unity and for seed and meal elasticities of about 0.8. Freight rates are important explanatory variables for seed and oil price links, although quite inelastic, while the lagged dependent variables are both highly significant and the adjustment coefficient indicates long run elasticities about 40 per cent greater than the respective short run values. The hypothesis of unambiguous parameter variation is rejected for the rapeoil and rapemeal equations, since both fixed and variable parameter forms of the policy variables cannot be jointly included. However some evidence of parameter variability is seen.

The signs of the policy indicator variables in these and later equations requires further comment. In importing regions such as Japan, the domestic price is usually maintained above the equivalent world price to dampen demand and hence import expenditures. When the level of foreign exchange reserves or the trade balance rises, governments have more to spend on imports and are willing to increase imports thus causing domestic prices to fall and inflation to moderate. The expected sign of the policy indicator variables in importing regions is then negative. In fixed parameter format neither balance of trade nor foreign exchange reserves were found to significantly explain Japan rapemeal price, however a dummy variable for rapeseed product liberalization shows a significant negative effect on prices since 1970/71.[12]

Table 4 about here

The Japanese soybean and product functions (Table 4) are quite similar to their rapeseed counterparts. Over 93 per cent of the variation in the dependent variables is explained by the independent variable sets, there is no significant autocorrelation, and the standard errors represent between 6 and 11 per cent of the dependent variable mean values. The world price variables all have positive signs, very large t values and estimated coefficients which indicate an elasticity of about 0.9 for beans and meal and a short run elasticity of about 0.5 for oil. The lagged dependent variables in the oil functions are highly significant and suggest long run elasticities about double the short run values. Freight rates are significant only for bean price while the policy variables are significant only in the soyoil price function. Domestic soyoil prices have an inelastic response to both these variables. The hypothesis of parameter variation therefore cannot be rejected for the Japan soyoil link.

Table 5 about here

Finally, the Brazilian soybean and product price linkage functions are presented in Table 5. Over 89 (and in four cases over 97) per cent of the variation in the dependent variables is explained by the independent variable sets, there is no significant autocorrelation except in one of the soybean equations, and the standard errors range between 6 and 18 per cent of the dependent variable mean values. The world price variables all have positive signs, very large t values, and estimated coefficients which indicate an elastic response for beans, a short run elasticity of about 0.65 for oil, and a variable elasticity for meal depending on the specification. The freight rate variables are correctly signed where significant, and the lagged dependent variables in the oil functions are highly significant and suggest long run elasticities about double the short run values. The hypothesis of parameter variation cannot be rejected for the soybean price link, and in addition some partial evidence of parameter variation is seen in the oil and meal linkages.

In Brazil, there is a two-price scheme in operation for soyoil and soymeal, and the domestic price is set lower than the equivalent world price. Trade policies such as export quotas, export taxes and overvalued exchange rates have been used to divert supplies to the domestic market and hence lower the domestic price (Lattimore et. al). When the trade balance rises, the country can afford to sacrifice export earnings without precipitating a balance of payments problem, so the level of intervention in the domestic market increases. This situation has been empirically verified for Brazil for beef and corn by Lattimore et. al and for soybeans and products by Gulliver et. al.

However, with an unchanged world price, an increase in the level of intervention results in a decrease in the domestic price, an expansion in domestic consumption and a reduction in exports. With this reasoning the expected sign of the policy indicator variables for oil and meal in Table 5 is negative.

There would seem to be an obvious explanation for the signs on the policy indicator variables in the Brazil soybean price equations being opposite to those for oil and meal. The fact that soybeans are inputs into the crushing process, and the presence of ceilings on domestic soyoil and soymeal prices, means that the government's attention is focussed mainly on the higher valued oil and meal products. Thus intervention in the oil and meal markets, as discussed above, follows that for beef and corn. However, with a relatively small crushing capacity over most of the sample period and a relatively undeveloped marketing infrastructure, the domestic crushing demand is likely to be well satisfied almost regardless of soybean prices (Griffith and Meilke). In this situation the government has no need to keep bean prices low to retain supplies on the domestic market. Market prices therefore climb above the equivalent world price to take advantage of the inelastic domestic demand. A balance of payments surplus causes the level of intervention in the oil and meal markets to increase, and this may be paid for to some extent by increased taxes in the bean market. The expected sign of the policy indicator variables for soybeans in Table 5 is therefore positive.

CONCLUSIONS AND IMPLICATIONS

The theme of this paper has been that an improvement in econometric model specification is required for more accurate policy evaluation. This improvement should allow a greater reflection of the institutional realities of the market being modelled, particularly public sector behaviour, and should provide a stronger link between the decision rules of market participants and the economic environment in which market participants make their decisions. The theoretical model and empirical analysis developed in this paper is believed to be an important extension of past econometric commodity models. Endogenous policy response functions are specified and estimated, and these provide better predictions of public sector behaviour. Further, the estimation method includes a variable parameter specification, and as well as explicitly recognizing the instabilities inherent in political-administrative systems, this allows some of the instability in private sector parameters to be subsumed in the public sector equations. These specificational improvements lead to a greater understanding of government intervention in the oilseed complex, and help overcome part of the recent criticism of the usefulness of econometric models for long run policy evaluation. If econometric commodity models can be seen to be more realistically specified, the results of policy simulations with these models will be better accepted and applied econometricians can play a more decisive role in the policy formulation process.

The empirical results are highly significant and most encouraging, especially those relating to the policy indicator variables. We would of course,prefer import quotas, export taxes etc. to be included as explicit explanatory variables in the policy response links, but given data unavailability the policy indicator approach seems to be a reasonable "second best" alternative. The highly significant coefficients on these policy indicator variables implies that the past practice of ignoring these aspects of economic behaviour results in a substantial masking of the structural inter-dependencies between public and private sector decision-makers. The hypothesis of parameter variation could not be rejected for approximately fifty per cent of cases, and this suggests that in these cases the variable parameter representation discussed in this paper provides a better explanation of public sector behaviour than more conventional specifications.

The apparent success of endogenising certain aspects of government intervention in the oilseed complex suggests that other aspects may be endogenised as well. Some possibilities are C.C.C. activity in the world soyoil market, government sponsored stock accumulation in importing regions, and (data allowing) explicit recognition of actual values for some policy variables such as quotas and taxes. Further, given that the overall level of intervention in the oilseed complex is low, the potential benefits should be substantial of applying the types of procedures discussed above to more highly regulated domestic and trading sectors such as beef, eggs, milk and wheat.

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FOOTNOTES

1. Although the objective functions of public policy makers are not always stated explicitly.

2. This discussion assumes for simplicity a first order difference equation. Similar although more complicated results would hold for higher orders.

3. This is the case for prospective policy evaluations. For retrospective evaluation, the relevant policy variables would be specified over some period in the past when a particular policy was actually or assumed to be operative.

4. As somewhat of an aside, Lucas's insistence on the rationality of economic agents has been taken by many as an explicit justification for rational expectations in general and the permanent income and natural rate hypotheses in particular (Anderson 1978a, 1978b , Sargent and Wallace). However, it would appear that his arguments are more profound than this simple view.

5. Reuber has in fact estimated such reaction functions.

6. Note that since the composite disturbance term in (12) is unlikely to be "well-behaved", some care is required in interpreting results and/or taking corrective action (Maddala, Rausser and Mundlak, Ward and Myers).

7. Although recent attempts to incorporate more comprehensive expectations patterns in econometric models hold some promise (Chavas and Johnson, Scobie and Gellatly).

8. The choice of explanatory variables used to predict the level of support prices in largely unregulated markets is to some extent ad hoc. In the case of highly regulated commodities the explanatory variables may be defined as an explicit pricing formula or may be identified from the actual legislation.

9. Note that the intercept term of an equation such as (23) is likely to be variable too, but it is excluded from the present discussion for ease of exposition.

10. Ideally, the effects of quantitative import (or export) controls should be explicitly included too. However it is often difficult to determine when such a restriction is in place, let alone be able to place a quantitative value on it. In these circumstances, the second best strategy seems to be as argued above.

11. It should be noted again that the use of OLS as an estimator could result in some problems if the equation determining the coefficient (such as equation 11) is stochastic (Maddala). In particular, the residuals of the estimable form (such as equation 12) are likely to be heteroscedastic.

12. Import quotas on rapeseed, rapeoil and rapemeal were altered in April, 1971 so that these products were transferred from the highly restrictive "Fund Allocation" licencing category to the least restrictive "Automatic Approval" category.

Table 1: Guaranteed Prices for Rapeseed and Soybeans – Fixed Parameter Estimates

Region	Dependent Variable (Mean)	Independent Variables: Market Price (t-1)	Cost Index (t-1)	Lag Dept. Variable	Other Variables	Con-stant	Statistics: $\bar{R}^2$	DW (H)	SEE	n
Japan	PGRSJP (4483)	PFRSJP-1 0.687 (4.80) [0.62][0.68]	PINPJP-1 5.141 (0.95) [0.13][0.14]	PGRSJP-1 0.089 (1.65)	PMSBJP-1 9.72 (2.91) [0.32][0.35]	-640	0.989	2.14 (0.28)	176	15
EEC	PGRSEC (103.8)		PINPFR-1 0.124 (1.87) [0.16][4.71]	PGRSFR-1 0.967 (8.80)		-7.68	0.956	1.60 (0.86)	5.5	15
U.S.	SOYLOAN (2.21)	PFSBUS-1 0.065 (0.93) [0.09][0.22]	PINPUS-1 0.0074 (4.05) [0.56][1.38]	SOYLOAN-1 0.595 (6.10)	DUM1974 -3.20 (-15.48)	-0.32	0.938	1.61 (0.91)	0.161	18
Brazil	PGSBBR (513.8)		FPPIBR-1 1.56 (3.03) [1.01][1.43]	PGSBBR-1 0.292 (0.83)		-121	0.972	1.85 (NA)	68.8	9

Table 2: Guaranteed Prices for Rapeseed and Soybeans - Variable Parameter Estimates

		Independent Variables						Statistics			
Region	Dependent Variable (Mean)	Market Price (t-1)	Price*Cost (t-1)	Cost Index (t-1)	Lag Dept. Variable	Other Variables	Con-stant	$\bar{R}^2$	DW (H)	SEE	n
Japan	PGRSJP (4576)	PFRSJP-1 1.091 (5.48) [0.98] [2.05]	PFRS*PINP -0.009 (-3.85) [-0.91] [1.91]	PINPJP-1 68.85 (4.64) [1.74] [3.65]	PGRSJP-1 0.534 (1.85)	PFRS*PMSB 0.0007 (1.19) [0.10] [0.22]	-5876	0.994	2.54 (0.33)	138	14
EEC	PGRSFR (103.8)	PMRSEC-1 0.992 (2.32) [1.60]	PMRS*PINP -0.0069 (-2.39) [-1.52]	PINPFR-1 2.12 (3.09) [2.74]			-172	0.760	0.52	12.7	15
U.S.	SOYLOAN (2.21)	PFSBUS-1 -0.227 (-1.85) [-0.32] [-1.23]	PFSB*PINP 0.0016 (4.46) [0.42] [1.48]		SOYLOAN-1 0.742 (6.84)	DUM1974 -3.21 (-16.43)	0.56	0.945	1.89 (0.26)	0.153	18
Brazil	PGSBBR (513.8)	PFSBBR-1 -3.87 (-3.05) [-0.51]	PFSB*FPP1 0.0077 (3.02) [0.62]	FPPIBR-1 1.57 (4.24) [1.02]			25.0	0.989	2.72	39.9	9

Table 3: Japanese Wholesale Price Linkages for Rapeseed, Rapeoil and Rapemeal

Commodity	Dependent Variable (Mean)	Independent Variables					Statistics			
		World Price	Policy Variable	Freight Rate	Lag Dept. Variable	Constant	$\bar{R}^2$	DW (H)	SEE	n
Rapeseed	PMRSJP (167.6)	PERSWD 0.787 (2.59) [0.79]		FRCNJP 4.90 (1.38) [0.32]		-18.44	0.916	1.88	25.2	14
Rapeoil	PWROJP (115.4) (fixed parameter)	PEROWD + TAROJP 0.945 (6.19) [0.95] [1.30]	BOPJP -0.0045 (-6.48) [-0.13] [-0.18]	FRCNJP 1.76 (1.68) [0.17] [0.23]	PWROJP-1 0.266 (6.39)	-28.60	0.987	2.45 (0.89)	6.52	14
	PWROJP (115.4) (variable parameter)	PEROWD + TAROJP 1.029 (6.50) [1.04] [1.53]	PEROWD * BOPJP -0.00004 (-6.43) [-0.14] [-0.20]	FRCNJP 1.53 (1.43) [0.15] [0.22]	PWROJP-1 0.323 (7.07)	-40.91	0.987	2.28 (0.57)	6.56	14
Rapemeal	PWRMJP (35.84) (fixed parameter)	PERMWD 0.958 (7.22) [0.78]	LIBDUMR -5.37 (-1.84)			9.39	0.834	1.90	3.56	16
	PWRMJP (35.84) (variable parameter)	PERMWD 1.046 (5.01) [0.85]	PERMWD * FERJP -0.000012 (-1.53) [-0.08]			8.24	0.828	1.97	3.63	16

The world price is corrected for exchange rates.

Table 4: Japanese Wholesale Price Linkages for Soybeans, Soyoil and Soymeal

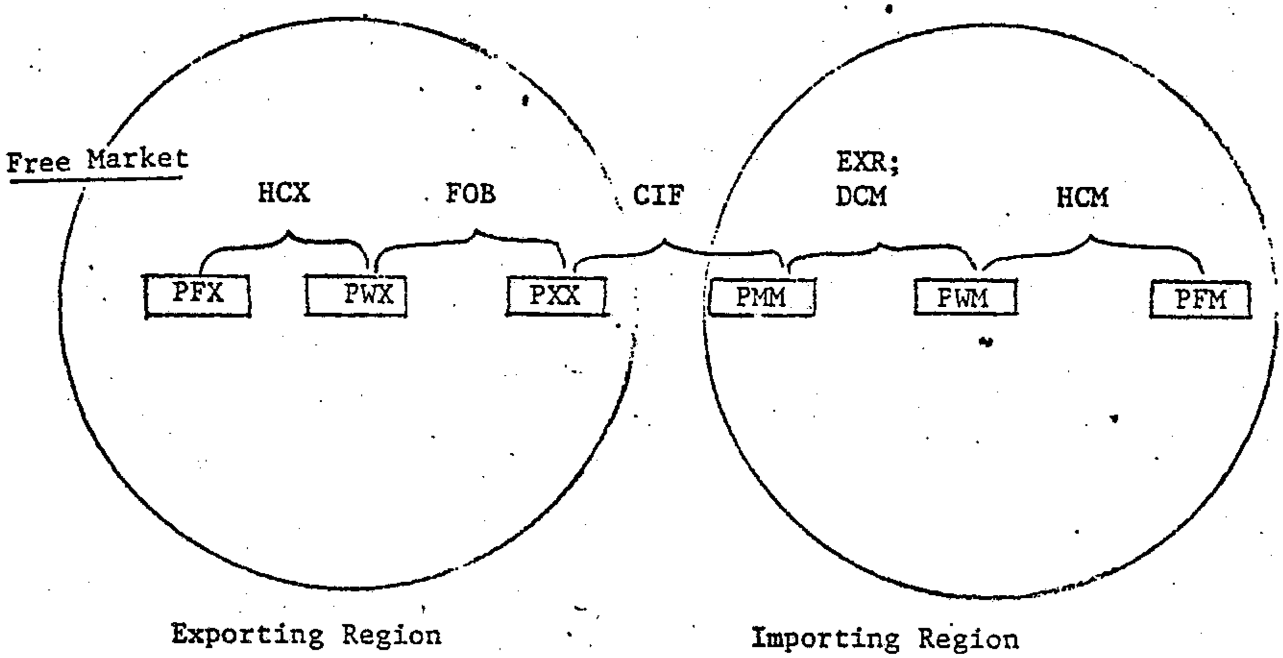
Commodity	Dependent Variable (Mean)	Independent Variables						Statistics			
		World Price	Policy Variable	Policy Variable	Freight Rate	Lag Dept. Variable	Constant	$\bar{R}^2$	DW (H)	SEE	n
Soybeans	PMSBJP (157.5)	PESBWD 0.881 (6.40) [0.86]			FRUSJP 1.94 (1.60) [0.17]		-3.73	0.935	2.57	16.3	14
Soyoil	PWSOJP (173.9) (fixed parameter)	PESOWD + TASOJP 0.740 (10.63) [0.51] [1.34]	BOPJP -0.0017 (-1.66) [-0.03] [-0.08]			PWSOJP-1 0.618 (8.80)	-12.89	0.959	1.89 (0.23)	11.3	16
	PWSOJP (173.9) (variable parameter)	PESOWD + TASOJP 0.680 (7.06) [0.47] [0.88]	BOPJP -0.0088 (-1.78) [-0.16] [-0.29]	PESOWD*BOPJP 0.00008 (1.62) [0.14] [0.26]		PWSOJP-1 0.468 (4.45)	22.9	0.964	2.05 (0.13)	10.5	16
Soymeal	PWSMJP (55.88)	PESMWD 0.0012 (18.29) [0.90]					7.06	0.954	2.08	3.60	17

The world price is corrected for exchange rates.

Table 5: Brazilian Wholesale Price Linkages for Soybeans, Soyoil and Soymeal

Commodity	Dependent Variable (Mean)	Independent Variables						Statistics			
		World Price	Policy Variable	Policy Variable	Freight Rate	Lag Dept. Variable	Constant	$\bar{R}^2$	DW (H)	SEE	n
Soybeans	PFSBBR (41586) (fixed parameter)	PESBWD 85.25 (25.29) [1.16]	BOPBR 7.97 (4.77) [0.07]				-3695	0.989	2.27	4591	16
	PFSBBR (41586) (variable parameter)	PESBWD 72.40 (7.45) [1.01]	FERBR 9.20 (3.96) [0.15]	PESBWD * FERBR -0.0057 (-3.39) [-0.26]			-3620	0.977	3.16	7440	16
Soyoil	PWSOBR (2568) (fixed parameter)	PESOWD 0.995 (4.90) [0.62] [1.24]		FERBR -0.168 (-2.94) [-0.13] [-0.26]	FRBREC -55.48 (-1.49) [-0.26] [-0.52]	PWSOBR-1 0.496 (5.20)	940	0.989	2.13 (0.25)	190	13
	PWSOBR (2568) (variable parameter)	PESOWD 1.086 (4.26) [0.68] [1.20]	PESOWD * BOPBR -0.000034 (-1.28) [-0.04] [-0.06]	PESOWD * FERBR -0.000076 (-3.13) [-0.18] [-0.31]	FRBREC -34.60 (-1.24) [-0.16] [-0.29]	PWSOBR-1 0.439 (4.49)	629	0.992	2.09 (0.17)	157	13
Soymeal	PWSMBR (72619) (fixed parameter)	PESMWD 62.13 (6.59) [0.76]	BOPBR -27.39 (-3.16) [-1.09]		FRBREC -6189 (-3.20) [-0.29]		75	0.915	1.38	15434	11
	PWSMBR (72619) (variable parameter)	PESMWD 90.42 (3.40) [1.18]		PESMWD * FERBR -0.0024 (-0.60) [-0.13]			524	0.892	1.71	17592	17

The world price is corrected for exchange rates.

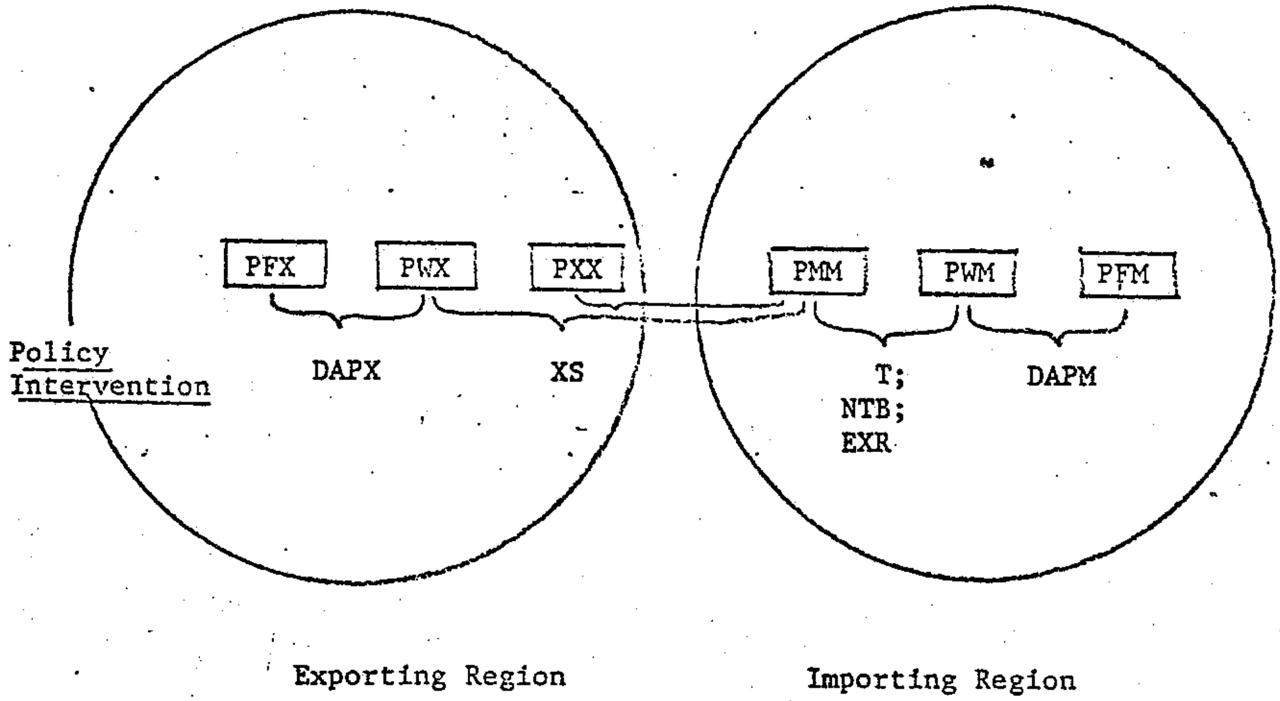


Where PF = farm price,
PW = wholesale price,
PX = export price
PM = import price,

HC = handling charge or farm wholesale margin,
FOB = costs to place in export position,
CIF = extra costs to place at import border,
DC = distribution charge or importers margin,
EXR = exchange rate between regions,

and the suffix X or M refers to exporting and importing regions respectively.

Figure 1: Price Relationships in the Free Market Case



where DAP = domestic agricultural policies, T = tariff barriers,
XS = export subsidies, NTB = non-tariff import barriers,

and the other variables are as previously defined.

Figure 2: Price Relationships in the Policy Intervention Case