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PUBLIC INTERVENTION

AND

PRODUCER SUPPLY RESPONSE*

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For market behaviour and policy analysis as well as for
forecasting, the concept of supply response is crucial. Cochrane
emphasized dynamic supply relationships, the effects of technical
change on response, and the potential asymmetry in farmers' response
to increasing and decreasing prices. More recently the importance of
risk has been emphasized in the specification of supply response
relationships (Rausser, Just (1974, 1975) and Hildreth). Houck and
Ryan introduced explicit exogenous governmental policies, namely the
"effective" support price. This work has been extended by the inclusion
of future prices as proxies for expected prices, which presumably reflect
the influence of both governmental policies and private sector markets
(Gardner). These studies along with the work surveyed in Tomek and
Robinson, have provided the empirical basis and direction for further
research on supply response. Nevertheless, it is the contention of
this paper that much of this research provides a grossly inadequate
foundation for useful policy analysis as well as forecasting. Most
conspicuous is the lack of progress in modelling the effects of
government intervention on producers' supply response, the behaviour
of government policy makers, and reactions and feedback effects between
the private and public sector.

Government Intervention

The demand for and propensity of governments to actively intervene in agricultural and food systems is well known and need not be elaborated here (Brandow). Such interventions assume many forms; in some countries it·is the national government that actively intervenes in the hopes of achieving self-sufficiency; in other countries it is individual marketing boards or marketing orders which attempt to influence private sector behaviour; in still other countries especially planned economies, governments directly intervene in both the domestic systems and international trade.

The distortions arising from governmental intervention and international trade have been documented on numerous occasions. The effects of these various forms of governmental intervention are pervasive, regardless of whether they assume the form of income supports, supply controls, or barriers to trade. Many of these policies have the direct influence of transferring risk from individual producers to taxpayers or consumers, while others redistribute the risk within the private commodity system among the various participants along vertical commodity chains. Surely all of these policies distort the traditional market price signal mechanism to producers. Hence, the producers in effect become shielded from the full impact of price variations and learn to respond not only to market price variables but to governmental policy variables as well. Once the relationship between governmental policies and risk in the private sector is recognized, we must proceed one step further and introduce the notion of a public

good. In particular, a public good by definition allows "equal
consumption" by all agents. Hence, if governmental intervention
alters the level of total risk within the system or redistributes
that risk by lowering the amount of risk faced by all farmers, then
we have the classical definition of a public good effect. Of course,
there is a difference between the consumption of such a good and the
utility various farmers derive or equivalently an "unequal ability to
consume the public good" (Rausser and Riboud).

One of the principal incentives for governmental intervention
is the basic instability of the private sector. This instability
emanates from the qualitative characteristics associated with yield
uncertainties, highly inelastic demand and supply, along with the other
structural characteristics of agricultural systems. Conventional wisdom
has long held the view that the resulting unstable market can and
should be stabilized by conscious economic policies of national govern-
ments. As Lindbeck has pointed out however, such recommendations
neglect instability and imperfections in the political-administrative
system. Lindbeck argues that the most reasonable approach is to
explicitly treat instabilities and imperfections in both market and
political-administrative systems. This view is substantiated by the
historical performance of governmental intervention in domestic
agricultural commodity systems. Certainly, differences between various
short-term economic forecasts often depend less on the internal
functioning of the private sector than on different assumptions of
future policies.

In the above setting, an important issue that arises in the specification of agricultural supply response relationships pertains to the relevant decision-making or behavioural units. In the context of short run supply response, previous research would strongly suggest that the relevant behavioural units are the producers themselves. At most, the work of Houck and Ryan along with others, deals only with conditional behavioural responses on the part of the producers where the conditioning elements relate to governmental policy. Given the feedback relationships among government policy makers and producers, however, it is quite possible that governmental policies which appear beneficial in the short run could well prove in the long run to be undesirable. Moreover, the very nature of economic theory leads us to expect that the conditional behavioural relationships of producers will change drastically over time as a result of governmental intervention. For example, Lucas has argued that a change in policy will result in a change in the environment facing economic units. Given rationality, this will result in shifts of the equations representing the behaviour of such units. 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.

In the long run, for policy analysis and particularly for forecasting purposes, it would seem essential to endogenize both the private and public sector behaviour related to supply response. Little empirical evidence unfortunately has been accumulated on quantifying

the behaviour of governmental administrators. Nevertheless, our posture in the specification of these relationships should be "positive" rather than "normative". As Lindbeck (p. 11) notes, an eclectic approach is needed which combines proxies for "electibility" with more idealistic variables such as producer's and consumer's welfare in the criterion function of the governmental decision-makers. Such a "positive" approach is entirely consistent with recent advancements in the theory of economic regulation (Stigler, Peltzman). Much of this literature is concerned with wealth redistributions through the regulatory process. In Peltzman's framework, the governmental decision-maker or regulator arbitrates among the interest groups in seeking to maximize his majority, i.e., his probability of election, re-election, or re-appointment.

Alternative Frameworks

Clearly, the conventional neoclassical formulation will not do as a framework for quantifying the interaction and feedback effects between public and private sectors. The typical use of expected prices and opportunity costs as explanatory factors for supply response is predicated on competitive markets and fails to account for government policy variables that distort and in some instances supplant the market signalling mechanisms.

A partial solution is provided by what might be referred to as
the modified conventional formulation. Here, the neoclassical paradigm
is essentially maintained with the additional effects of risk or
exogenous governmental intervention are allowed. For instances in which
governmental intervention results in only mild distortions of market
signals and only short run impacts are under examination, this is a
reasonable approach. For the general case it should be recognized that
governments do not operate in a vacuum, but are an integral and
essential part of the supply response mechanism.[1] Attempts must be
made to explain and provide forecasts of governmental responses and
producers' influence on government as well as producers' responses to
market forces, risk factors and governmental intervention. To operation-
alize such attempts, the effects of governmental intervention on risk
and wealth distribution must be conceptualized and some unconventional
empirical methods will be needed.

Government Intervention and Risk

The specification of the structural representation for
governmental behaviour depends upon the form and shape of governmental
intervention. Alternative forms of government intervention will
result in different influences on the level and distribution of both
wealth and risk within the commodity system. For example, a buffer
stock policy transfers market risk from the private sector to the
public sector and often redistributes risk within the private sector.

Processors and assemblers of feedgrains generally face less "relative risk" on quantity, quality and price dimensions under buffer stock schemes. That is, relative to the total level of risk in the system.

The reduction and/or redistribution of market risk within the private sector, however, is obtained at the price of augmented institutional risk. In particular, much of the price risk in the private markets is supplanted by institutional sources of risks. These risks are especially apparent when producers attempt to anticipate the direction and magnitude of government policy variable changes. To be sure, the level of market risk can be influenced (reduced) by a number of policies which correspondingly augment the level of institutional risk.

Empirical Methods

The structural specification of both public and private sector behavior also requires the use of unconventional empirical methods. These methods include parameter variation, qualitative econometric, and market disequilibrium estimation procedures. Parameter variation specification and estimation procedures recognize the Lucas observations noted earlier; the abstract nature of econometric models and their inherent misspecifications;[2/] and the need in policy analysis and

forecasting for results that are tractable and interpretable (Rausser and Mundlak). These methods allow models to be specified as linear in the variable space but non-linear in the parameter space. They treat parameter effects as random and nonstationary. In the context of the private sector the probability distributions on the parameters depend upon market force variables as well as governmental policy variables. A similar distinction exists for the public sector.

Qualitative econometric procedures subsume disequilibrium methods and deal directly with noncontinuous endogenous variables. These procedures have been surveyed in the Fall, 1976 issue of the Annals of Economic and Social Measurement. They should be useful in the quantification of behavioural relationships for the public sector, especially where policies assume the form of discrete states whose probabilities are of particular interest. For quantification of private sector behaviour, it has been demonstrated that qualitative econometric estimates of market demand and supply relationships for wheat are quite different than conventional estimates (Rausser and Riboud). The former estimates explicitly recognize that price support schemes truncate the complete probability distributions assumed by commonly employed statistical methods and thus Tobin-like estimation methods are required.

Market disequilibrium procedures are needed when the exchange occurs at "false" prices, i.e., prices which do not clear the market. For the private sector representation of supply response and demand, this requires the substitution of the typical market clearing identity by a condition on quantity exchanged, viz, that the quantity exchanged is the minimum of supply and demand (Fair and Jaffee). In the case of price supports, without public demand for inventories (or buffer stock schemes), such disequilibrium representations are clearly appropriate. For quota schemes of all types, again we find the potential for disequilibrium specifications. To the extent that demand is unsatisfied at a nonmarket clearing price (exogenous or endogenous to the private sector), the quota will prevail. On the other hand, if demand falls short of the quota, buyers will dictate the quantity exchanged.[3/]

Illustrative Application

Many of the above issues can be illustrated in the context of the Canadian dairy industry. Here the degree of interaction between milk producers and regulatory agencies is significant and feedback effects are well established. The regulatory agencies respond to changing market conditions, including producers' responses to policy variables, by continually adjusting the policy instruments at their disposal. Moreover, the forms of intervention have virtually eliminated market price risk and the principal source of risk is institutionally oriented.

Producers respond to this risk as well as to distorted market signals. In this setting, an exogenous treatment of governmental policy variables will not suffice. Instead, a structural specification requires behavioural equations for both producers, private markets, and the regulatory agency.[4]

Government intervenes in the dairy industry principally through supply control instruments and income support measures. Supply control instruments include market sharing quotas and penalties for exceeding individual quota levels. Producers are hypothesized to respond to market sharing quota constraints by altering the size of the dairy herd, through variations in either the rate of culling or retention of dairy heifer replacements, and by changes in the percentage of cows being milked. Producers also face institutional risk in the sense that they have less than perfect knowledge about government intentions to alter the level of market sharing quotas. The response to this risk, measured by variation in quotas, is measured by producers' decisions to alter dairy herd culling rates and percentage of cows being milked. The existence of over-quota penalties implies the need for producer decisions to market or to retain milk for on-farm use, depending on relative returns. In fact, the relevant expected market return at the margin for the Canadian milk producer can be either the net target return for milk within quota and eligible for direct subsidy, or producers return exclusive of subsidy for milk shipped within the "sleeve",[5] or the penalized producer return for milk shipped in excess of quota.

Income support measures include direct subsidies to milk producers and offers to purchase surplus butter and skim milk powder at guaranteed minimum prices. Price supports at the processed product level are designed to permit higher milk prices to be passed on to producers by processing plants. Subsidies and support prices are used as joint policy instruments to attain target returns for milk producers. Producer responses to target returns variations are taken to be changes in herd size, percentage of cows milked, and average milk yield per cow (through altering quantity and composition of feeds).

Endogenous Policy Variables

Due to space limitations, preliminary results are offered in this paper only for the equations representing the important government policy variables. These variables are listed vertically in Table 1, and the explanatory variables are listed horizontally. The endogenous variables are denoted by Y, variables exogenous to the policy block are denoted by X, qualitative exogenous variables are denoted by D (see Table 2), and variables which are endogenous in the private sector representation are denoted by Z. In the body of Table 1 are recorded the expected qualitative effects on the endogenous policy variables. In determining the expected effects, it is important to recognize that the government sets both income supports and quotas. Sufficient quotas are issued in the hopes of achieving an equilibrium of supply and demand at the specified price support level. To be sure, this policy scheme is in contrast to either an open-ended income support scheme or a supply control system with no price intervention.

TABLE 1 -- Qualitative Effects in Endogenous Dairy Policy Behavioural Equations

Endogenous Policy Variables \ Explanatory Variables	Dairy Feed Cost (X6)	Consumer Price Index (X1)	Gross Target Return on Industrial Milk (Y1)	Direct Producer Subsidy (Y11)	Assumed Processing Plant Margin (Y6)	Change in Government Butter Stocks (ΔY14)	Change in Government Skim Milk Powder Stocks (ΔY15)	World Price of Skim Milk Powder (X3)	World Price of Butter (X4)	Domestic Support-World Price Differential for Powder (Y3-X5)	Domestic Support-World Price Differential for Butter (Y2-X4)	Government (Internal) Deficit (X3)	Exchange Rate (Can.$ per U.S.$) (X2)	Short term Commercial Interest Rates (X7)	Aggregate Demand for Fluid Milk (Z1)	Aggregate Market Sharing Quota (Y7)
Gross Target Return on Industrial Milk (Y1)	+	+														
Support Price for Butter (Y2)			+	?	+	?			+							
Support Price for Skim Milk Powder (Y3)			+	?	+		?	+								
In-Quota Holdback from Direct Subsidy (Y4)							+			+		+				-
Penalty on Milk Produced Over-Quota (Y5)			+			+	+					+				
Assumed Processing Plant Margin (Y6)	+															
Aggregate Market Sharing Quota (Y7)		?	+		+	-						-				
Declared Farm Price of Fluid Milk (Y8)			+												+	
Net Exports of Butter (Y9)						+					-		+	+		
Net Exports of Skim Milk Powder (Y10)							+				-		+			

Most all the expected positive and negative signs in Table 1 are self-explanatory. For example, a positive effect of the assumed processing plant margin on support prices is expected due to the government's desire to ensure adequate market returns to producers net of processing margins. Conversely a negative relationship is hypothesized for the effect of changes in government butter stocks on aggregate market sharing quota. This is to account for government attempts to maintain approximate supply/demand balance and avoid larger inventory carrying costs.

A question mark denotes a relationship whose expected sign is ambiguous. For example, the effect of direct producer subsidies on support prices could be either positive or negative, depending on effective coalitions of taxpayers' or consumers' interests. In the Canadian dairy industry casual observation suggests that taxpayers' interests have been more effectively lobbied than consumers'; hence a negative sign might be expected.

The empirical results for the policy block are presented in Table 2. These results are indeed encouraging; the degree of explanation is quite satisfactory and the estimated sign effects are in general correspondence with a priori reasoning.[6] Note that one of the most important endogenous variables is Y_7, the aggregate market sharing quota. Each explanatory variable entering this equation plays a specific role; net target return is a proxy for producers' welfare; assumed processing margin represents processors' interests;

TABLE 2 — Empirical Results for Endogenous Dairy Policy Behavioural Equations

	$Y_{1(t-1)}$	Y_1	Y_2	Y_3	Y_6	$Y_{5(t-1)}$	$Y_{7(t-1)}$	Y_7^{-1}	$Y_{8(t-1)}$	Y_{11}	Y_{12}	$Y_{14(t-1)}$	$\Delta Y_{14(t-1)}$	$Y_{15(t-1)}$	$Y_{15(t-2)}$
Y_1	0.816 (0.0571)														
Y_2		0.0656 (0.0122)			0.246 (0.0908)				-0.111 (0.0468)			1.81E-04 (1.72E-04)			
Y_3		0.0770 (0.00289)			0.0760 (0.0338)				-0.0586 (0.0115)						
Y_4					0.772 (0.0363)		0.772 (0.0363)							0.579 (0.0272)	0.193 (0.00908)
Y_5						0.663 (0.120)					0.0163 (0.0103)			9.97E-03 (3.42E-03)	
Y_6	0.138 (0.129)														
Y_7					37.9 (20.2)		0.182 (0.149)				18.5 (3.80)		-0.0486 (0.0481)		
Y_8	0.535 (0.104)								0.413 (0.116)						
Y_9			-42400 (13900)								187.0 (44.2)				
Y_{10}				-15.5 (9.88)										0.0171 (0.0176)	0.0190 (0.0169)

continued...

TABLE 2 — continued

	$\Delta Y_{15(t-1)}$	Z_8	X_1	X_2	X_3	X_4	X_5	X_6	X_7	D_1	D_2	D_3	Const.	$\bar{R}^2$	S.E.R.
Y_1			0.0541 (0.0170)				0.0482 (0.0104)	-0.113 (0.0644)		0.299 (0.0755)	0.0506 (0.0784)		0.184 (.057)	0.996	0.150
Y_2					0.175 (0.0754)								0.225 (0.0323)	0.980	0.0226
Y_3	-4.05E-05 (3.46E-05)					0.115 (0.0162)							-0.163 (0.0127)	0.998	0.00780
Y_4				4.66E-05 (2.87E-05)		-0.772 (0.0362)							0.121 (0.0157)	0.947	0.314
Y_5			3.22E-03 (1.02E-03)	1.48E-03 (3.09E-04)									-0.0713 (0.0446)	0.936	0.0456
Y_6													-0.0471 (0.967)	0.830	0.999
Y_7			-1.90 (0.393)	-3.20E-03 (2.60E-03)									142 (28.7)	0.892	6.101
Y_8		1.86E-06 (7.30E-07)											-1.22 (0.922)	0.994	0.173
Y_9			35700 (23300)	7.84 (2.08)	-42400 (13900)			814 (663)	-2310 (2960)	12500 (2990)	8790 (2520)		-41000 (24500)	0.641	4.51E-03
Y_{10}			-1.40 (15.4)	-6.51E-04 (14.9E-04)		-15.5 (9.88)		-1.45 (2.08)		-2.72 (1.49)	-2.00 (1.36)		6.64 (15.7)	0.271	2.34

IDENTITIES:
1. $Y_{11} = Y_1 - (4.2 Y_2 + 8.0 Y_3) + Y_6$
2. $Y_{12} \triangleq Y_1 - Y_4$, Net target return on industrial milk
3. $Y_{13} = Y_1 - Y_{11} - Y_5$, Penalized producer return for over-quota industrial milk
4. $Y_{14} = Y_{14-1} + Z_2 - Z_3 + Y_9 + Z_4 - Z_{4-1}$
5. $Y_{15} = Y_{15-1} + Z_5 - Z_6 + Y_{10}$

Z_2 - butter production
Z_3 - butter retail sales
Z_4 - commercial stocks butter

Z_5 - powder production
Z_6 - retail and industrial sales
Z_7 - commercial stocks powder
Z_8 - domestic disappearance of fluid

D_1 - seasonal dummy - 1st quarter
D_2 - seasonal dummy - 2nd quarter
D_3 - seasonal dummy - 3rd quarter

change in government stocks and the government deficit are proxies
for taxpayers' interests; the consumer price index is a proxy for
consumer concerns; lagged quotas represent the government's major
reference point. The estimated effect of each of these variables
corresponds with the presumed qualitative effects except for the
consumer price index. For given price supports above "market equili-
brium prices", the payoff to producers is increased by larger quotas
and thus producer groups can gain by forming effective coalitions to
increase quotas. Similar reasoning holds for processors who gain from
handling larger volumes. As government deficits increase taxpayers
have incentives to lobby for reduced quotas. Likewise, larger
inventories imply greater treasury exposure and thus a desire on the
part of government to decrease the quota. In the case of consumer
welfare interests, the price index proxy should tend to augment quotas.
However, consumer interests are diffuse and no effective coalition is
observed. Hence, the estimated negative effect appears to reflect
government's attempt to balance supply and demand through the
imposition of quotas in an inflationary economy.

Conclusion

The specification of behavioural equations for both private
and public sectors allows comprehensive long and short run forecasts
to be made not only of supplies, demands and prices, but also of the
important governmental policy variables. Hence, the basic proposition

of this paper is that for agricultural commodity markets that exhibit a high degree of governmental intervention, specification of the correct structural form depends on responses of both the private and public sectors together with their feedback effects. The preliminary empirical results obtained in this paper support the view that acceptable representations of behavioural equations for the public sector can be captured.

FOOTNOTES

1. In the context of international grain markets, a step in
    this direction has been provided by Abbott. He empirically
    estimated a "modified reduced form" for private sector
    behaviour. In particular, private sector excess demand
    relationships are estimated whose qualitative parameter
    effects depend not only on private but as well on public
    sector behaviour.

2. The major sources of misspecifications include omitted
    variables, data limitations and proxy relationships,
    aggregation, inappropriate functional forms and the like.

3. It should be noted that disequilibrium representations and
    their corresponding "mixture" of structural equations can
    be approximated by parameter variation methods. For further
    details, see Rausser and Mundlak.

4. Space precludes presentation of the complete private and
    public sector models which are available in Stonehouse and
    Rausser.

5. "Sleeve" refers to some pre-determined portion of market
    sharing quota that is not eligible for direct subsidy;
    it is designed to allow producers to ship the maximum
    volume of subsidized quota milk without incurring over-
    quota penalty.

6. The policy block was estimated by OLS and TSLS. The
    results obtained for each of these estimation methods were
    basically equivalent.

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