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THE IMPACT OF CANADIAN COMMODITY STABILIZATION PROGRAMS ON RISK REDUCTION AND THE SUPPLY OF AGRICULTURAL COMMODITIES

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THE IMPACT OF CANADIAN COMMODITY STABILIZATION PROGRAMS ON RISK REDUCTION AND THE SUPPLY OF AGRICULTURAL COMMODITIES[1]

(Working Paper 2/89)

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1. INTRODUCTION

Agriculture in general is characterized by production risk and price risk. When agricultural producers make output decisions, they frequently do not know the quantity of the product which they will have available at the end of the production period due to natural and biological factors of a stochastic nature. In addition, if the product is sold on the open market, farmers generally do not know a priori what price they will receive because of the effects of uncertain shifts in supply and demand. As a result, the Canadian government has introduced a variety of programs that allow the individual producer to share or transfer production and/or price risk. These programs vary with the particular commodity but, in general, consist of: (1) price pooling (as with Canadian Wheat Board prices); (2) supply management (as with the supply restricting marketing boards); (3) insurance schemes (as with crop insurance); and (4) buffer fund schemes (as with the Tripartite Red Meats program (TRMP) and the Western Grain Stabilization program (WGSP)). In addition to these permanent programs, the Canadian government has introduced some ad hoc programs (such as the Special Canadian Grains program) to deal with specific problems. These programs don't have the same risk-sharing or risk-transferring effect as the permanent programs since their introduction is itself a source of uncertainty. A detailed discussion of the various forms of commodity stabilization employed in Canada is provided in Appendix A.

In this study we focus only on the fourth type of program used in

Canada, namely the buffer fund stabilization program. This includes the price stabilization scheme (as in the various programs operated under the Agricultural Stabilization Act) and the income stabilization scheme (as in the WGSP). There already exists a considerable body of economic literature on the welfare effects of these types of commodity stabilization programs. We summarize this literature in Appendix B. We have two major concerns that arise from this literature. And it is these concerns that form the basic motivation for this study. Firstly, we are concerned about policy prescription based on the early literature. The early literature suggests that price stabilization in the presence of supply variability makes producers better off. In addition society as a whole gains although consumers lose. However, the early literature ignores the effects of production and price uncertainty that arise because of the time lag between the decision to produce and the realization of output. Secondly, we are concerned that in an attempt to produce general results, much of the literature has used highly-stylized market models with stabilization rules that don't bear much relationship to those that exist in practice.

There are two main facets to the question of uncertainty: (a) the role of producer expectations; and (b) the role of producer risk attitudes. In section 2 we provide an overview of expectations and how alternative assumptions concerning expectations can influence the theoretical effects of stabilization programs. We also show that if one assumes that producers have rational expectations, the effects of stabilization may depend critically on the assumed model structure (e.g. the shape of the demand curve and the planned supply curve). We briefly discuss the effects of non-neutral producer risk attitudes. However, a more detailed discussion of producer risk attitudes is left to phase II of the study.

With respect to our second concern, we argue that the results of stabilization may depend critically on the particular rules which govern the stabilization program. The particular rules of a program can be expected to shape the producer expectations. Hence, in order to analyze the effects of stabilization it is not adequate to rely solely on the theoretical results of highly-stylized models. One should also attempt to analyze the effects of a stabilization program on a case-by-case basis where the particular rules of the program are explicitly incorporated. There have been previous attempts in this direction, but they tend to be essentially static and non-stochastic in nature and do not incorporate producer expectations [see for example, Manitoba Agriculture (1984)]. Such studies attempt to estimate the effects of a particular program by superimposing it on a particular historical time period. However, such an approach cannot incorporate the dynamic effects of stabilization rules on production. In addition, their analysis depends on a particular historical sequence of years which may have little relevance in probability for any future sequence. This is an important limitation when (as is often the case) the stabilization rules are dynamic and payouts and levies depend critically on the particular sequence of years.

As a consequence of the above concerns, we believe that modelling attempts to assess the impact of Canada's stabilization programs need to: (a) incorporate production and price uncertainty; (b) incorporate forward-looking expectations on the part of producers; (c) explicitly allow for the stochastic nature of agricultural markets and production; and (d) allow for the dynamic nature of agricultural production, agricultural markets and stabilization rules. We believe that an appropriate methodology for doing this is dynamic stochastic simulation. This allows both for the incorporation of uncertainty and price expectations into a flexible modelling framework and for the introduction of dynamic stabilization rules (e.g. moving averages) and dynamic effects (e.g. partial adjustment).

In each of sections 3 and 4 we provide an empirical example of the use of dynamic stochastic simulation to assess stabilization programs. Both examples incorporate forward-looking price expectations by producers. They are examples of the direction in which we think the methods to assess commodity stabilization should move. They are, however, qualitatively different from each other in that they emphasize different aspects of the assessment problem. The first example (section 3) examines the effects of alternative stabilization rules under the assumption that producers have "Muthian" rational expectations. The basic model structure represents a simple competitive market operating under autarky or trade. It is a 'generic' model in the tradition of Massell (1969) and Van Kooten, Schmitz and Furtan (1988). The second example (section 4) assesses the effects of a particular market structure (the prairie grains economy) and a particular stabilization rule (as given by the Western Grain Stabilization program). This example also assumes forward-looking expectations but they are not fully rational in the way derived by Muth. That is, they are not obtained as the mathematical expectation of the underlying structural market model. This is because of the complexity of imposing such expectations on the model.

In summary the two modelling approaches focus on different aspects of the problem of understanding the effects of commodity stabilization programs. As with all modelling exercises they entail some simplification of reality. The first modelling approach focuses on rational expectations and does so by simplifying market structure and the stabilization rules. The second modelling approach focuses on a 'realistic' market structure and 'realistic' stabilization rules and does so by simplifying the representation of expectations. We believe that both research approaches will be useful in providing insights into the effects of commodity stabilization programs in Canada. Ultimately, it would be useful to bring the two approaches together in the same model.

2. EXPECTATIONS AND COMMODITY STABILIZATION MODELS

The literature on commodity price stabilization is extensive in its coverage, diverse in its objectives, complex in its theoretical constructs, and confusing in its results. The purpose of this section is to clarify and simplify the results of this broad body of literature highlighting the role of expectations. We begin by reviewing the early framework under which price stabilization was analyzed and then discuss how the results change as some of the assumptions are modified or relaxed.

2.1 Early Framework

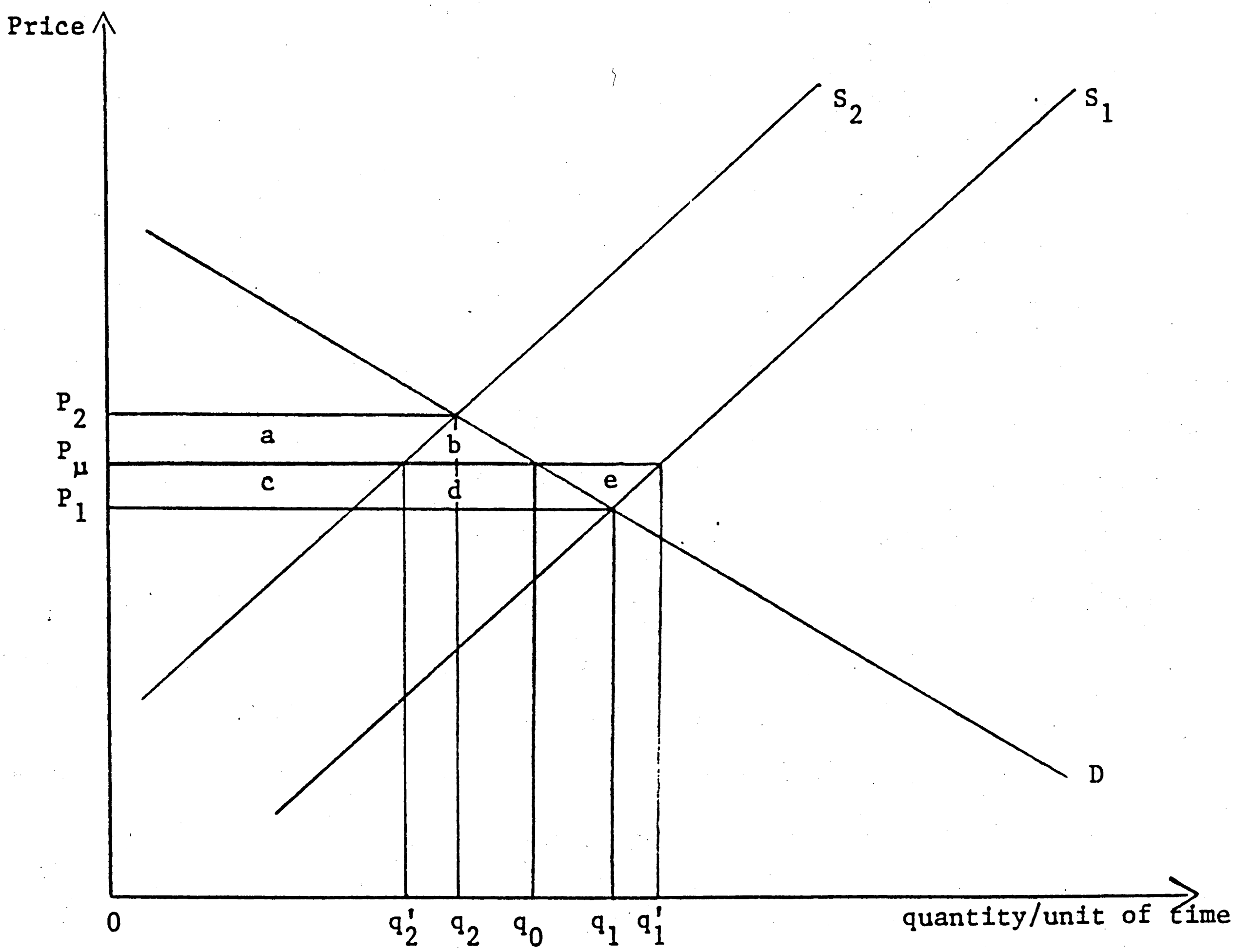
Much of the early work on price stabilization uses the notions of consumer and producer surplus (see Currie, Murphy and Schmitz). Consumer surplus is the difference in the maximum money amount that consumers would be willing to pay and what they actually do pay. In graphical terms, it is measured by the area above the equilibrium price and below the demand curve. Producer surplus, on the other hand, is the benefit that producers receive from selling the commodity at the existing prices. It is measured as the return to fixed factors and is simply the area to the left of the supply curve and below the market price.

Using these concepts, Waugh concluded that consumers prefer price instability if they can take advantage of it by buying more at low prices and less at high prices. Oi, on the other hand, showed that producers also prefer price instability to stability. The key to this analysis is that producers are assumed to adjust instantaneously to price changes. This implies that a high price corresponds with high quantity or, alternatively, that producers' expected price and expected output at planting time are actually realized.

The above results, while intriguing, cannot hold in a market environment where both consumers and producers are considered jointly. In a market setting, for these results to hold, it is required that there be a Santa Claus in the background who is losing. Unfortunately, the economic surplus to make both consumers and producers better off from instability has to come from somewhere and, as Massell (1969) showed, this needed surplus is nowhere to be found when consumers and producers are considered jointly.

The Massell model is used as the point of reference for further analysis and, therefore, it is explained in some detail. The Massell approach is presented in Figure 2.1. Consumer demand is represented by D and stochastic supply is represented by S_1 and S_2, each of which occurs in alternating periods. Thus, equilibrium prices are P_1 and P_2, respectively. Assume that prices are stabilized at P_μ, by means of a buffer stock authority which buys excess supply, $q_1' - q0$, when S_1 occurs and sells $q0 - q_2'$ when S_2 occurs. In the event of S_1, compared to the stabilized price P_μ, consumers lose area (c + d) while producers gain area (c + d + e) for a net gain of area e. With S_2 and moving to a stabilized price P_μ, producers lose area a, but consumers gain area (a + b) for a net social gain of area b. The average overall effect of price stabilization with such a stock policy is a gain of area (b + e). Two results emerge: (a) producers gain from price stabilization; and (b) consumers lose from price stabilization, but their losses are outweighed by producer gains so that society as a whole can gain. Using a similar analysis, but allowing for demand fluctuations instead of supply fluctuations leads to different results. It can be shown that price stabilization via a buffer stock still leads to a net welfare gain. However, this time it is consumers who gain from stabilization while producers lose.

FIGURE 2.1: Price Stabilization under Bi-modal Supply Variability



The results suggest that there are both gainers and losers from price stabilization of storable commodities through a reserve policy. However the gainers outweigh the losers so there may be net gains to society if a suitable way can be found for the gainers to compensate the losers. It is often also believed that the greater source of variability is on the supply side rather than the demand side. In this case, the results suggest that it is producers who will directly benefit from price stabilization.[1]

There have been a number of developments in the stabilization literature that were stimulated by the Waugh-Oi-Massell analyses. These include: (a) the generalization to a multi-commodity situation [Hanoch]; (b) partial price stabilization around a price band [Massell (1970); Just, Lutz, Schmitz and Turnovsky]; (c) underwriting [Quiggin]; (d) income stabilization [Houck]; (e) private versus public storage as a means of providing stability [Helmberger and Weaver]; (f) stabilization under autarky versus free trade [Hueth and Schmitz]; (g) the use of buffer funds rather than buffer stocks [Van Kooten, Schmitz and Furtan]; (h) stabilization with non-linear demand [Johnson and Gray]; (i) the use of dynamic rather than static analysis [Spriggs]; and (j) alternative assumptions regarding expectations [Newbery and Stiglitz] and risk preferences [Just (1974,1975); Just and Hallam]. We provide a brief discussion of this research literature in Appendix B. Of particular importance to the present study are the following threads which emerge from this literature. They are that the results of a commodity stabilization program are sensitive to: (a) the assumptions regarding

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[1]This belief might be reasonable for a commodity which is not exported. However, for commodities that enter the international market, the export demand may be highly variable as a result of supply conditions and political considerations in other countries.

expectations formation; (b) the particular rules of the stabilization program and the structure of the market to which it relates; and (c) the assumptions regarding risk attitudes. The first two of these elements are treated in detatil in this phase one report, while the third element is only treated briefly. The main discussion of the third element is left to the phase two report where it fits more appropriately. This is because the effects of different risk attitudes are best analyzed using the farm-level approach of phase two than the aggregater level approach of phase one. We now discuss these three elements.

2.2 Producer Expectations

One of the most important determinants of agricultural supply is producer expectations of prices. Expectations are important because of the time lag between the decision to produce and the realization of output and price. Commodity stabilization programs typically affect supply through their effects on producer expectations. Hence the specification of producer expectations in a model is crucial to an adequate assessment of the effects of a stabilization program on supply. Over the years there have been a number of alternative specifications of expectations. They include static expectations, adaptive expectations and rational expectations.

2.2.1 Static and Adaptive Expectations

Static expectations is the term often used to describe an expectations scheme represented by the most recent period's price. Thus, if ${}_tP_{t+1}$ represents the producer's price expectation of price in period (t+1) given information up to period t, then static expectations is: ${}_tP_{t+1} = P_t$.

Nerlove (1958) represented producer expectations as adaptive expectations, in which producers were assumed to adjust their expectations by some fraction of the mistake they made in their expectations in the previous period. Thus:

$$ {}_{t}p_{t+1} - {}_{t-1}p_t = \beta\,(p_t - {}_{t-1}p_t) $$

where β is the coefficient of adjustment in expectations.

Static and adaptive expectations have been widely used in commodity models that have attempted to explain the fluctuations in prices and outputs. Such commodity models are based on the "cobweb" idea introduced by Ezekiel in 1938. For example, the simple cobweb model uses static expectations and can be described as follows:

$$ q_t^d = d(p_t, \alpha) \qquad \text{Demand} $$

$$ q_t^s = s({}_{t}p_{t-1}, \beta) \qquad \text{Supply} $$

$$ {}_{t}p_{t-1} = p_{t-1} \qquad \text{Price expectations} $$

where q and p refer to quantity and price, respectively, and α and β are demand and supply shifters, respectively. The model states that current production depends upon the price prevailing in the previous period, but the market clearing price is determined by the intersection of that output with the demand function. As illustrated in Figure 5.1, if price was high in one period, producers expect price to remain at that level; but, due to over-production on their part, price falls. Likewise, if they expect price to be low ex ante, it turns out to be high ex post.

The stability of the cobweb mechanism depends upon the functional forms of the demand and supply curves. For linear curves, if the supply curve is steeper than the demand curve the cobweb cycles converge to equilibrium. However if the demand curve is steeper than the supply curve then there is instability as market clearing quantities and prices diverge from equilibrium over time. The use of adaptive expectations generally has the effect of considerably dampening the price-output cycles. Indeed, it is possible that, under certain conditions, price approaches the equilibrium price from one direction only--that is, price fluctuations do not occur.

The use of static and adaptive expectations has been criticized by Begg (pp. 25-26). He argues that such expectations are entirely backward looking, using only past values of the variable about which expectations are to be formed. This may lead to the omission of information relevant to producer expectations or the inclusion of information that is not relevant. For example, if last year there was a permanent change to a price stabilization rule, this information would be relevant to producers' price expectations this year but would be excluded. On the other hand, if last period's price were high as a result of a temporary weather shock, this information would be included yet would likely be irrelevant to producers' price expectatiions this year. Begg also argues that static and adaptive expectations are examples of ad hoc rules which "have the disturbing implication that they allow individuals to make systematic forecasting errors period after period, without requiring any amendment to the basis of the forecasting rule itself" (Begg, p. 29). Therefore, he argues, models that use static or adaptive expectations must be rejected in favor of the rational expectations theory which does not permit individuals to make systematic errors of this kind.

2.2.2 Rational Expectations

Rational expectations assumes that individuals behave in such a way that they use all the relevant information at their disposal at the time decisions are made. It is then assumed that these individuals behave in a way predicted by an appropriately constructed economic model. This does not, however, require all individuals to have the same information. All that is required is that, at the margin, there exist individuals who are able to arbitrage across markets so that the particular sector under consideration behaves rationally.

Rational expectations requires an assumption concerning expectations formation. The assumption is that individuals use all of the information at their disposal at the time of the decision. While past values of some random variable x (say price) which is to be forecast are generally important, reliance solely on these values may be misleading, as discussed above. Rather, any available information which might be important in explaining the future value of x is potentially also important in determining future expectations regarding x. It might be noted that among the proponents of the rational expectations hypothesis there is some difference of opinion on what constitutes usable information. In the early literature on rational expectations it was assumed that all information available at a given time period was used. However, some more recent proponents have argued that since information is costly, this is not the case. There may be information which is (or could be) available, but because it is too costly to obtain it is not used. Hence it does not enter into the information set of rational producers. Allowing for the existence of information costs, one could view the static and adaptive expectations as very special cases of rational expectations. They are special cases in which information is so costly that producers only make use of past information on the variable about which expectations are to be formed. They also make use of past information in a very specific way.

In the following discussion of rational expectations, let us abstract from the question of information costs. Let I_t represent the information set at time t about x and let x_{t+n} represent the value x will take at time t+n. Then, given an appropriate economic model, it is possible to obtain an objective probability distribution associated with x at time t+n, conditional on the information that is available. Thus, the conditional expectation of x—the expected value of x given the information set at time t—is:

$$E[x_{t+n} | I_t] = \int_a^b x_{t+n} \, f(x_{t+n} | I_t),$$

where f() is the conditional probability distribution of x_{t+n}, and a and b are the lower and upper bounds on the values that the random variable x can take.

The conditional expectation of x_{t+n} can be considered a forecast of x in time period t+n, with the forecast dependent on the information set at time t (I_t) with some forecast error ε_{t+n} defined as

$$\varepsilon_{t+n} = x_{t+n} - E[x_{t+n} | I_t].$$

The forecast error has two important properties.

(1) $E[\varepsilon_{t+n}] = 0$. Any error in making forecasts is due only to random shocks which cannot be predicted.

(2) $E[\varepsilon_{t+n} | I_t] = 0$. The orthogonality property states that the forecast error cannot be correlated with any component of the information set. If there is a correlation between ε_{t+n} and I_t then a better forecast of x_{t+n} at time t could be obtained by taking this correlation into account, and therefore should be employed.

Muth (1960), in his path-breaking article, then argued that rational expectations implies that there is an equivalence between individuals' subjective expectations concerning an economic variable and the objective conditional expectation of that variable. If the subjective expectation is denoted by ${}_t x_{t+n}$ then ${}_t x_{t+n} = E[x_{t+n} | I_t]$.

It is often argued that rational expectations is unrealistic as it implies perfect foresight. However, rational expectations reduces to the special case of perfect foresight only when uncertainty is absent and information is complete. In this case we would write ${}_t x_{t+n} = x_{t+n}$. Further, note:

> "Expectations are rational if, given the economic model, they will produce actual values of variables that will, on average, equal the expectations. Expectations will diverge from actual values only because of some unpredictable uncertainty in the system. If there were no unpredictable uncertainty, expectations of variables would coincide with the actual values—there would be perfect foresight. The rational expectations hypothesis differs from perfect foresight because it allows for uncertainty in economic systems" (Sheffrin, p. 9).

Muth (1960) showed that the use of static or adaptive expectations in a Cobweb-type model implied that producers never learn. They continue to make mistakes even though they have the information represented by an appropriate economic model. They imply that producers' expectations will always be different from what would be predicted by such a model. On the other hand, the use of rational expectations in such a model imply that producers learn. Disregarding information costs, producers' expectations are assumed to coincide with the predictions of the model. This does not mean that price expectations or the price predictions from the model cannot be autoregressive. On the contrary, Muth shows that the rationally expected price is autoregressive if errors are serially correlated or there is inventory speculation. (They may also be autoregressive if there are information costs.)

2.3 Rational Expectations Models of Commodity Stabilization

We begin with a closed-economy model in which equilibrium price is determined at the intersection of the domestic supply and demand curves. We will assume that our economy is subject to supply shocks.[2] This is analogous to the model discussed by Waugh, and Massell (1969) except that instead of using two upward-sloping (actual) supply curves we will assume: (a) that producers cannot have an instantaneous production response to a particular price outcome so that the actual supply curve is vertical; (b) actual supply is a random variable about the planned supply; and (c) the planned supply curve is upward-sloping. For this model we can show that the implications of a price stabilization program are critically dependent on the assumed shape of the demand function and the shape of the probability distribution of output.

Before proceeding with the discussion, it is necessary to distinguish between three measures of price. (1) The average price ($\bar{p}$) is simply the expected price or mean of the probability distribution of price. (2) The action certainty equivalent price ($\hat{p}$) is that "price which, if it prevailed on the market, and if there were no risk, would yield exactly the same supply response as does the random price" (Newbery and Stiglitz, p. 64). That is, in the presence of supply risk (given the distribution of output), $\hat{p}$ is the price which corresponds to average supply. (3) If producers are not risk neutral then the utility certainty equivalent price is defined as "the price which would generate the same level of expected utility in the absence of risk" (Newbery and Stiglitz, p. 64). The action and utility certainty

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2 The case of demand variability has been examined in a similar context by Van Kooten, Schmitz and Furtan.

equivalent prices are identical if producers are risk neutral. However, in order to predict the effects of risk on supply, only the action certainty equivalent price is relevant; the utility certainty equivalent price is only relevant for welfare analysis.

In the analysis to follow we shall assume that producers are rational and employ all information available to them at the time they must make production decisions. Thus we abstract from the problem of information costs.

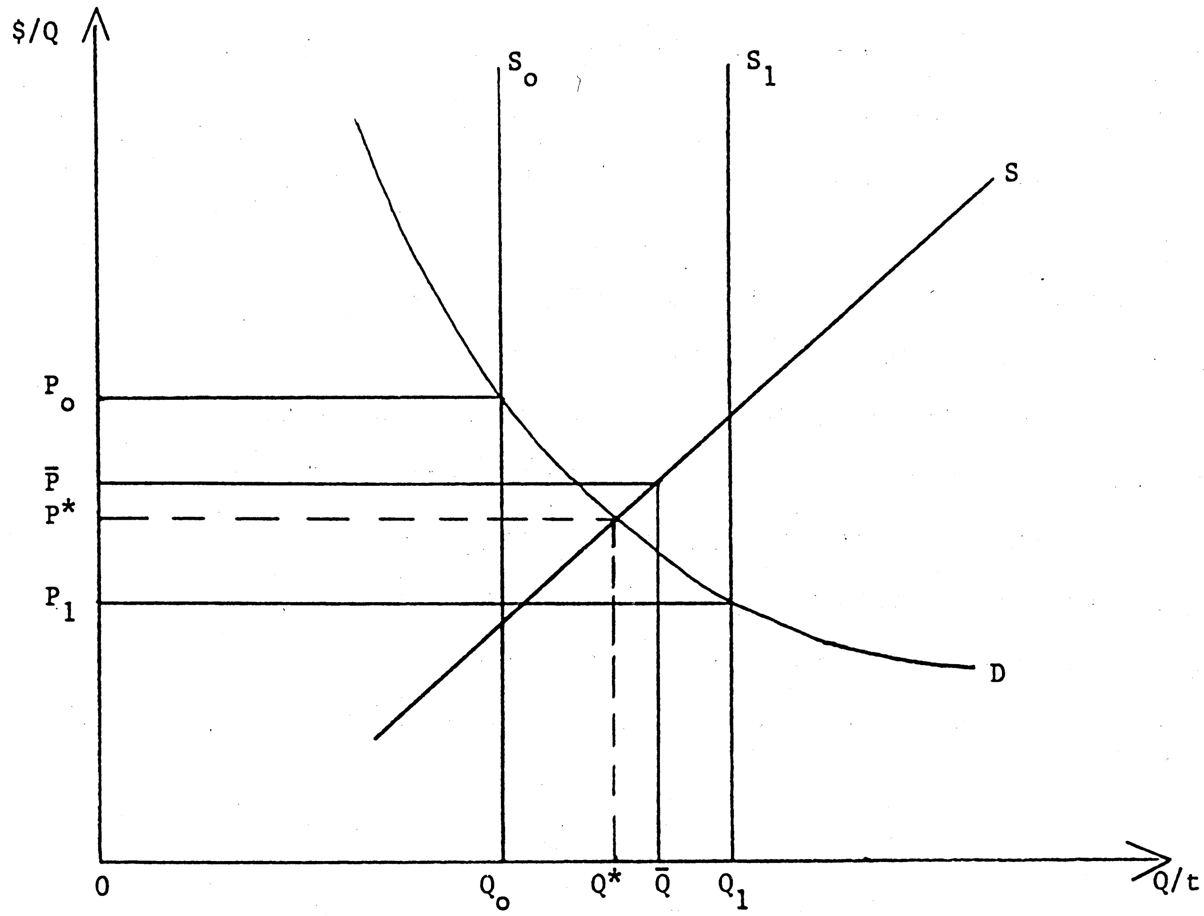
Consider first, the case represented in Figure 2.2. In this Figure, curve S is the planned supply curve while curve D is the demand curve. The point (P^*,Q^*) represents a rational expectations equilibrium. Assuming producers know these curves, they will plan to produce Q^* output. Price P^* is the (action) certainty equivalent price and is also the rationally expected price. Actual supply may differ from planned supply because it is subject to stochastic (weather) shocks. Hence, let us assume that actual supply varies from one period to the next, taking values Q_0 and Q_1 with equal probability, such that:

$$Q_i = Q^* + u_i, \quad i = 0,1.$$

where, $E(u_i) = 0$ and hence $u_0 = -u_1$.

Note that this discrete bimodal distribution on output will yield a discrete bimodal distribution on price. Price will be P_0 or P_1 with equal probability. This implies that the average price outcome is $\bar{P}$. In the case of a linear demand curve the average price is the same as the rationally expected price. However, in the case of the non-linear demand curve (as in Figure 2.2) the average price is different from the rationally expected (certainty equivalent) price. For the convex-shaped demand curve average

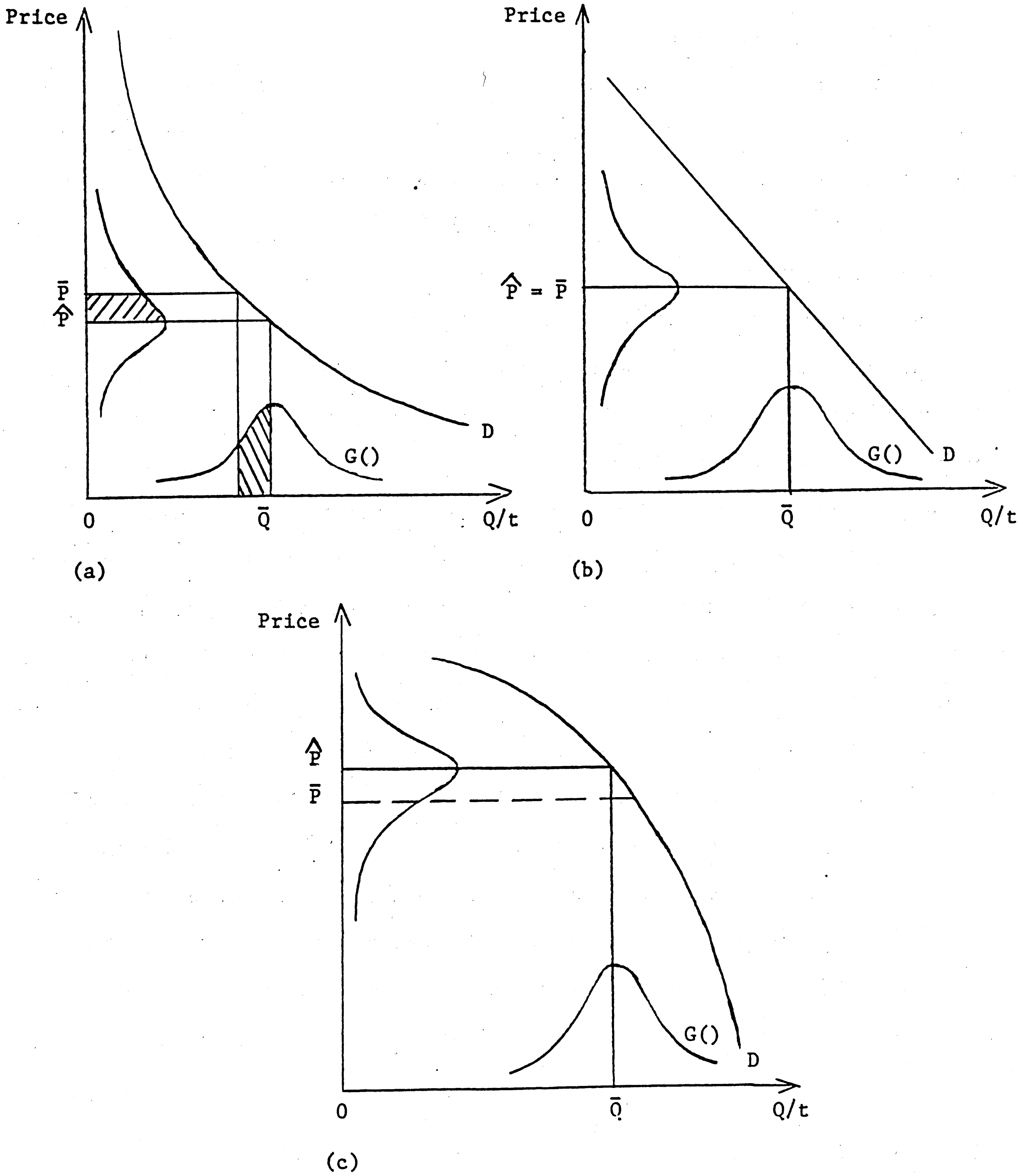
FIGURE 2.2: Rationally Expected Price given Binary Output Uncertainty



price is higher than the rationally expected price. If producers used average price as their expected price, this would not be 'rational' sinceproducers would then not be using all the information at their disposal. In particular, using such a price would imply a planned output which is greater than Q*. Rational producers would take this information into account and use it to revise their expectations. The rationally expected price is the one price which rational producers would not have an incentive to revise (since it uses all the information at their disposal). This is the one which simultaneously satisfies the demand function and the planned supply fuction.

Now let us relax the assumption that actual supply has a discrete bimodal distribution and assume instead that it has a continuous unimodal distribution. This will give rise to a unimodal probability density function of prices. See Figure 2.3 for an illustration. In this figure, $\bar{Q}$ is the planned expected total supply which has the distribution function G(). Given the demand function, it is possible to construct the probability density function for realized prices. For illustration, in panel (a) of Figure 2.3, the shaded area under the probability distribution for output is equal to the shaded area under the probability distribution for realized price. If G() is normally distributed, the distribution of price will be normally distributed only if demand is linear (Figure 2.3(b)). The price distribution will be skewed if demand is nonlinear: it will be skewed toward higher prices if demand is convex (panel (a)) and toward lower prices if demand is concave (panel (c)). If demand is convex, the average price will be greater than the price of the average output—the certainty equivalent price; if demand is concave, $\bar{p}$ will be less than $\hat{p}$. Only if the demand function is linear will $\bar{p}$ = $\hat{p}$.

FIGURE 2.3: Rationally Expected Price for Various Demand Specifications



It is clear from Figure 2.3(a) that, if demand is convex, the average price is greater than the certainty equivalent price. This creates a dilemma if the government introduces a buffer fund price stabilization program in which price is stabilized at the average level. This is because such a program would generate an output response since the average price level is different from the (action) certainty equivalent price level that would exist in a market with no program and rational producers. To clear the market, consumer price would tend to fall below the stabilized producer price and there would be a net payout from the Government to producers. The output response to stabilization is in addition to any output response that might occur because the scheme reduces risk. To abstract from this latter output effect we assume that producers are risk neutral even though a more realistic assumption might be risk aversion.

Van Kooten, Schmitz and Furtan (1988) reworked the Massell model introducing the concept of Muthian rational expectations. Like Massell these authors assumed a discrete bimodal distribution on output and price stabilization at the average price level. Their conclusions differed significantly from Massell's in two respects. First, they concluded that buffer fund stabilization would have no welfare effects. This contrasted with the results of Massell who argued that price stabilization would lead to a net welfare gain to society. Second, they concluded that a rule to stabilize price at the average level implies that there will always be a net transfer of revenue from the government to producers. In other words, such a program would not be actuarially sound. In our first simulation exercise, we will show that these two conclusions do not necessarily hold. Their results hinge on the assumptions of a completely inelastic planned supply curve and autarky. Thus, given a non-linear demand curve and an upward-sloping planned supply curve (as in Figure 2.4), it is clear that an attempt to stabilize price at the average level will result in an output response, at least in the short run, as rational expectations producers now expect their price to be $\bar{P}$.

Suppose that the government decided to introduce a buffer fund price stabilization program into a market that could be adequately represented by the Waugh-Massell binary framework (as in Figure 2.2). Any such program will use a set of rules for determining the stabilization price. For example, the government may establish the stabilization price according to costs of production, at the average price level, or at a level that will render the buffer fund actuarially sound. Let us consider just the last two types of rules. If the demand curve is convex we know that the average price rule will lead to producer expectations which will exceed the rational expectations equilibrium in a market with no program. The same may happen if the stabilization price is set in such a way that expected contributions to the fund would just offset expected payouts. In this latter case the stabilization price would be set equal to P^* where, in terms of Figure 2.2:

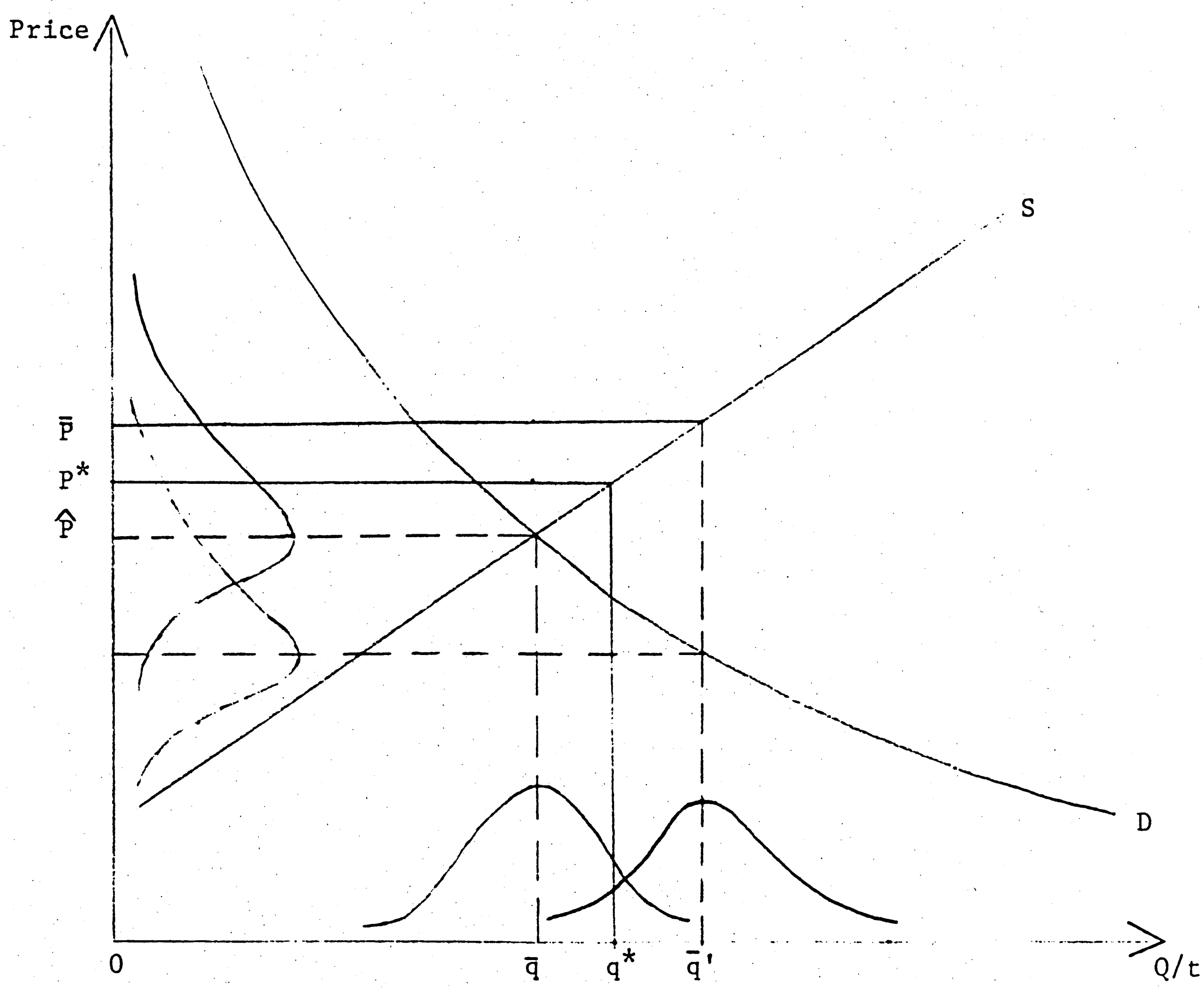
$$P_1Q_1 - P^*{}_{Q1} = P^*Q_0 - P_0Q_0.$$

Solving for P^* we obtain:

$$P^* = (P_0Q_0 + P_1Q_1)/(Q_0 + Q_1).$$

Hence the stabilization price is the weighted average of returns. It can be shown that this price will be less than the average price: $\bar{P} = (P_0 + P_1)/2$. However, it may be greater or less than the certainty equivalent price ($\hat{P}$). If risk neutrality is assumed, then any attempt to stabilize the producer price at a value different from the certainty equivalent price (determined by

Figure 2.4



the intersection of demand and planned supply) will result in an output response as producers' ex-ante decisions will change. For example, with reference to Figure 2.4, if the stabilization price is $\bar{P}$, then producers will aim to produce $\bar{q}'$ rather than $\bar{q}$.

2.4 Stabilization Rules

One of the main features of the early literature on the effects of stabilization programs is its use of highly-stylized models with stabilization rules which do not bear much resemblance to the actual rules used in stabilization programs in Canada today. For example, the rule used in the papers by Waugh, Oi and Massell is a fixed price rule. Thus given a buffer fund program, if market price tended to move below this agreed level there would be payouts from the fund and if price tended to move above this level then there would be contributions by producers. There have been attempts in the more recent literature to examine the effects of stabilization under different rules. For example, Massell(1970) investigated price band stabilization while Quiggin(1973) has investigated underwriting. This latter involves buffer funds in which a payout is made when market price goes below a price floor but there is no price ceiling. Hence producer contributions (if there are any) are not related to the market price level.

While these attempts are useful, there is a trade-off between analyzing highly stylized models with generic rules and commodity-specific models with the particular stabilization rules that are applicable. The former attempt to say something about the effects of stabilization in general while the latter attempt to say something about the effects of stabilization in a particular commodity context. We believe that the two approaches are complementary to the analysis of Canadian commodity stabilization programs.

This belief is reflected in the two simulation exercises carried out later in this report. The first simulation exercise (in section 3) uses the more generalist approach to focus on the type of rules that are common to the price stabilization programs of Canada. These include the use of moving averages of prices and price floors (underwriting). The second simulation exercise (in section 4) uses the specific approach to focus on the specific rules employed in the Western Grain Stabilization Program. Both simulation exercises are viewed as prototypes for further research into the effects of commodity stabilization programs in Canada.

2.5 Risk Attitudes

In general, it is believed that agricultural producers are risk averse. Hence the presence of production and price risk is thought to impose a cost on production. One of the objectives of Canadian stabilization programs has been to transfer this risk so as to make producers better off. The transfer is both intertemporal and spatial. Intertemporal transfers for an individual producer can make him better off if the transfer is from a time when he has a low marginal utility of income (i.e. in a high income year) to a time when he has a high marginal utility of income (i.e. in a low income year). Spatial transfers of risk are also made from producers to the government.

The effects of stabilization programs in reducing the risks faced by agricultural producers can be analyzed at the aggregate level or at the micro (farm) level. However, the most insightful analysis, given non-neutral risk attitudes, will take place at the micro level since risk attitudes are most relevant at the individual producer level. Here we will only make some brief comments about the aggregate-level analysis of the effects of risk reduction. A discussion of the micro-level effects is left to the phase two report.

Assuming that producers are generally risk-averse, the introduction of a stabilization program might be expected to result in a shift in the aggregate supply curve to the right (Just and Hallam). This is because risk is viewed as a variable cost of production whch is reduced to producers as a result of the stabilization program.

One of the problems with price stabilization programs is that such programs attempt to stabilize price, whereas producers are concerned about income risk (the net effect of price and production risk). It is quite possible that a price stabilization program will do a good job of stabilizing price but a poor job of stabilizing income. In this case, there might be no income risk reduction to producers and hence no outward shift in supply.

The Waugh-Oi-Massell literature on stabilization did not incorporate the risk reduction effects of stabilization on supply. However, Just (1974,1975) discusses its effect as a supply-shifter. In our first simulation exercise we abstract from these supply-shifting effects in order to concentrate on the effects of rational expectations on movements along the supply curve. However, in the second simulation exercise we explicitly allow for these supply-shifting effects in the estimation procedure. These effects are likely more significant in the second simulation exercise since it is concerned with income stabilization rather than price stabilization.

3. SIMULATION OF A PRICE STABILIZATION SCHEME

The purpose of this section is to illustrate the potential effects of a price stabilization scheme where one assumes stochastic production and price, but not stochastic demand. The implications of stochastic demand are left to further research. It is also assumed that producer expectations are formed rationally and producers are risk neutral. For the purposes of empirical detail we have modelled the simulation on the Canadian hog market. The purpose of the simulation exercise is to illustrate the conceptual points made in the previous section. Thus it attempts to show that the specification of rules and market structure matter when it comes to assessing the results of stabilization. In particular, we will explore the effects of fixed price, moving average and underwriting rules and show that the principal conclusions of Van Kooten, Shmitz and Furtan(1988) are sensitive to the assumed market structure. The level of abstraction required to illustrate these points means that we have sacrificed realism in the model. The task of reflecting these conceptual points in a more realistic model of the Canadian hog industry is left for further research.

We employ a dynamic stochastic simulation model to investigate the impact of price stabilization under alternative structures (autarky/large open economy and small open economy; linear and non-linear demand) and under alternative stabilization rules (fixed stabilization price; moving average stabilization price; and moving average stabilization price as a price floor). The approach is similar to that used by Miranda and Helmberger except that those authors were assessing the implications of a buffer stock program whereas we are assessing the implications of a buffer fund program.

3.1 Autarky/Large Open Economy

The Canadian hog market is initially simulated under the assumption of autarky. This implies that the economy's producers face a downward sloping aggregate demand for the commodity they produce. At the level of abstraction with which we shall operate, this is analytically equivalent to assuming a large open economy. The model is illustrated in Figure 2.4. In order to carry out the simulation we need to provide quantitative values to fix the demand and planned supply curves. To do this we first specify a certainty equivalent equilibrium price and quantity produced (and consumed) and specify the standard deviation of quantity produced. Based on historical data, the certainty equivalent equilibrium price and quantity were chosen to be $3.75 per kg and 700 million kgs. In a similar way the standard deviation of quantity was chosen to be 70 million kgs.

Next we make certain assumptions about the shape and price elasticities of the planned supply and demand curves. The planned supply curve is assumed to be linear with a range of assumed price elasticities (0.5, 1.0 and 1.5) occuring at the certainty equivalent equilibrium. This range of elasticities is not unreasonable in light of earlier empirical estimates. For example Chin, Pando and West (1974) estimated the long-run supply elasticity for Canada as a whole at 0.61, while for Eastern and Western Canada their estimates were 0.87 and 0.85 respectively. Martin and Zwart (1975) published estimates of 0.89 for estern Canada and 0.20 for Western Canada. We think their estimate for Western Canada is probably too low for the Western Canadian hog industry of today. It appears from both of these studies that a reasonable estimate of the long-run elasticity of supply for Canada is perhaps in the vicinity of 0.6 to 0.7. However, this is a primary supply elasticity whereas the analysis to be conducted below relates to the derived (retail) level. If one assumes a relatively fixed marketing margin over the relevant range then, at any given quantity, the supply elasticity will be higher at the derived level than at the primary level.

The hog demand curve is represented in the simulation model by two alternative shapes: linear and double-logarithmic. This follows from the discussion of the previous section that the specification of the demand curve matters in any assessment of the effects of a price stabilization program. We assumed an elasticity of demand of -1.0. This seems appropriate given an earlier estimate of -0.955 by Hassan and Johnson.

The basic simulation model can thus be summarized as follows where the subscript ranges are ($t = 1,\ldots,T$; $i = 1,\ldots,r$):

Supply

$$Q^*_{it} = 700(1-\varepsilon_s) + (700*\varepsilon_s/3.75)\ \hat{P}_i t$$

$$Q_{it} = Q^*_{it} + u_{it}$$

Demand

- linear: $P_{it} = 7.50 - 0.00536\ Q_{it}$
- nonlinear: $P_{it} = 2{,}625\ Q_{it}^{-1.00}$

Expected producer price

- competitive market: $\hat{P}_{it} = 3.75$
- fixed price rule: $\hat{P}_{it} = \sum_{t=1}^{T} \left(\sum_{i=1}^{r} P_{it} / r \right) / T$
- moving average price rule: $\hat{P}_{it} = \left[\sum_{k=1}^{5} (P_{i(t-k)} \right] / 5$
- underwriting price rule: $\hat{P}_{it} = \text{Max}\{\ 3.75,\ \left[\sum_{k=1}^{5} (P_{i(t-k)} \right] / 5 \}$

Net income transfer from the government to producers:

- fixed price rule: $PAY_{it} = \{ \left[\sum_{t=1}^{T} \left(\sum_{i=1}^{r} P_{it}/r \right)/T \right] - P_{it} \} * Q_{it}$

- moving average price rule: $PAY_{it} = \{[\sum_{k=1}^{5} (P_{i(t-k)}]/5 - P_{it}\}*Q_{it}$

- underwriting price rule: $PAY_{it} = Max\{ 0, [\sum_{k=1}^{5} (P_{i(t-k)}]/5] - P_{it}\}*Q_{it}$

Producer revenue:

$$REV_{it} = P_{it}*Q_{it} + PAY_{it}$$

and, where:

Q^*_{it} = planned output in period t, replicate i

ε_s = elasticity of supply

$\hat{P}_{it}$ = rationally expected price in period t, replicate i

Q_{it} = actual quantity produced in period t, replicate i

u_{it} = random shock to quantity produced in period t, replicate i

P_{it} = actual price in period t, replicate i

PAY_{it} = income transfer to producers (+) or to the government (-)

REV_{it} = producer revenue including income transfers.

Under the no-program simulation, the rationally expected producer price is constant at the intersection of the demand and planned supply curves (i.e. \$3.75/kg). Under stabilization, the rationally expected producer price is a function of the particular stabilization rule being used.

The first stabilization rule is the fixed price rule. This rule is essentially the same as the rule used by Massell(1969) and by Van Kooten, Schmitz and Furtan. The rule is to set the producer price at the arithmetic average of the market price which would maintain in a competitive market. Thus we can use this rule to explore further the results of these earlier studies without being restricted to the assumption of a bimodal output distribution. The second stabilization rule is the moving average rule. This is more realistic than the fixed price rule since it only assumes past information in establishing the stabilization price. The third stabilization rule is the underwriting rule. Under this rule, producers receive the moving average price if it exceeds the current market price. However, if the market price exceeds the moving average price, producers receive the market price. This is closer to the type of price stabilization programs used in Canada. It is quite like the old ASA programs for livestock. It is less like the new Tripartite programs which are based on the guaranteed margin concept or some provincial livestock stabilization programs in which payouts are based solely on costs of production.

Under the first rule, the fixed support price is determined by setting it at the average price determined from the competitive market simulation over 100 replicates and 30 years. For linear demand and planned supply curves, the average price is equal to the certainty equivalent price, that is, the price at which supply and demand intersect. However, this is not true if demand is nonlinear (with planned supply linear). As indicated in Figure 2.3, the average price is above the certainty equivalent price if demand is convex, and below the intersection of supply and demand if demand is concave.

Since the second and third rules involve the use of moving averages we have a minor problem in determining initial values for the stabilization price. Thus, for the first five years of the simulation we set the stabilization price at the average price as determined from the competitive market simulation. After the fifth year, the stabilization price is calculated according to our two moving average stabilization rules.

A summary of the simulation results for the autarky case is provided in Table 3.1. The results are for the linear and nonlinear demand and for

Table 3.1: Simulation Results Under Alternative Price Stabilization Rules and Autarky[a]

Stabilizn. Rule[b]	Quantity Produced	Consumer Price	Producer Price	Producer Revenue[c]	Income Transfer
A. LINEAR DEMAND					
		(elasticity of supply = 0.5)			
no rule	699 (69)	3.76 (.37)	3.76 (.37)	2599 (36)	—
rule 1	699 (69)	3.75 (.37)	3.76 (.00)	2627 (260)	28 (259)
rule 2	700 (70)	3.75 (.38)	3.76 (.15)	2630 (298)	32 (297)
rule 3	704 (70)	3.73 (.37)	3.74 (.16)	2732 (184)	133 (197)
		(elasticity of supply = 1.0)			
no rule	699 (69)	3.76 (.37)	3.76 (.37)	2599 (36)	—
rule 1	700 (69)	3.75 (.37)	3.76 (.00)	2629 (260)	30 (259)
rule 2	700 (73)	3.75 (.39)	3.76 (.13)	2631 (316)	35 (316)
rule 3	708 (71)	3.71 (.38)	3.72 (.15)	2736 (189)	138 (206)
		(elasticity of supply = 1.5)			
no rule	699 (69)	3.76 (.37)	3.76 (.37)	2599 (36)	—
rule 1	701 (69)	3.75 (.37)	3.76 (.00)	2632 (260)	39 (260)
rule 2	700 (77)	3.75 (.41)	3.75 (.13)	2632 (338)	39 (338)
rule 3	710 (72)	3.70 (.38)	3.71 (.15)	2739 (195)	142 (214)
B. NONLINEAR DEMAND					
		(elasticity of supply = 0.5)			
no rule	699 (69)	3.80 (.39)	3.80 (.39)	2625 (00)	—
rule 1	703 (69)	3.77 (.37)	3.80 (.00)	2668 (263)	43 (263)
rule 2	702 (70)	3.78 (.40)	3.78 (.15)	2657 (305)	32 (305)
rule 3	706 (70)	3.76 (.39)	3.77 (.16)	2760 (187)	135 (187)
		(elasticity of supply = 1.0)			
no rule	699 (69)	3.80 (.39)	3.80 (.39)	2625 (00)	—
rule 1	707 (69)	3.75 (.38)	3.80 (.00)	2684 (263)	59 (263)
rule 2	704 (73)	3.77 (.41)	3.78 (.14)	2660 (325)	35 (325)
rule 3	710 (71)	3.74 (.39)	3.74 (.15)	2764 (194)	139 (194)
		(elasticity of supply = 1.5)			
no rule	699 (69)	3.80 (.39)	3.80 (.39)	2625 (00)	—
rule 1	711 (69)	3.73 (.38)	3.80 (.00)	2700 (263)	75 (263)
rule 2	705 (78)	3.77 (.44)	3.77 (.14)	2664 (349)	39 (349)
rule 3	713 (72)	3.72 (.40)	3.73 (.15)	2767 (201)	142 (201)

[a] Mean values with standard deviations in parentheses
[b] Rule 1 = fixed price; rule 2 = moving average price; rule 3 = underwriting
[c] Includes government payments and levies

three alternative assumptions concerning the elasticity of supply. The implications of the results are as follows:

(1) Under the 'no rule' scenario, average price is higher when the demand curve is nonlinear (i.e. double log). This follows the logic of Figure 2.3(a).

(2) Under rule 1 and a nonlinear demand curve, the producer price is fixed at the average competitive price which is higher than the certainty equivalent equilibrium price. On average, this results in an increase in quantity produced and a decrease in consumer price. This result is contrary to the results of Van Kooten, Schmitz and Furtan who found no production and price effects (and hence no welfare effects). The production and price effects are less the lower is the assumed elasticity of supply. The Van Kooten, Schmitz and Furtan result corresponds to an elasticity of supply of zero.

(3) All three price stabilization rules lead to a reduction in the variability of producer price as measured by the standard deviation. However, they all lead to an increase in the variability of producer revenue. This result agrees with Van Kooten, Schmitz and Furtan who demonstrate theoretically that producer revenues are more variable under a price support program than under perfect competition. This was also demonstrated via a simulation model by Miranda and Helmberger. This result may be an argument against price stabilization since producers are generally thought to be more concerned with income stability rather than price stability.

(4) All stabilization rules suggest that on average there will be an income transfer from the government to producers. This is particularly the case for rule 3 (underwriting).

(5) Rule 3 tends to result in an increase in average production and a decrease in average producer and consumer prices. This applies both in the case of the linear and nonlinear demand curves. The depressing effect on producer price is interesting since it is precisely the opposite of the basic objective of the rule which is to support (underwrite) producer price.

3.2 Small Open Economy (Trade)

The situation for trade is illustrated using Figure 3.1. As output price is not determined within the domestic economy, we assume that it is a normally distributed random variable with known mean ($\bar{p}$) and variance (σ^2). That is, price is exogenous to the domestic economy. Rational producers correctly anticipate the distribution of (exogenous) output price and, therefore, in the competitive model, producers plan to produce that level of output (as determined by the planned supply curve) associated with the mean price, namely, q^*. However, the planned output is not realized as actual output is normally distributed with mean given by the planned level and standard deviation determined by random (weather) shocks as explained in the previous sub-section. Any output not sold in the domestic economy at the random, exogenously-determined price is sold abroad at that price; if there is excess demand, it is satisfied by imports.[3] Hence, in Figure 3.1, q^D is consumed domestically while the difference between realized output (q^R) and domestic consumption is exported. The basic simulation model given trade can thus be summarized as follows where the subscript ranges are (t = 1,...,T; i = 1,...,r):

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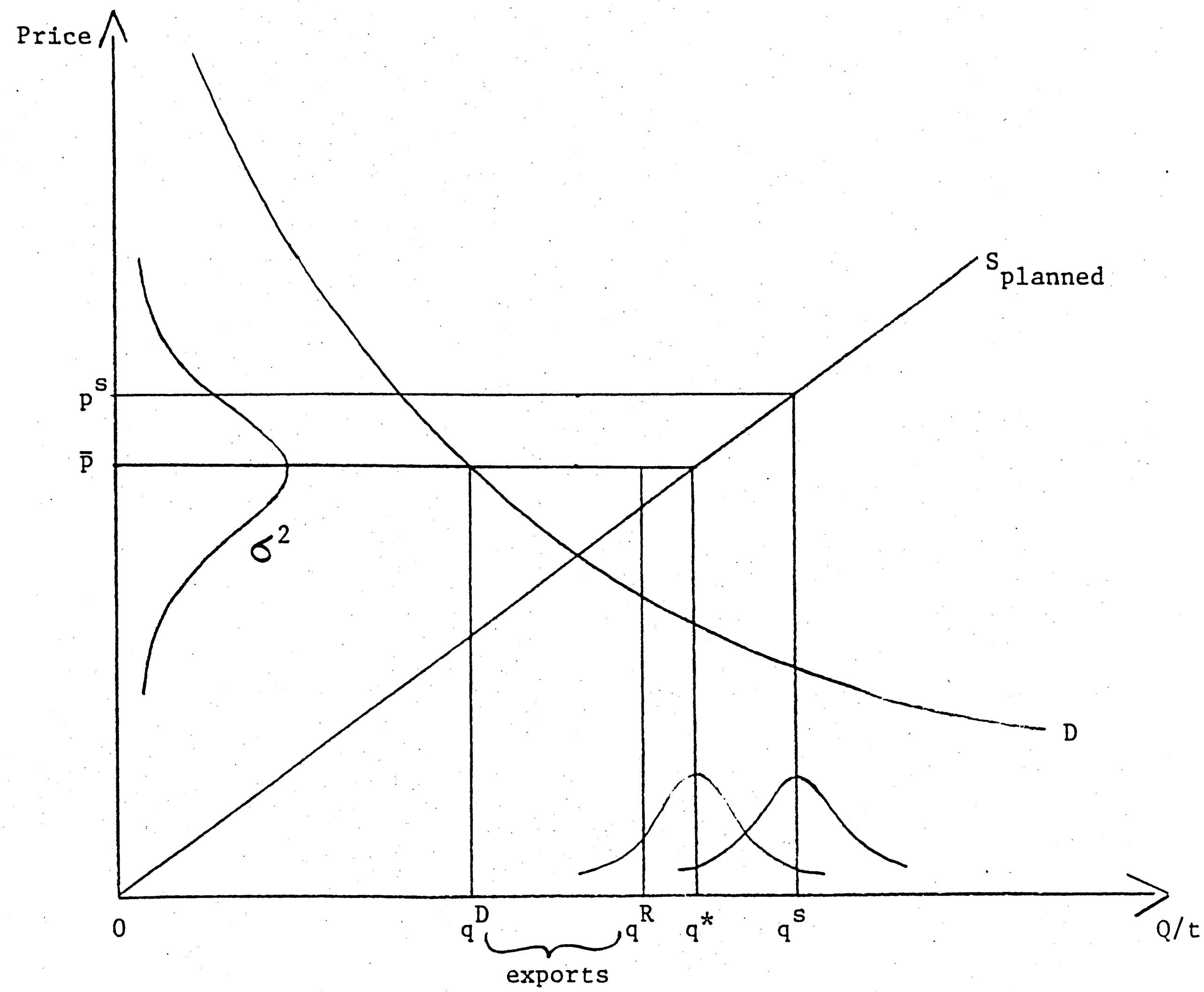
[3]Transportation costs are assumed to be negligible, which is probably not an unrealistic assumption given that exports or imports may occur at widely separated points in a geographic sense.

FIGURE 3.1: Buffer Fund Dynamics in an Open Economy



Consumer Price:

$$P_{it} = 3.75 + v_{it}$$

Expected producer price

- competitive market: $\hat{P}_{it} = 3.75$
- fixed price rule: $\hat{P}_{it} = \sum_{t=1}^{T} (\sum_{i=1}^{r} P_{it} / r) / T$
- moving average price rule: $\hat{P}_{it} = [\sum_{k=1}^{5} (P_{i(t-k)}]/5$
- underwriting price rule: $\hat{P}_{it} = \text{Max}\{ 3.75, [\sum_{k=1}^{5} (P_{i(t-k)}]/5\}$

Supply

$$Q^{*}_{it} = 700(1-\varepsilon_s) + (700*\varepsilon_s/3.75) \hat{P}_i t$$

$$Q_{it} = Q^{*}_{it} + u_{it}$$

Demand

- linear: $QD_{it} = 1400 - 186.67 P_{it}$
- nonlinear: $QD_{it} = 0.000381 P_{it}^{-1.00}$

Exports/Imports

$$QX_{it} = Q_{it} - QD_{it} \quad \text{(exports)}$$

Net income transfer from the government to producers:

- fixed price rule: $PAY_{it} = \{[\sum_{t=1}^{T} (\sum_{i=1}^{r} P_{it}/r)/T] - P_{it}\}*Q_{it}$
- moving average price rule: $PAY_{it} = \{[\sum_{k=1}^{5} (P_{i(t-k)}]/5 - P_{it}\}*Q_{it}$
- underwriting price rule: $PAY_{it} = \text{Max}\{ 0, [\sum_{k=1}^{5} (P_{i(t-k)}]/5] - P_{it}\}*Q_{it}$

Producer revenue:

$$REV_{it} = P_{it}*Q_{it} + PAY_{it}$$

and, where:

Q^*_{it} = planned output in period t, replicate i

ε_s = elasticity of supply

$\hat{P}_{it}$ = rationally expected price in period t, replicate i

Q_{it} = actual quantity produced in period t, replicate i

QD_{it} = quantity consumed domestically in period t, replicate i

QX_{it} = quantity exported in period t, replicate i

u_{it} = random shock to quantity produced in period t, replicate i

v_{it} = random shock to price in period t, replicate i

P_{it} = actual price in period t, replicate i

PAY_{it} = income transfer to producers (+) or to the government (-)

REV_{it} = producer revenue including income transfers.

As before, the simulation is based on historical data for the Canadian hog sector. The certainty equivalent equilibrium price is $3.75 per kg as before. Price is assumed to be determined in the international market and is taken to be stochastic to domestic producers and consumers. It is assumed to be a normal random variable with standard deviation of $0.90 per kg.[4] Equilibrium quantities for domestic consumption and exports are assumed to be 700 and 80 million kgs respectively. This implies an equilibrium production of 780 million kgs. The standard deviation of production is assumed to be 70 million kgs. Three alternative stabilization rules are investigated. They are the same three as investigated before in the autarky case: the fixed price rule, the moving average price rule and the moving average price underwriting rule. For each of the stabilization rules and each demand model, 100 simulations of 30 years each are used. The simulation results are summarized in Table 3.2.

---

[4]The standard deviation was determined from historical real price data.

Table 3.2 Simulation Results Under Alternative Price Stabilization Rules and Small Open Economy[a]

Stabilizn. Rule[b]	Quantity Produced	Producer Price	Producer Revenue[c]	Income Transfer	Net Exports
A. LINEAR DEMAND					
		(elasticity of supply = 0.5)			
no rule	779 (69)	3.74 (.89)	2912 (740)	—	77 (178)
rule 1	778 (69)	3.74 (.00)	2910 (259)	2 (700)	76 (178)
rule 2	778 (80)	3.74 (.39)	2928 (520)	19 (767)	76 (182)
rule 3	795 (73)	3.74 (.39)	3290 (571)	319 (460)	93 (179)
		(elasticity of supply = 1.0)			
no rule	779 (69)	3.74 (.89)	2912 (740)	—	77 (178)
rule 1	777 (69)	3.74 (.00)	2907 (259)	2 (699)	75 (178)
rule 2	777 (105)	3.74 (.39)	2941 (656)	35 (769)	76 (194)
rule 3	810 (83)	3.74 (.39)	3359 (627)	330 (479)	109 (184)
		(elasticity of supply = 1.5)			
no rule	779 (69)	3.74 (.89)	2912 (740)	—	77 (178)
rule 1	776 (69)	3.74 (.00)	2904 (259)	2 (698)	74 (178)
rule 2	777 (138)	3.74 (.39)	2954 (798)	52 (773)	75 (213)
rule 3	826 (98)	3.74 (.39)	3428 (696)	341 (500)	124 (191)
B. NONLINEAR DEMAND					
		(elasticity of supply = 0.5)			
no rule	779 (69)	3.74 (.89)	2912 (740)	—	29 (230)
rule 1	778 (69)	3.74 (.00)	2910 (259)	2 (700)	28 (230)
rule 2	778 (80)	3.74 (.39)	2928 (520)	19 (767)	28 (233)
rule 3	794 (73)	3.74 (.39)	3290 (571)	319 (460)	44 (231)
		(elasticity of supply = 1.0)			
no rule	779 (69)	3.74 (.89)	2912 (740)	—	29 (230)
rule 1	777 (69)	3.74 (.00)	2907 (259)	2 (699)	27 (230)
rule 2	777 (105)	3.74 (.39)	2941 (656)	35 (769)	27 (244)
rule 3	810 (83)	3.74 (.39)	3359 (627)	330 (479)	60 (235)
		(elasticity of supply = 1.5)			
no rule	779 (69)	3.74 (.89)	2912 (740)	—	29 (230)
rule 1	776 (69)	3.74 (.00)	2904 (259)	2 (698)	26 (230)
rule 2	777 (138)	3.74 (.39)	2954 (798)	52 (773)	26 (260)
rule 3	826 (98)	3.74 (.39)	3428 (696)	341 (500)	76 (241)

[a] Mean values with standard deviations in parentheses
[b] Rule 1 = fixed price; rule 2 = moving average price; rule 3 = underwriting
[c] Includes government payments and levies

This Table shows the mean and standard deviation of simulation results for quantity produced, producer price, producer revenue, income transfer and net exports. The results for the consumer price, included in Table 3.1, are not shown here. The consumer price was found to have a mean of $3.74 and a standard deviation of $0.89 in every simulation run. The implications of the results are as follows:

(1) The average quantity produced is not affected by stabilization rules 1 and 2, but does tend to increase under rule 3 (underwriting). The distortion in production increases the more elastic the planned supply. The variability of output is increased under rules 2 and 3 but not under rule 1. Rule 2 results in the largest distortion in the variability of output.

(2) The average producer price is unaffected by any of the stabilization rules. The variability of producer price is reduced under all three rules.

(3) The average producer revenue is increased under rules 2 and 3 but not under rule 1. The variability in producer revenue tends to decrease under all three rules. This is in contrast to the autarky case in which the variability in producer revenue increased under all three rules. This suggests that price stabilization may assist producers in reducing their income variability provided they are producing a commodity for which the price is determined on the world market.

(4) There seems to be an average net income transfer from the government to producers under rules 2 and 3 but not under rule 1. The result for rule 1 is in contrast to that found for the autarky case and is in contrast the conclusions of Van Kooten, et al. Those authors argued that a fixed price rule would lead to a net transfer of income from the government to producers.

We find this is true for the autarky/large open economy model (which is what they implicitly assumed) but not for the small open economy model.

(5) There is an increase in net exports under rule 3 but not under the other rules. This can be traced back to the positive output effect generated by rule 3. Rules 2 and 3 tend to lead to a modest increase in the variability of net exports.

3.3 Conclusions

Our results provide evidence that price stabilization per se may or may not provide benefits to producers or consumers. It depends on the structure of the model and the particular stabilization rule used. For example, the variability in producer revenue may increase or decrease as a result of price stabilization depending on whether we assume an autarky/large open economy model or a small open economy model. The average level of producer revenue depends on the choice of stabilization rule. Thus rule 3, which has an extra built-in subsidy component, through the underwriting mechanism, results in a higher average level of producer revenue than the other two rules. Under autarky, average consumer prices tend to be higher when a non-linear demand curve is assumed than when a linear demand curve is assumed.

Methodologically, this simulation exercise does three things. First, it suggests that the effects of introducing a stabilization program depend critically on the particular stabilization rules employed. Thus the results from using a very simplistic rule as in the early literature may be very different from the results obtained with an alternative, more realistic stabilization rule. Second, it suggests that these rules should be incorporated into an analysis of price stabilization via the producer expectations variable. If one assumes that producers have rational expectations, then when a stabilization rule is introduced or modified, this should form part of the information set available to the producer to generate his price expectations and hence affect his supply decisions. Third, this exercise suggests that dynamic stochastic simulation is a very useful tool for analyzing the effects of different stabilization rules. Simulation allows one to model a particular commodity market with particular stabilization rules. Stochastic simulation allows for the fact that a stabilization rule requires uncertainty (e.g. in price or production) in order to be triggered. Dynamic stochastic simulation allows for the analysis of stabilization rules which are dynamically determined (e.g. moving average rules) or have dynamic effects (i.e. lagged effects resulting from lack of information or adjustment costs).

This simulation exercise has just scratched the surface for this type of analysis. One extension to the analysis would be to analyze the effects of price stabilization in the presence of stochastic demand. The example analyzed in this section focussed only on stabilization in the presence of stochastic supply. However, it could be argued that in the case of some commodities (and hogs might be a good example) random shocks in demand may be more important than random shocks in supply.

Other extensions include the analysis of other dynamic (i.e. moving average) stabilization rules such as price bands, and "guaranteed margin" stabilization (e.g. the Tripartite Red Meat Stabilization Programs). In addition, the model needs to be extended to allow for dynamic supply adjustment and to allow for the dynamic effect of information costs on the formation of producer expectations. Finally, the model needs to explicitly allow for producers to have non-neutral risk attitudes.

In the next simulation exercise, we again use dynamic stochastic simulation but with a different slant. More attention will be paid to incorporating the particular stabilization rules and market structure that are currently relevant to the Canadian grain sector. We will assume that producers have forward-looking producer expectations, but they are not fully rational in the Muthian sense.

4. SIMULATION OF AN INCOME STABILIZATION SCHEME

This simulation exercise involves the use of dynamic stochastic simulation to assess the effects of the Western Grain Stabilization Program. Like the previous simulation exercise this exercise uses forward-looking expectations. However this exercise has a number of features which distinguish it from the previous one. They are: (a) it examines income stabilization rules rather than price stabilization rules; (b) it allows producers to have non-neutral risk attitudes; (c) it is more 'realistic' in that it attempts to replicate the actual market structure and the actual stabilization rules (including the subsidy component) facing the Canadian grains industry; and (d) it looks at the international effects of stabilization.

This last point has become important in light of the current multilateral trade negotiations. Various agricultural trading nations are coming to realize that there may be significant adverse international effects from stabilization. These concerns arise particularly in the case of grains. In connection with these negotiations there has been some debate over the appropriate measures to use in measuring the international effects of protection. In Appendix C we include a summary of these measures along with an evaluation. In our opinion the trade volume effect (TVE) and the rate of price distortion (RPD) are the most appropriate, if not the most politically acceptable. Hence, in the simulation exercise we will use these two measures.

The Western Grain Stabilization Program (WGSP) was introduced in Canada in 1976 as a way of reducing the income instability facing prairie grain producers. It is distinguished from price stabilization programs in that it attempts to stabilize the net cash flow of grain producers rather than price. The impact of the Western Grain Stabilization Program is illustrated with the aid of Figure 4.1. In this Figure, producers are assumed to face an upward-sloping planned supply curve (S^P). They also face a downward-sloping planned demand curve. This demand curve includes domestic demand, inventory demand and planned export demand all of which are assumed in the model to be price-responsive. Thus we are implicitly assuming the large open economy case for Canada. The choice of the large-country assumption is debatable in the case of Canadian grains. We have chosen this because to assume the alternative (i.e. small open economy case) would be to assume away potential international price effects. By choosing the large-country assumption we can approach arbitrarily close to the small-country case by assuming an arbitrarily large export demand elasticity.

Prior to the WGSP, producers' expected price is equal to the certainty equivalent (world) market price (P_0). Thus they plan to supply Q_0 and plan to export ($Q_0 - Q_1$). The WGSP may have two effects that can be represented using the comparative statics of Figure 4.1. Firstly, it may cause a movement up the planned supply curve. This would be the case if producers have autoregressive expectations of the aggregate payout.[5] For example, if a sizeable payout were expected to be due this year, autoregressive expectations may imply that a sizeable payout would also be expected next year. In this case, producers would have an incentive to increase output this year as a way of increasing their levy contributions so as to maintain or increase their share of the expected payout next year. This may be

[5] Autoregressive expectations are constistent with rational expectations where the presence of information costs prevent complete and instantaneous adjustment of expectations to the presence of new information.

represented by a move to point (P_2, Q_2) in Figure 4.1. Secondly, it may cause a shift in the planned supply curve if the stabilization program affects producer income risk. If producers are in general risk-averse then the existence of a risk-reducing stabilization program shifts the planned supply curve to the right. The resulting effect may be represented by a move to point (P_2, Q_3) in Figure 4.1. The expected market-clearing (world) price falls to P1. Domestic producers expect to receive area P_2abP_1 as a transfer payment from the government.

Apart from these two static effects there are also dynamic effects since the program payouts are determined according to moving average rules. These dynamic effects have been discussed at length in the previous simulation exercise. Basically, the moving average rules are expected to moderate the effect of market shocks on expectations.

In the following we first of all estimate the model to be simulated using econometric methods and the historical sample period, 1966 to 1986. Then we will use the model to explore how the WGSP modifies the effects of domestic production uncertainty and international demand uncertainty.

4.1 Model Specification

In this model we will assume that Canada is a large grain exporting nation and, therefore, faces a downward-sloping export demand curve. The simulation model is as follows.

$$HA_t = \alpha_0 + \alpha_1 E(P_t) + \alpha_2 E(APAY_t) + \alpha_3 CCNUM_t + \alpha_4 D1_t + \alpha_5 D2_t + e1_t \qquad (4.1)$$

$$QP_t = HA_t . YLD_t \qquad (4.2)$$

$$QDD_t = \beta_0 + \beta_1 P_t + \beta_2 INC_t + \beta_3 QDD_{t-1} + e2_t \qquad (4.3)$$

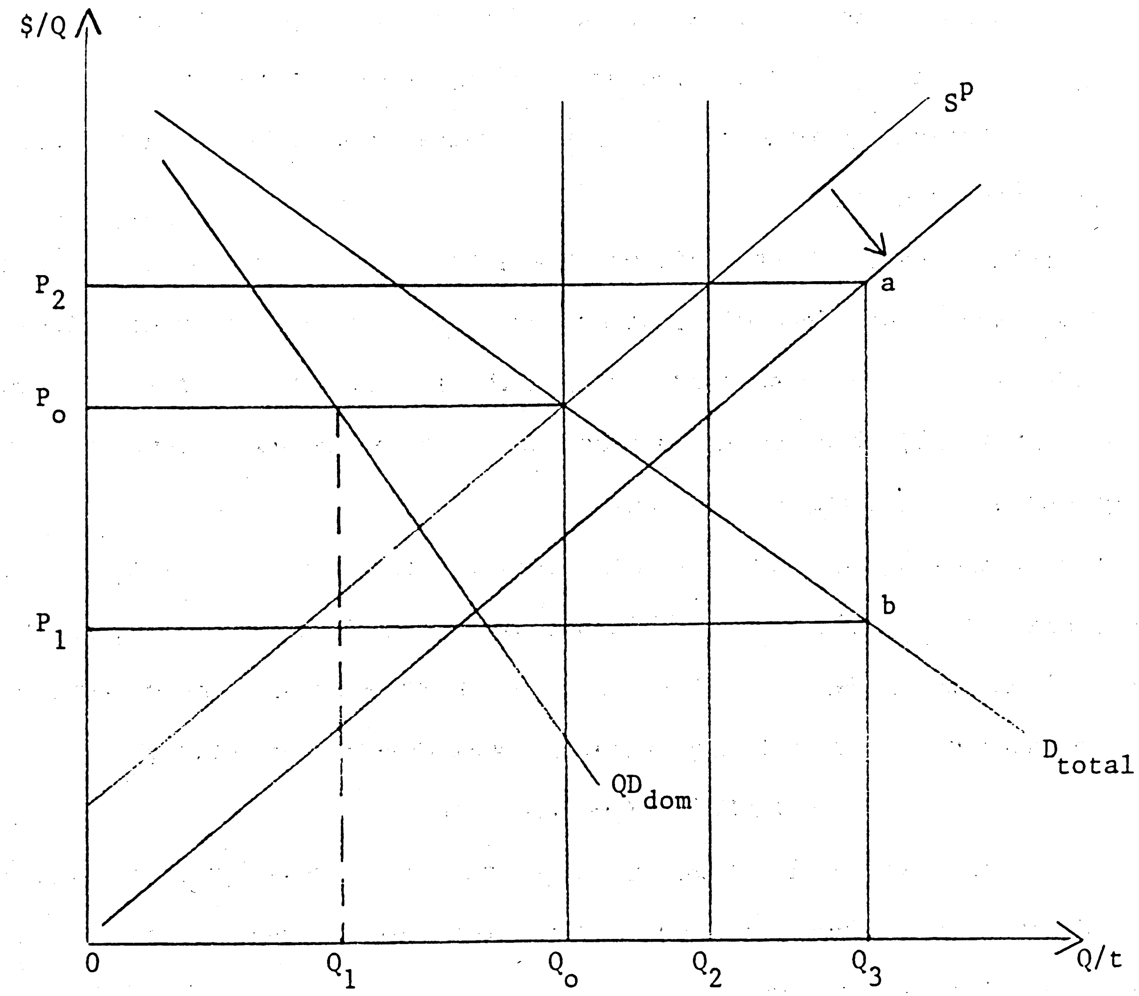
$$QDS_t = \gamma_0 + \gamma_1 [E(P_{t+1}) - P_t] + e3_t \qquad (4.4)$$

$$QDX_t = \delta_0 + \delta_1 P_t + e4_t \qquad (4.5)$$

$$QP_t + QPNP_t + QDS_{t-1} = QDD_t + QDS_t + QDX_t \qquad (4.6)$$

$$E(P_t) = \Phi_0 + \Phi_1 P_{t-1} + \dots + \Phi_k P_{t-k} \qquad (4.7)$$

FIGURE 4.1: Economic Effects of the Western Grain Stabilization Program



$$E(APAY_t) = Max\{ 0, E(PPAY_t)\} \quad (4.8)$$

$$E(PPAY_t) = E(WPR_t) [\sum_{i=1}^{5} NCF_{t-i} - E(NCF_t)] \quad (4.9)$$

$$E(NCF_t) = E(ER_t) E(APR_t) [E(GGP_t) - E(GGE_t) E(MPR_t)] \quad (4.10)$$

$$E(GGP_t) = E(GM_t) E(P_t) \quad (4.11)$$

$$E(GM_t) = \eta_0 + \eta_1 GM_{t-1} + \dots + \eta_k GM_{t-k} \quad (4.12)$$

$$E(GGE_t) = g_0 + g_1 GGE_{t-1} + \dots + g_k GGE_{t-k} \quad (4.13)$$

$$E(WPR_t) = WPR_{t-1} \quad (4.14)$$

$$E(ER_t) = ER_{t-1} \quad (4.15)$$

$$E(APR_t) = APR_{t-1} \quad (4.16)$$

$$E(MPR_t) = MPR_{t-1} \quad (4.17)$$

The variables in these equations have the following interpretations.

HA = area planted to the seven WGSA crops in the Canadian prairies. The seven crops are wheat, barley, oats, rye, flax, canola, and mustard (thousand hectares).

P = average per unit return from the seven crops. It equals the ratio of gross grain proceeds to grain marketings ($ per tonne).

APAY = aggregate (prairie-wide) payout from WGSP ($ thousand).

$E(X_k)_s$ = expectation in period s of variable X in period k.

CCNUM = cattle and calf numbers in Western Canada (thousands).

D1 = dummy variable for the LIFT program. It takes on a value of 1 in 1970 and 0 otherwise.

D2 = dummy variable for the WGSP program. It takes on a value of 1 for the years beginning 1976 when the WGSP was introduced and 0 otherwise.

QP = production of the seven grains (thousand tonnes).

YLD = yield of the seven grains (tonnes per hectare).

QDD = domestic use of the seven grains (thousand tonnes).

INC = personal disposable income in Canada ($ million).

QDS = year-ending inventory of the seven grains (thousand tonnes).

QDX = Canadian exports of the seven grains (thousand tonnes).

QPNP = non-prairie production of the seven grains (thousand tonnes).

PPAY = potential payout from WGSP ($ million).

WPR = weighted participation ratio

NCF = net cash flow ($ million)

ER = eligibility ratio

APR = actual producer ratio

GGP = gross grain proceeds ($ million)

GGE = gross grain expenses ($ million)

MPR = marketing-production ratio

GM = grain marketings (thousand tonnes).

Equation (4.1): Area Response (HA)

Equation (4.1) is the area response equation and is estimated using OLS regression. In this equation, it should be understood that all expectations are made in period t-1. The specification of this equation involves the following variables:

(a) $E(P_t)$ is expected price for which values over the historical period are calculated from the estimated autoregressive equation (4.7). The use of an autoregressive equation is consistent with rational expectations for either a model involving information costs or Muth's market model with inventories.[6]

(b) $E(APAY_t)$ is the expected aggregate payout. Values for this variable over the historical period are obtained by solving the equations (4.7) to (4.17) over the historical period using actual historical values for the exogenous variables and where the parameters in equations (4.7), (4.12) and (4.13) have been estimated using OLS regression. It could be argued that the specification of $E(APAY_t)$ is too simplistic, since there are some relationships which are ignored. For example, following Muth, it is possible to use the mathematical expectation of P_t from the model to represent producer expectations instead of using the autoregressive equation (4.7). In a similar vein it would be possible to use the mathematical expectation of QP_t to help derive producer expectations of GM_t and GGE_t instead of using the autoregressive equations (4.12) and (4.13). To the extent we do not do this, the specification of $E(APAY_t)$ is not fully rational.

The rationale for including E(APAY) in the area response equation is as follows. We assume that there is an autoregressive relationship in E(APAY). Thus,

$$E(APAY_{t+1}) = a_1 + a_2E(APAY_t). \qquad (4.18)$$

In words, this means that producers' expectation of next year's aggregate payout is related to their expectation of this year's aggregate payout. At the individual level, it is further assumed that the producer expects his individual payout next year to be proportional to the expected aggregate payout multiplied by his relevant levy contributions (i.e. for the most recent three years). Thus,

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[6]However, we do not impose the implied parameter restrictions implied by Muth's market model with inventories.

$$E(IPAY_{t+1}) = k\ E(APAY_{t+1})\ [E(PLEVY_t) + \sum_{i=1}^{2} PLEVY_{t-i}] \qquad (4.19)$$

where: k = constant of proportionality;

IPAY = the individual payout from the WGSP; and

PLEVY = the individual producer levy.

It is further assumed that the individual producer expects his levy to be proportional to his expected output $[E(IQ_t)]$. Thus,

$$E(PLEVY_t) = m\ E(IQ_t). \qquad (4.20)$$

Combining the results of equations (4.18) to (4.20), we have:

$$E(IPAY_{t+1}) = n*E(APAY_t)*E(IQ_t) + p.$$

where, n is the constant of proportionality and p includes constant terms and those variables which are not related to current profit and output. The individual's expected payout for next year enters into his expected profit function giving:

$$\begin{aligned} E(IPROFIT_t) &= E(P_t)\ E(IQ_t) + E(IPAY_{t+1}) - E(COST_t). \\ &= [E(P_t) + n\ E(APAY_t)]\ E(IQ_t) + p - E(COST_t). \end{aligned}$$

Deriving the individual and aggregate supply functions in the usual way, $E(P_t)$ and $E(APAY_t)$ appear as explanatory variables.

(c) CCNUM represents the substitution possibilities between livestock and grain production on the prairies. Thus, for example, during the mid 1970s when the relative profitability of cattle to grain production shifted in favour of grain, there was a substantial switch from cattle production into grain production.

(d) The variable D1 reflects the depressing effect on area planted to grains in 1970 as a result of the Federal Government's LIFT program.

(e) The variable D2 reflects the possibility that the WGSP will increase grain acreage by reducing risk to producers.

In summary, note that this equation allows for two separate effects of WGSP on area planted to grains. Firstly, it allows for a shift due to the expectation of a payout and, secondly, it allows for a shift due, perhaps, to the expected reduction in income risk.

The estimated area response equation is as follows:

REGRESSOR	COEFFICIENT	T-VALUE	ELASTICITY
Constant	24020	17.05	
E(P)	20.98	4.28	.13
E(APAY)	.001632	1.86	.03
CCNUM	-.9285	-5.50	-.39
D1	-4194.	-6.12	
D2	758.8	1.50	

$RBAR^2$ = .920, D.W. = 1.91, N = 20 (1967/8 to 1986/7).

All coefficients in this equation have signs that are reasonable. All coefficients except the one associated with D2 are significant at the 10 percent significance level. The variables related to the WGSP are E(APAY) and D2. The coefficient on E(APAY) suggests that an increase in the expectation of a payout of $100 million in a given year leads to an increase in grain area of 1.63 million hectares (about 8 percent). The coefficient on D2 suggests that the presence of the WGSP has led to a permanent increase in grain area of 759 thousand hectares (about 4 percent). This may be explained by the WGSP's ability to reduce income risk together with a presumed tendency of agricultural producers to be risk-averse. The coefficients on E(APAY) and D2 do not look unreasonable in magnitude. However, one should be careful not to overstate the result for D2. The variable used to pick up the risk-reducing effect of the WGSP is a dummy variable. It is not very significant and could be picking up the effect of other forces affecting planted area such as technological advance. It is suggested that further research is warranted in the specification of this effect. Phase II of this project should be useful in providing information that will improve the specification of this effect on planted area.

Equation (4.2): Production Identity (QP)

This imposes the requirement that production equals area multiplied by yield. In the first simulation, yield is subjected to random perturbations.

Equation (4.3): Domestic Demand (QDD)

The variables in this equation are fairly straightforward. With respect to the price variable, it is endogenous to the model. To avoid the effects of correlation with the error term on the parameter estimation, instrumental variables estimation was used. The instrument chosen for the price variable was obtained as the fitted values from the OLS regression of price on the predetermined and exogenous variables in the model.

The income variable reflects the notion that, for normal goods, as income rises in an economy so does the quantity consumed, ceteris paribus. The lagged QDD variable reflects the idea that users of grain only partially adjust consumption in a given time period to their desired level as a result of habit persistence or costs of adjustment.

The estimated equation is:

REGRESSOR	COEFFICIENT	T-VALUE	ELASTICITY
Constant	4270.	1.43	
P	-20.27	-3.15	-.15
INC	.0939	3.35	.09
QDD_{t-1}	.8209	4.23	

$RBAR^2 = .574$, $h = 0.26$, $N = 20$ (1967/8 to 1986/7)

Equation (4.4): Inventory Demand (QDS)

The variable in this equation is the difference between expected price next year and current price. It is expected that ending stocks of grain would be positively related to this variable. The lower is current price relative to the expected price next year, the greater the incentive to hold stocks in expectation of making a speculative gain. The expected price variable is the same as that used in the supply equation except carried forward one period. Since this price difference variable includes the current price which is endogenous to the model, instrumental variables estimation was again used here. The estimated equation is:

REGRESSOR	COEFFICIENT	T-VALUE	ELASTICITY
Constant	17970	20.28	
$E(P_{t+1}) - P$	623.3	6.08	4.06*

$RBAR^2 = .594$, DW = 1.39, N = 20 (1967/8 to 1986/7)

* This elasticity is with respect to price and not the price difference.

Equation (4.5): Export Demand (QDX)

We do not estimate this equation but rather assume two alternative values for the export demand elasticity, namely, -2.0 and -10.0. Under certain assumptions, one may think of this elasticity as a weighted average of the export demand elasticities for wheat and coarse graisn. Dividing grains into wheat and coarse grains, the export demand elasticity for prairie grains [ε(XD)] can be expressed as:

$$\varepsilon(XD) = a.\varepsilon(PW).\varepsilon(XDW) + (1-a).\varepsilon(PCG).\varepsilon(XDCG)$$

where,

a = ratio of prairie wheat exports to prairie grain exports

ε(PW) = elasticity of wheat price with respect to grain price

ε(XDW) = elasticity of export demand for prairie wheat

ε(PCG) = elasticity of coarse grain price with respect to grain price

ε(XDCG) = elasticity of export demand for prairie coarse grains.

Thus, for example, if ε(PW) = ε(PCG) = 1.0, the export demand elasticity for all prairie grains is a weighted average of the export demand elasticities for wheat and coarse grains where the weights are the relative export quantities. Continuing this example, if ε(XDCG) is −40 (i.e. highly elastic), ε(XDW) is −2 and a is 0.8 then ε(XD) is −10.

Given the assumed export demand elasticities, the curve is fitted through the mean historical price and export values. Export demand is subject to random perturbations in the second simulation.

Equation (4.6): Supply-Utilization Identity

This equation imposes the requirement that at equilibrium the quantity supplied to the market must equal the quantity demanded.

Equation (4.7): Autoregressive Price Expectations

In equation (4.7) we use a first-order autoregressive equation in price since the second order is not significant at the 5 percent significance level. The estimated autoregressive equation is:

REGRESSOR	COEFFICIENT	T-VALUE
Constant	24.12	1.45
P_{t-1}	.8191	6.57

$RBAR^2$ = .696, h = 1.98, N = 20

Equations (4.8) to (4.17): The Producer Expectation of Payout

This set of equations is used to generate the expected aggregate payout from the WGSP, E(APAY), which influences production. Equations (4.8) to (4.11) are identities associated with the stabilization rules. Equations (4.12) and (4.13) are autoregressive expectations equations for grain marketings (GM) and gross grain expenses (GGE). They were estimated as a first-order and second-order autoregressive equations respectively based on statistical significance of the regression coefficients. Thus:

$$E(GM_t) = 3975.1 + 0.8754\ GM_{t-1}$$

$$E(GGE_t) = 92.61 + 1.578\ GGE_{t-1} - 0.5982\ GGE_{t-2}$$

Equations (4.14) to (4.17) are also expectations equations. However, these involve expectations on variables with only a short history. Hence we assume static expectations.

4.2 Model Simulation Results

The preceding model is simulated over the historical period during which the WGSP program has been in operation (1976 to 1986). Two scenarios are considered, namely, the WGSP scenario (i.e., what actually occurred) and the no-WGSP scenario. For each scenario, two simulations are conducted. The first is designed to explore how the WGSP modifies the effects of domestic production variability on producer revenue, price and exports. The second is designed to explore how the WGSP modifies the effects of export demand variability on producer revenue, price and production.

4.2.1 Simulation 1 (Domestic Yield Variability)

For this simulation, equation (4.2) of the simulation model becomes:

$$QP_t = HA_t \cdot (AVEYLD + u_t) \qquad (4.2a)$$

where u is a random error term and AVEYLD is the mean yield over the sample period. It is assumed that domestic grain yield is a normally distributed random variable with mean and standard deviation estimated from sample yield data for the period 1966 to 1986. Unbiased estimates of the mean and standard deviation are 1.7668 and 0.1977 tonnes per hectare, respectively. The results of the simulation are summarized in Tables 4.1 and 4.2. The results for an export demand elasticity of -2.0 are provided in Table 4.1, while the results for an export demand elasticity of -10.0 are found in Table 4.2.

It is clear from these tables that the WGSP has a substantial effect in reducing the variability of producer revenue. In some years the effect of domestic yield variability on the standard deviation of producer revenue is cut by more than half as a result of the WGSP. On average, producer revenues are also higher under the WGSP as a result of the positive planned supply response generated by the program. The additional planned supply generated by the program has, on average, a positive effect on exports and a negative effect on price. The price effect is about $4/tonne if the export demand elasticity is -2.0 and less than $2/tonne if the export demand elasticity is -10.0. As a result of the program, exports are expected to increase on average by about one million tonnes. It is not clear that the WGSP acts as a filter on price and export variability. In some years, the variability in price and exports as a result of domestic yield variability is reduced by the WGSP, while in other years it is increased. In summary, the international effects of WGSP are that it will tend to have a slight depressing effect on world price, but to what extent depends on the assumption of the export demand elasticity. If Canada faces a fairly flat export demand curve, as indicated by an elasticity of -10.0, the effect is negligible. Some analysts have suggested that the WGSP may in fact help to reduce international instability by encouraging more stable supply in Canada. This was not borne

Table 4.1: Effects of Domestic Yield Variability (Export Demand Elasticity = -2.0)

Producer Revenue

YEAR	WGSP SCENARIO MEAN	WGSP SCENARIO STAND. DEVN.	NO-WGSP SCENARIO MEAN	NO-WGSP SCENARIO STAND.DEVN.
1976	3184	98.3	2829	233.9
1977	3300	91.6	2845	229.5
1978	3826	117.6	3497	273.5
1979	3939	260.8	3735	340.7
1980	5064	474.4	4880	528.7
1981	5261	354.5	5092	376.4
1982	5255	352.4	5036	420.5
1983	5465	249.2	5103	403.9
1984	5777	319.8	5330	452.9
1985	5404	162.0	4485	385.7
1986	4530	100.8	3524	205.3

Average Grain Price

YEAR	MEAN	STAND.DEVN.	MEAN	STAND. DEVN.
1976	123.13	7.780	127.88	7.899
1977	122.34	7.291	126.61	7.923
1978	138.90	7.703	143.28	7.895
1979	152.06	8.310	158.23	8.089
1980	198.05	8.376	202.60	8.566
1981	185.73	8.098	189.40	7.584
1982	184.86	8.927	188.98	8.057
1983	179.18	9.134	183.24	8.346
1984	184.84	10.376	191.88	8.728
1985	150.69	11.158	163.11	9.970
1986	114.14	8.642	123.07	9.340

Grain Exports

YEAR	MEAN	STAND. DEVN.	MEAN	STAND. DEVN.
1976	15611	2599	14025	2638
1977	16759	2435	15333	2647
1978	16858	2573	15395	2637
1979	25488	2776	23428	2702
1980	23632	2798	22112	2861
1981	24002	2704	22776	2533
1982	22934	2982	21558	2691
1983	28175	3051	26816	2788
1984	26030	3466	23677	2915
1985	25810	3727	21662	3330
1986	29316	2887	26335	3120

Table 4.2: Effects of Domestic Yield Variability (Export Demand Elasticity = -10.0)

Producer Revenue

YEAR	WGSP SCENARIO		NO-WGSP SCENARIO	
	MEAN	STAND. DEVN.	MEAN	STAND.DEVN.
1976	3106	165	2578	307
1977	3183	139	2567	277
1978	3647	207	3174	383
1979	4123	445	3776	472
1980	5049	628	4986	556
1981	5110	488	4825	578
1982	4945	394	4483	530
1983	5274	316	4901	601
1984	5861	495	5330	628
1985	5419	338	4572	465
1986	4445	212	3259	365

Average Grain Price

YEAR	MEAN	STAND.DEVN.	MEAN	STAND. DEVN.
1976	114.90	2.06	116.31	1.92
1977	114.26	1.81	115.28	1.72
1978	133.82	2.10	134.64	2.02
1979	157.99	2.08	159.52	2.07
1980	202.00	2.23	202.25	1.90
1981	179.78	2.25	180.62	2.26
1982	170.86	2.18	172.27	2.15
1983	174.24	2.05	174.74	2.43
1984	192.44	2.25	193.96	2.28
1985	155.79	2.78	157.79	2.11
1986	111.21	2.97	113.20	2.42

Grain Exports

YEAR	MEAN	STAND. DEVN.	MEAN	STAND. DEVN.
1976	14719	3439	12366	3213
1977	16222	3028	14524	2871
1978	15450	3510	14079	3372
1979	26634	3479	24076	3449
1980	22515	3717	22099	3177
1981	22499	3764	21092	3771
1982	21484	3640	19127	3598
1983	27936	3431	27098	4064
1984	26348	3753	23816	3808
1985	25049	4640	21716	3527
1986	28426	4965	25108	4048

out when the source of theinstability was domestic yield instability.

4.2.2 Simulation 2 (International Instability)

For this simulation, the error term in equation (4.5) is assumed to be normally and independently distributed with a mean of zero and a standard deviation estimated from the data for the period 1966 to 1986. When we assume an export demand elasticity of -2.0, the estimate of standard deviation is 21,657; when the elasticity is assumed to be -10.0, the estimate of standard deviation is 92,512. The results of the simulation are presented in Tables 4.3 and 4.4.

As in the case of domestic yield variability, the effect of the WGSP is to increase the level and reduce the variability in producer revenue. The WGSP also leads to an increase in the average level of production and a reduction in the variability of prairie grain production in response to international variability. Hence, the WGSP does filter out the effects of international instability in demand on domestic production and revenue. The effect on price is generally to lower the level. The variability in price is lowered in some years, but raised in others in response to the WGSP.

Government Payouts

Over the historical period 1976 to 1986, we have simulated the extent of government payouts for both simulations and provide a summary of these in Table 4.5. Payouts under the program occur in all years, although for the case of domestic yield variability they are almost insignificant in 1980. For the case of domestic yield variability, a levy was imposed in more than 50 percent of the replicates for each of the years 1979 through 1981, whereas in all of the simulations for the case of international demand variability, there was a government payout in the majority of replicates. With international demand variability, the average size of government payouts was substantially greater than for the case of domestic yield variability. Overall, however, the WGSP constituted an income transfer from taxpayers to agricultural producers that cannot be considered insignificant.

4.3 Conclusions

The simulation exercise carried out in this section examined how the WGSP influences producer revenue, price, production and exports. In accordance with what we have said earlier, the exercise incorporates: (a) the use of forward-looking expectations; (b) the use of a commodity-specific model with the specific stabilization rules applicable to that commodity; and (c) the use of dynamic stochastic simulation.

The analysis suggests that the WGSP generally increases the level of production, exports and producer revenues while it generally decreases the level of prices. It also generally decreases the variability in production and producer revenues while its effect on the variability of price and exports is uncertain. Thus, the domestic producer effects of the program (as measured by the level and variability of production and producer revenues) appear to be positive, while the international effects (as measured by the levels of the price distortion effect and the trade volume effect) are negative.

These results should be treated with caution. They are preliminary and suggestive, but not definitive. In particular it is recommended that more research attention be given to the specification and estimation of the area response equation which is central to the analysis. Our estimate of the effect on area planted of simply having the WGSP (i.e. the coefficient on variable D2) is crude. The work being done in phase II of this study is relevant to the process of obtaining a better estimate of this effect.

Table 4.3: Effects of International Variability (Export Demand Elasticity = -2.0)

Producer Revenue

YEAR	WGSP SCENARIO		NO-WGSP SCENARIO	
	MEAN	STAND. DEVN.	MEAN	STAND. DEVN.
1976	3531	923	3448	1242
1977	3615	753	3195	1110
1978	4135	947	3713	1166
1979	3447	606	2877	1002
1980	3737	670	3389	1133
1981	3901	878	3704	1277
1982	4018	1044	3642	1434
1983	3803	979	3287	1279
1984	3891	759	3203	1149
1985	4244	1012	3667	1419
1986	3880	997	3208	1229

Average Grain Price

YEAR	MEAN	STAND. DEVN.	MEAN	STAND. DEVN.
1976	113.02	43.12	127.42	45.88
1977	119.15	41.11	126.05	42.45
1978	133.12	46.00	140.06	43.03
1979	131.19	44.99	138.84	45.87
1980	131.82	41.31	145.33	47.45
1981	107.04	43.74	126.66	42.46
1982	102.89	44.86	117.45	45.49
1983	105.56	48.27	117.99	45.60
1984	139.25	45.20	140.08	49.96
1985	134.19	46.16	136.61	51.63
1986	107.78	42.49	105.39	40.19

Prairie Grain Production

YEAR	MEAN	STAND. DEVN.	MEAN	STAND. DEVN.
1977	36492	567	34173	1551
1978	37607	627	35584	1400
1979	30598	722	28836	1158
1980	33530	884	31916	1372
1981	40303	985	38704	1640
1982	43977	970	40749	1560
1983	39364	857	37086	1452
1984	33628	830	31446	1233
1985	38421	987	35933	1511
1986	42292	1057	40135	1674

Table 4.4: Effects of International Variability (Export Demand Elasticity = -10.0)

Producer Revenue

YEAR	WGSP SCENARIO		NO-WGSP SCENARIO	
	MEAN	STAND. DEVN.	MEAN	STAND.DEVN.
1976	3822	1161	3324	1253
1977	3702	900	2940	1475
1978	4145	978	3128	1374
1979	3484	683	2274	940
1980	3763	886	2874	1170
1981	4338	1101	3501	1351
1982	4496	1243	3727	1473
1983	4243	1060	3572	1385
1984	3887	839	2874	1296
1985	4319	1218	3120	1301
1986	4164	1092	3660	1550

Average Grain Price

YEAR	MEAN	STAND.DEVN.	MEAN	STAND. DEVN.
1976	123.99	50.77	122.84	46.29
1977	120.24	46.35	116.78	57.67
1978	130.52	47.52	118.27	49.77
1979	130.05	49.19	112.90	45.79
1980	131.73	52.65	126.99	50.48
1981	121.92	47.33	122.01	46.39
1982	119.31	50.21	121.09	48.06
1983	122.38	50.31	128.11	49.38
1984	126.76	55.56	123.94	55.10
1985	130.45	56.97	118.59	49.78
1986	115.12	44.99	122.05	51.37

Prairie Grain Production

YEAR	MEAN	STAND. DEVN.	MEAN	STAND. DEVN.
1977	36684	827	34018	1565
1978	37748	818	35278	1902
1979	30671	743	28250	1340
1980	33526	955	31140	1370
1981	40368	1249	38070	1745
1982	44164	1169	40578	1704
1983	39746	995	37203	1534
1984	34024	794	31719	1335
1985	38734	966	35444	1667
1986	42599	1209	39551	1614

Table 4.5: Profile of Payouts Under WGSP over 100 Replicates

(a) Domestic Yield Variability (Simulation 1)

	Export demand elasticity of:			
	-2.0		-10.0	
Year	Average Payout ($mil)	No. of Replicates Generating Payout	Average Payout ($mil)	No. of Replicates Generating Payout
1976	220	100	315	97
1977	381	99	469	100
1978	228	96	320	93
1979	9	11	20	16
1980	2	4	7	5
1981	32	24	75	38
1982	55	27	139	54
1983	208	79	248	75
1984	157	57	97	38
1985	576	100	463	91
1986	944	100	908	100
Mean	256		278	

(b) International Demand Variability (Simulation 2)

	Export demand elasticity of:			
	-2.0		-10.0	
Year	Average Payout ($mil)	No. of Replicates Generating Payout	Average Payout ($mil)	No. of Replicates Generating Payout
1976	252	52	308	50
1977	415	67	355	55
1978	416	62	607	69
1979	605	76	724	83
1980	477	68	513	70
1981	561	75	491	65
1982	572	62	502	53
1983	626	78	463	65
1984	554	76	652	78
1985	406	55	451	65
1986	493	57	433	47
Mean	489		500	

5. CONCLUSIONS

In this study, we reviewed the economics literature on commodity stabilization. The early literature by Waugh, Oi and Massell which forms the basis for much of the policy thinking today suffers from some critical defects. They are: (a) this literature assumes that producers respond immediately to a price change and hence abstract from the question of producer expectation formation; (b) the models are highly-stylized in that they assume linear demand and supply curves, a discrete bimodal distribution of errors in supply or demand, and a very simplistic stabilization rule; and (c) producers were assumed to be risk-neutral.

In connection with these statements, we have attempted to demonstrate the following results.

(a) There is production and price uncertainty at the time the producer must make his production decisions. Hence producer expectations are important and we argue for the use of forward-looking or rational expectations.

(b) The results for stabilization can be dependent on the shapes of the demand and supply curves and the particular stabilization rules that are applied. Hence we should evaluate stabilization schemes on a case-by-case basis using models with a high degree of "realism" rather than relying on the results of highly-stylized models.

(c) Producers are not risk-neutral and hence our models should allow for risk-averse behaviour on the part of producers. Indeed, if producers were risk-neutral why would there be a need for stabilization.

These results were generated using two alternative modelling approaches. Both approaches recognized the need to assume forward-looking expectations and more realistic models. However, the fact that we examined two different approaches is a recognition that there is a trade-off between the specification of producer expectations and model complexity. Muthian rational expectations are a function of the assumed model structure. Thus, the more complex the model, the more complex it is to specify Muthian rational expectations. The first approach thus concentrates on the effects of rational expectations while the second approach concentrates on achieving greater "realism" (and hence complexity) in the model. We allowed for risk-averse behaviour in the second simulation exercise, albeit in a very simplistic way. It is clear that risk aversion is an important determinant of how producers respond to stabilization programs and requires more careful analysis at the micro (farm) level. This is because producers are not homogeneous in their risk attitudes.[7] This micro-level analysis of the influence of risk attitudes on supply is the subject of phase II of this study.

The main directions for further research are as follows.

(1) Integrate the two approaches we have suggested in this study. Thus, it would be useful to investigate the implications of fully rational expectations in a commodity model which contains a high degree of realism. Given that we already have a "realistic" model of the effects of WGSP, an attempt could be made to impose full rationality on this model.

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[7] Data collected by the Saskatchewan TOP Management program indicate that young farmers who are in debt are risk takers and that they become less risk preferring as commodity prices increase. On the other hand, older farmers who are in debt tend to be risk averse, but they become less risk averse as prices increase. There is also a group of farmers, who are well off from an equity standpoint and may account for a large proportion of total production, that are risk neutral and remain so even when prices rise.

(2) Develop "realistic" models for the livestock commodities. Such models would be dynamic stochastic simulation models with forward-looking expectations so that the effects of livestock stabilization programs can be assessed.

(3) Use these models to examine the effects of alternative stabilization programs which might be preferable to what we currently have (such as a combined buffer fund/buffer stock program for grains).

(4) Use these models to compare the Canadian commodity stabilization/support programs with those of other major agricultural trading nations. Such a study should be able to reveal the comparative levels of distortion created by the various alternative support measures.

(5) Use these models to examine the cross-commodity impacts of commodity stabilization.

There are two aspects to the assessment of cross-commodity impacts. Firstly, as Buttel and Gertler have argued, commodity stabilization programs tend to discourage diversification of the farm enterprise, and tend to encourage farmers to produce the stabilized commodity over non-stabilized commodities. This encourages a misallocation of resources and hence result in an inefficient farming sector.

Secondly, if the objective of a commodity stabilization program is to stabilize farm income, then stabilizing income from one enterprise (e.g. grains) may actually destabilize farm income if the producer has a related but unstabilized enterprise (e.g. livestock). For example, if grain prices are low, the producer receives a stabilization payment. However, as a livestock producer, the lower grain prices mean lower input costs. Therefore, his net revenue from livestock increases (<u>ceteris paribus</u>) at the same time that his net revenue on the grain side experiences a decline in net revenue. If these two should balance, the producer experiences no change in his net revenue from all operations. Hence the grain stabilization payment is actually destabilizing total farm income. It appears that a decoupled income insurance program along the lines suggested by Finkle and Furtan may be one answer to this problem.

APPENDIX A: REVIEW OF COMMODITY STABILIZATION IN CANADA

Commodity stabilization programs are established with the general objectives of stabilizing and enhancing producer prices or incomes. In order to carry out these objectives, it may be necessary to control price or the quantity produced. Quantity stabilization is carried out through supply control, that is, output is regulated so as to achieve a desired market price. Price stabilization usually requires the setting of a price floor, thereby removing price troughs. As a means of stabilization and income transfer in Canada, price/income support programs are more common than supply management. Such programs buffer the producer against a fall in price or in revenue by providing commodity-specific price or income support. The stabilization programs are financed by government and (often) by producer contributions through regular premiums.

Stabilization programs may be categorized according to the type of program or according to the level of the sponsoring government. Since many of the agricultural commodities are traded between provinces, the enabling legislation is generally federal with the provincial legislation determining the specific ways in which programs are carried out.

At the present time, there are eight federal government agricultural programs which may be considered stabilization schemes because they reduce the degree of production or marketing risk. These are:

1. Agricultural Products Act
2. Agricultural Stabilization Act
3. Western Grain Stabilization Act
4. Crop Insurance Act
5. Waterfowl Crop Damage Compensation Program

6. Ad Hoc Assistance Programs

7. National Farm Products Marketing Act

8. Canadian Wheat Board Act

The crop insurance programs and the Waterfowl Crop Damage Compensation Program are carried out in partnership with the provinces. The National Farm Products Act allows for price stabilization through supply management objectives and the Canadian Wheat Board Act allows for the stabilization of prices through price pooling.

A.1 The Agricultural Products Act

The Agricultural Products Act is designed to stabilize the price of agricultural commodities through the purchase and sale of surplus products when prices are depressed. The following products are eligible for coverage under the Act: livestock and livestock products; poultry and poultry products; milk and milk products; fruit and fruit products; honey; maple syrup; tobacco; fibre and fodder crops; and any other product of agriculture designated by the Governor in Council. The mandate of the Act is carried out by a three-member board which has the authority to buy, sell or import agricultural products or make arrangements to do the same in any country, and, as such, is mandated to transport, store and process such products and to purchase products on the behalf of any government agency. In carrying out these duties, the board may, at the direction of the Governor in Council, sell commodities below the purchase price.

The Agricultural Products Board (APB) is used at times when a federal agency would like to purchase a commodity in order to further government agricultural policy. For example, as a result of surplus feed grain production on the prairies in the late 1960s, western livestock producers were able to purchase feed grains direct from producers at prices less than those paid by eastern livestock growers. The eastern interests were unhappy with this situation and pressed the federal government for a change in policy. In 1973, therefore, the federal government implemented an "interim feed grain policy". At this time, the APB was authorized to buy feed grains directly from grain producers at a price midway between the Canadian Wheat Board initial price and projected final payment. However, this 'off-Board' price did not relate western feed grain prices to U.S. corn prices and, as a result, western grains were overpriced and imports of U.S. corn to the eastern market increased.

The APB is also used in cases where prices of specific crops are depressed as a result of over production. For example, grapes, peaches, pears, raspberries and processed fruit have, at various times, been included under the provisions of the Act. This generally occurs when price falls below the cost of production and the industry appeals to the government for help. The APB then buys the product at a negotiated price which is usually below the average price in recent years. Through purchase agreements, the APB takes control of the product and assumes storage and other marketing costs. Any profits or losses subsequently accrue to the Government of Canada.

A.2 Agricultural Stabilization Act

The Agricultural Stabilization Act (ASA) is designed to provide price stabilization and to allow for the maintenance of a fair relationship between prices received and the costs of goods and services, and to assist the industry in realizing fair returns on its labour and investment. Cattle, hogs, lambs, wool, industrial milk and cream, corn, soybeans, and other grains (oats, spring wheat, winter wheat and barley) not produced in the designated area defined in the Canadian Wheat Board Act are eligible under ASA. Mandatory programs based on the prescribed price are required for these commodities. Potatoes and apples are also commodities which have wide regional markets and are thus designated eligible under ASA. At the discretion of the Governor in Council, other commodities can be added to the foregoing list.

The prescribed price or stabilization support level is set at not less than 90 percent of the five-year average market price adjusted by the five-year average production costs. When the current market price falls below the prescribed or stabilization price, the difference is paid as a stabilization payment. The Governor in Council determines how the cost of production is calculated, although the methodology has remained essentially the same over time. The Governor in Council also makes the decision as to whether the support should be at a level higher than the 90 percent minimum. In effect, the ASA protects producers from short-term fluctuations through deficiency payments.

The livestock stabilization programs initiated under the 1958 Act came under fire from producer groups in the early 1970s. There were widespread complaints that the support offered by ASA was unsatisfactory in light of rapidly escalating feed grain prices. In most provinces this led to a proliferation of provincial programs to 'top load' or supplement ASA programs.

A.2.1 Provincial Livestock Stabilization Programs

The main differences between the federal ASA programs for livestock and the provincial programs are in the determination of the support level and in the requirement for producer contributions. The support levels for the ASA programs are related to movements in market prices while those for the provincial programs typically are based on cost of production. The federal programs do not require producer contributions while the provincial programs include contributions both from the province and the producer participants. In most cases, the producer contributions are a percentage of the value of marketings. In a few cases (e.g., the maritime hog stabilization programs), producer contributions are made only when market price exceeds the support price by some amount.

As an example of the federal and provincial price support mechanisms, consider the hog stabilization programs. Until 1986, the federal program was prescribed under the 1958 ASA as amended in 1975. An ASA Board stabilized prices at a 'prescribed price' equal to 90 percent of the average market price for the preceding five years, plus current cash costs minus average cash costs for the preceding five years. Most provinces also operated their own hog stabilization programs which were designed to supplement the support offered by this federal stabilization program. These involved a support price based on costs of production and, in some cases, past market prices. In British Columbia, for example, the support price was set equal to 100 percent of the total costs of production. In Ontario, on the other hand, the support price was set at 95 percent of the previous five-year average price adjusted by changes in cash costs. All of the provincial programs were voluntary and funded partly by the producer participants and partly by the provincial government. Most provincial programs called for equal contributions by the participants and government. This was true in British Columbia, Saskatchewan and the Atlantic provinces, but in Ontario and Quebec the provincial government contributed two-thirds to the participants' one-third. In Manitoba, the participants contributed roughly two-thirds to the government's one-third. Since all of these programs involved government contributions, these programs were not only stabilization programs, but also income transfer programs in the long run. The programs may present a problem because if, as a result of the program, the market price is not revealed to the producer, the signaling effect is lost and this may lead to an artificial increase in production. Beginning in 1986, in response to federal and provincial dissatisfaction with the existing programs, the federal government introduced the Tripartite red meat stabilization programs.

A.2.2 Tripartite Red Meat Stabilization Programs

As a result of the proliferation of provincial stabilization programs and the escalating support provided under these programs, the federal and provincial governments have developed Tripartite stabilization programs under ASA. Since these Tripartite programs replace existing ASA programs for livestock, only provinces which have enrolled in the program are eligible for federal benefits under ASA. The first Tripartite programs for sheep, cattle and hogs were implemented in 1986. Funding in a particular province involves equal contributions from the producers, the provincial government and the federal government as a percentage of the volume of marketings. The federal government and participating provinces utilize enabling legislation to operate the program. The administration includes federal and provincial institutions. There are five separate Tripartite and red meat stabilization programs one each for the cow calf, backgrounder, slaughter cattle, hog and lamb sectors. While each program is unique, for the most part, stabilization is based on a guaranteed margin concept. The support price for a particular period is the cash costs for that period plus a percentage of the average margin for some preceding period. The margin for a period is calculated as the price minus cash costs for the product produced in that period. The actual percentage of the average margin that is used varies depending on the program. All calculations are made on the basis of national prices and costs. Currently, only Alberta, Saskatchewan, Manitoba and Ontario are enrolled in the hog program. Under this program, the support price is set quarterly and is equal to the current cash costs of production plus 95 percent of the average margin during the same quarter of the preceding five years. When the average market price falls below the support price the difference is paid out to participants. The hog stabilization fund is supported by equal one-third contributions by the federal government, the provincial government and the producer participants, and are set on the basis of a percentage of the volume of marketings.

Alberta, Saskatchewan, Ontario and Prince Edward Island are enrolled in the national Tripartite scheme for lambs, while only Alberta, Ontario and Prince Edward Island are enrolled in stabilization programs for cow-calf and slaughter beef. This is the result of problems with the administrative details of the programs rather than the intent of the programs.

A.3 Western Grain Stabilization Act

The Western Grain Stabilization Act (WGSA) program is also a support program. The intent of the program is to stabilize net income or, alternatively, the gross margin to the grain sector. The program is based on a cash flow concept with payouts occurring whenever a producer's net cash flow falls below the preceding five year average (Spriggs). Net cash flow is measured on both an aggregate basis and a per tonne basis. The program is voluntary for all producers in the Canadian Wheat Board (CWB) designated region of the seven eligible grains and oilseeds. The program is funded by levies based on producer receipts, with the federal government paying a levy (i.e., levy rate times grain revenue) equal to the producer levy rate plus 2 percent. In the long run, the intention is that producers will contribute one-third of the program levy, with two-thirds contributed by the federal government.

The WGSA program attempts to stabilize prairie-wide net cash flow from grain marketings and, at the same time, provide income support to participant producers through the federal government's levy contributions. That is, the program is also designed to stabilize aggregate income for the industry rather than the incomes of individual producers. Hence, it does not really offer income stabilization insurance to the individual producer. Typically, income is associated with individuals, and there have been requests (by Alberta Agriculture and Saskatchewan Agriculture in 1985) to implement changes which would make the program sensitive to regional or individual needs. However, WGSA includes only income from the seven major grains, while the majority of producers also receive income from other grains or livestock.

There is a lack of empirical evidence to support the argument that WGSA has provided stabilization and, therefore, a more efficient allocation of resources, particularly as income accrues ex post (Fulton). However, it is possible that the program has increased the costs of production by increasing capital asset and input prices due to the capitalization of program benefits.

A.4 Crop Insurance Act

The Crop Inusurance Act offers financial protection against crop loss caused by uncontrollable natural hazards--weather, fire, insect pests and plant diseases. Crop insurance is available on spring wheat, durum wheat, barley, oats, flax, canola, fall rye, sunflowers, tame mustard, field peas, spring rye, canary seed and lentils. Coverage can be selected at either 60 or 70 percent of the most recent yield history for the individual crops in the area, with higher coverage allowable on summerfallow than on stubble crops. Since the crops which can be insured are limited, the risk of introducing new crops is increased more than would be the case were there no insurance.

The insurance program is financed jointly by the federal and provincial governments and the producers, with federal-provincial, cost-share agreements determining the level of federal contributions. In Newfoundland and Quebec, the federal and provincial governments each pay 25 percent of the premiums and share the administrative costs. In all other provinces, the federal government pays 50 percent of premiums and the province pays the administrative costs. Producers pay no more than 50 percent of the total premiums under any of the cost sharing agreements.

The rules for eligibility also differ between provinces. For example, in Manitoba the rates for summerfallow crops and stubble cops are the same.

This has a less distorting effect on agronomic decisions than in Saskatchewan where the rates are not the same. One would expect that, where there is more intensive cultivation, the operation would be more vulnerable to weather and pests and, therefore, it would be more beneficial to insure the crop. In Saskatchewan, the areas which have the highest levels of participation are in the south and west where summerfallowing is a more general agronomic practice. In general, participation rates are higher where there is greater risk to cash flow through crop failure, as on mid- to large size-farms where the primary income is derived from farm income and from producers who specialize in one crop. Program participation rates for the major provinces are provided in Table A.1.

Table A.1 Participation Rates in Crop Insurance

Saskatchewan	75%	Quebec	48%
Manitoba	75%	Ontario	40%
Alberta	60%	British Columbia	26%

Source: d'Ailly

A.5 Waterfowl Crop Damage Compensation Program

The Waterfowl Crop Damage Compensation Program is designed to compensate producers for crop damage caused by migratory waterfowl covered by the International Migratory Bird Convention. Compensation is paid on a 50-50 cost share basis between the federal and provincial governments. This program is considered to be income stabilizing and is restricted to grain producers in Alberta, Saskatchewan and Manitoba.

A.6 Ad Hoc Assistance Programs

Ad hoc programs are administered by Order-in-Council under Section 5 of the Agriculture Act in order to maintain the production base when an agricultural sector has suffered losses due, for example, to drought. Decisions are made on an ad hoc basis and there is no specific source of funding. The programs are usually implemented under a cost-share agreement with the provinces and it is the provinces that often administer the program. The recent Special Canadian Grains Program falls in this category and has provided compensation to prairie grain producers for depressed world grain prices.

A.7 Supply-Restricting Marketing Boards

In response to pressure for a national scheme to restrict the supply of milk and improve the price to producers, the Canadian Dairy Commission (CDC) was established in 1966 by an Act of Parliament. The purpose of the Commission was to coordinate the production and marketing of milk across Canada. The CDC introduced the concept of production quotas. As a result of the experience with supply restrictions on milk and continued interprovincial warfare between the other provincial marketing boards (particularly in eggs), the National Farm Products Marketing Agencies Act was passed in 1972. Commodities which are included in the Canadian Dairy Commission Act and the Wheat Board Act are not covered under this act. National marketing boards were established in eggs, turkeys and broilers in 1972, 1973 and 1978, respectively.

The essential feature of these marketing boards is their ability to stabilize and support the product price through supply control. Supply-restricting marketing boards may stabilize the producer price and/or income received from a commodity by controlling the supply of the commodity which reaches the market. With stable demand, a constant supply will imply a constant price and, consequently, a constant income. With variable demand, supply may be controlled to achieve either stable price or stable income. Clearly, the more dominant reason for supply control is to generate a transfer of income from consumers to agricultural producers (or more correctly, the owners of the rights to production).

In order that marketing boards may control the supply of the commodity under their jurisdiction, quota is assigned. In general, quota is apportioned on the basis of the size of the facilities at the time the marketing board was introduced. In the case of eggs, quota is dependent upon the historic marketings of the product. Increases in quota are allocated differently. It may be offered uniformly across existing producers or allocated on a percentage basis between existing producers and new applicants.

Attitudes towards quota have changed with the evolution of marketing boards. Today quota is universally considered to be the property of the marketing board and is, theoretically, without commercial value. If the quota does have a commercial value, this value must be captured in the output price. There have been attempts to reduce or eliminate the speculative value of quota trading by the use of quota transfer regulations in all provinces and for all commodities, but these have generally been a failure.

Although each provincial marketing agency has its own particular set of regulations governing the transfer of quota, the regulations fall into two broad categories. On the one hand, there are those regulations that allow for the free transfer of quota without a tie to any part of the production process. This is done by private trade or public auction. On the other hand, there are those transfers that can only occur if the purchaser also buys property. Property may be either the physical production facilities or the actual assets of production (e.g., milk cows). Howsoever the transfer takes place, it must be approved by the marketing board. The method of transfer used in the three prairie provinces is that of tying the quota to production facilities whereas, and in general, in the other provinces quota is freely traded. Table A.2 provides a more detailed summary of quota management and transfer regulation by commodity boards.

Transfer regulations have implications for the freedom of exit from and entry to the industry. For example, if quota is tied to physical facilities, the purchaser may lose in two ways: (i) the purchaser may pay a higher price for production facilities as the value of the quota has become capitalized in facilities; or (ii) if the relevant marketing board rejects the transfer, the buyer now owns specialized facilities, but without production rights. Exit from the industry may be impaired if the production barn is located on the home quarter and a producer wishes to remain in grain farming but leave a supply managed operation.

A.8 The Canadian Wheat Board Act

The Canadian Wheat Board is a compulsory export marketing agency for wheat, oats and barley grown in Manitoba, Saskatchewan, Alberta and the Peace River region of British Columbia. A five member Board oversees the buying and selling of the grain and reports to Parliament through the Minister of State for the Wheat Board.

TABLE A.2: SUMMARY OF QUOTA MANAGEMENT AND TRANSFER REGULATION BY COMMODITY BOARDS

	B.C.	ALTA.	SASK.	MAN.	ONT.	QUE.
BROILERS						
Entry	Buy Farm Buy Quota	Buy Farm Allocation by Board	Buy Farm Buy Bldgs.	Buy Farm Buy Bldgs.	Buy Farm	Buy Farm Rent Bldg.
Expansion	Buy Farm Buy Quota Rent Quota	Buy Farm Brd. Alloc	Buy Bldgs. Buy Farm	Buy Farm Buy Bldgs.	Buy Farm Brd. Alloc.	Buy Farm Buy Quota Rent Bldg.
Quota Max.	102,875 kg.	3% a)	40,000	30,000	80,000Units	13,935 sq.M
Contraction	Farm Sale Cancel Sell Quota	Farm Sale Cancel	Farm Sale Cancel Sell Bldgs.	Farm Sale Cancel Sell Bldgs.	Farm Sale Revert to Board	Rent Quota Sell Quota
Termination	Farm Sale Cancel	Farm Sale Cancel	Farm Sale Cancel Sell Bldgs.	Farm Sale Cancel Sell Bldgs.	Farm Sale Revert to Board	Rent Quota Sell Quota
Family Transfers	Yes	Yes	Yes	Yes	Yes	Yes
TURKEYS						
Entry	Buy Farm Buy Quota	Buy Farm Brd. Alloc.	Buy Farm	Buy Farm Buy Bldg.	Buy Farm Buy Quota	Buy Farm Buy Quota
Expansion	Buy Farm Buy Quota	Buy Farm Brd. Alloc.	Buy Farm	Buy Farm Buy Bldg.	Buy Farm Buy Quota Rent Bldg.	Buy Farm Buy Quota Rent Bldg.
Quota Max.	4% a)	4% a)	11,363 kg.	363,636 kg.	909,090 kg.	13,935 sq.M
Contraction	Farm Sale Cancel Sell Quota	Farm Sale Cancel	Farm Sale Cancel	Farm Sale Cancel Sell Bldg.	Farm Sale Cancel Sell Quota	Rent Quota Sell Quota Sell Farm
Termination	----------As for Contraction----------					
Family Transfer	Yes	Yes	Yes	Yes	Yes	Yes

...Continued

Table A.2 Continued

	B.C.	ALTA.	SASK.	MAN.	ONT.	QUE.
EGGS						
Entry	Buy Farm Buy Quota	Buy Farm	Buy Farm	Buy Farm	Buy Farm Buy Quota	Buy Farm Buy Quota Rent Quota
Expansion	Buy Farm Buy Quota	Buy Farm	Buy Farm	Buy Farm Buy Bldg.	Buy Farm Buy Quota	Buy Quota Rent Quota
Quota Max.	20,000	1.5% a)	30,000	20,000	30,000	50,000
Contraction	Farm Sale Sell Quota	Farm Sale Revert to Board	Farm Sale Revert to Board	Farm Sale Revert to Board	Farm Sale Revert to Board	Sell Quota Rent Quota
Termination	Farm Sale Sell Quota	Farm Sale Revert to Board	Farm Sale Revert to Board	Farm Sale Revert to Board	Rent Quota Revert to Board Farm Sale	Sell Quota Rent Quota Farm Sale
Family Transfer	Yes	Yes	Yes	Yes	Yes	Yes
FLUID MILK						
Entry	Buy Quota Buy Farm	Buy Quota Buy Farm	Buy Farm	Buy Farm D.E. b)	Buy Farm Buy Quota	Buy Farm Buy Quota
Expansion	Buy Quota	Buy Quota	Buy Farm	D.E. Buy Cows Buy Farm	Buy Quota Buy Farm	Buy Quota Buy Farm
Quota Max.	—	—	—	—	—	—
Contraction	Sell Quota Revert to Board Sell Farm	Sell Quota Revert to Board Sell Farm	Sell Quota Revert to Board Sell Farm	D.E. Cancel Sell Cows Sell Farm	Sell Quota Sell Farm	Sell Quota Sell Farm Revert to Board
Termination	----------As for Contraction----------					
Family Transfer	Yes	Yes	Yes	Yes	Yes	Yes

a) % of total provincial quota; b) Daily Entitlement

Note: Hatching Eggs is not presented here since the Board exists only in Alberta. Refer to Hatching Egg Section of report.

Source: Dawson, Dau and Associates.

Grain prices are set in March for the new crop year and this initial price acts as a market signal influencing planting decisions. Producers sell their grain to the Board, at which time the producer receives the initial payment. At the end of the crop year, pooled prices are determined from the average of CWB sales. If pooled prices are above the initial price, a final payment is paid to producers; however, if the average selling price throughout he crop year is below the initial price, the federal government covers the deficit. Pooling wheat through the Canadian Wheat Board shelters the producers from seasonal fluctuations in price, but such pooling does not stabilize yearly fluctuations due to local weather or world market conditions. Fianlly, producers pay all CWB marketing costs.

A.9 Summary

Commodity price stabilization programs provide for a more stable economic climate of agricultural production. When the applicability and general limits of protection can be known in advance, the amount of risk faced by producers in the production and marketing of the commodity is reduced. Many of the programs are provided on a cost-share basis, primarily between the federal and provincial governments, but also with producers. However, while the degree of producer cost sharing varies from one province to another, and from one commodity to another, government payments or transfers are a common component of many of the programs. That is, many of the stabilization programs are not actuarially sound. Exceptions are CWB price pooling and supply management. A summary of commodity stabilization programs and the degree of regulation is provided in Table A.3.

Table A.3: Summary of Commodity Stabilization Programs and Degree of Regulation

More Support/Intervention				Less Support/Intervention
		Type of Program		
Subsidized Supply Management	Supply Management	Federal Funded Stabilization	Bi-and Tri-partite Stabilization	Producer-Financed Stabilization
		Examples		
Dairy Program	Eggs Poultry	Non-CWB Grains Fruits	WGSA Red Meat	None
		Characteristics		
Producer Monopoly	Producer Monopoly	Federal Payments when Warranted	Federal-Producer-Producer Financing of Payments	Producer Financed Payments
Imports Restricted	Imports Restricted			
Domestic & Export Subsidies				
Inventory and Administration Contributions				

Source: d'Ailly

APPENDIX B: REVIEW OF COMMODITY STABILIZATION LITERATURE

The early literature on commodity price stabilization has been discussed in the body of the report in section 2. This literature includes the seminal works by Waugh (1944), Oi (1961) and Massell (1968). The summary of the literature below includes the main developments since these articles.

B.1 A Utility-Maximizing Approach

The Waugh and Oi analyses have been generalized by Hanoch to a multi-commodity situation. In generalizing the Waugh approach, the benefits are included in terms of a concave (or convex) utility function, rather than in terms of consumer surplus.[8] Using the indirect utility function approach, Turnovsky, Shalit and Schmitz provide conditions under which the Waugh proposition holds (later they provide conditions under which the Oi theorem is satisfied). The desirability of price instability depends on the share of the consumer's budget allocated to the commodity and decreases with the magnitude of the price and income elasticities, but increases with the degree of relative risk aversion.

In the single product case, if firms are risk takers, producers will prefer price instability over price stability. However, as the degree of risk aversion increases so does the firm's preference for stability over instability. For the multi-product firm, the preference for price instability depends upon several conditions, including the total revenue contributed by each of the goods produced. A risk-averse firm may prefer instability in some of its product markets and not in others; it is more

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[8]Utility maximization theory suggests that consumers will allocate expenditures among commodities so that the satisfaction derived from the last dollar spent on each is equal. The utility function will be concave if the individual is risk averse and convex if the individual is risk loving.

likely to prefer price instability in those goods that contribute relatively little to total revenue.

B.2 Partial Price Stabilization

In the above discussion, storage is assumed to be costless. When positive storage costs are introduced, it is no longer optimal to pursue complete price stabilization. Massell (1970) introduced a partial stabilization scheme that was later elaborated on by Just, Schmitz and Turnovsky. This buffer stock policy has the effect of modifying the demand curve by purchasing and selling of commodities to make up for differences in actual and modified demand.

This model, in essence, uses a linear adjustment rule which ensures that a fixed proportion of the excess of any given crop over a normal crop is saved for periods of shortage. However, not all partial stabilization schemes follow a linear adjustment rule. A non-linear adjustment rule is needed when buffer stocks alter the probability distribution of the market price in a non-symmetric way. In practice, the most common scheme of partial price stabilization is that of a price band (i.e., the authority allows prices to fluctuate between a price ceiling and a price floor).

Using a rational expectations model with Monte Carlo simulation, Miranda and Helmberger investigate the use of a buffer stock scheme for stabilizing prices. (In Section 3, we employ a similar model for the case of a buffer fund.) The authors simulate a price band program where the government purchases the commodity from producers at one price and releases the commodity for sale at another, higher price. The results of the simulations contradict many accepted notions of such programs. Some of the major conclusions are as follows:

(1) A price band policy may lower steady-state mean price below its competitive level.

(2) Perfect price stability can only be achieved if the price band width is zero and government stocks are allowed to increase to infinity (explosive policy).

(3) If government stock holding does not become infinite, "widening the price band by raising the release price stabilizes market price, contradicting the claims of several writers" (p. 51).

(4) "For many nonexplosive policies, ...the entire price band lies below the long-run price" (p. 52).

(5) Raising the support price actually destabilizes producer revenues, as proven theoretically by Van Kooten, Schmitz and Furtan.

Miranda and Helmberger conclude that, "if price and revenue stability are both important goals, then an efficient policy will entail a low price support and a wide band" (p. 56).

B.3 Price versus Income Stabilization

An important point raised by Newbery and Stiglitz, and by Bigman, is that in some cases stabilization of prices enhances income variability. Their proof is mathematical and they show that this result holds when demand elasticity exceeds 1/2. However, one can get the same result using the Massell framework in which it is also possible to discuss the role of private versus public stockholding. Assume that, in Figure 2.1, price fluctuations are caused by supply fluctuations. Without storage, producer incomes over the two periods are P_1q_1 and P_2q_2. Income is less than if q_o is sold both periods since $2(P_uq_o) > (P_1q_1 + P_2q_2)$. Storage which stabilizes price need not yield stable incomes. Suppose for supply S_1, the government stores q_0q_1' and pays producers P_μ in the same period S_1 occurs. Then, in that period, income is $P_\mu q_1'$; in the next period, supply is S and the government releases the stocks. Producer income is now only $P_\mu q_2$. The scheme is self-financing since government outlays for stocks equals the money received when stocks are released.

There are two additional results worth noting. (1) Producers still prefer price stabilization, even with government storage, to price instability since $P_\mu q_o + P_\mu q_1' > P_1q_2 + P_2q_1$. (2) In the absence of government storage, producers would store privately in view of the price stabilization result above. Also, the producers may have the objective of income stabilization which means they would store q_0q_1' for sale in the following period. However, note the important result: with private storage, both income and price are stabilized as, to achieve price P_μ, producers have to store q_oq_1' (for which they get no payment) and sell it in the next period. Thus, in the case presented, the degree of income variability generated by price stabilization depends critically on whether the public or the private sector does the storing.

B.4 Instability in Imperfect Markets

The above analysis is based on perfectly competitive markets. Bieri and Schmitz consider a marketing firm which has both monopoly and monopsony power. Their models clearly demonstrate that storage improves the economic position of private marketing firms and that losses are borne by consumers and/or producers. Also, as these models show, price instability can be "manufactured". This is opposite to the type of price instability in the Waugh, Oi and Massell models where instability is due to natural phenomena such as weather.

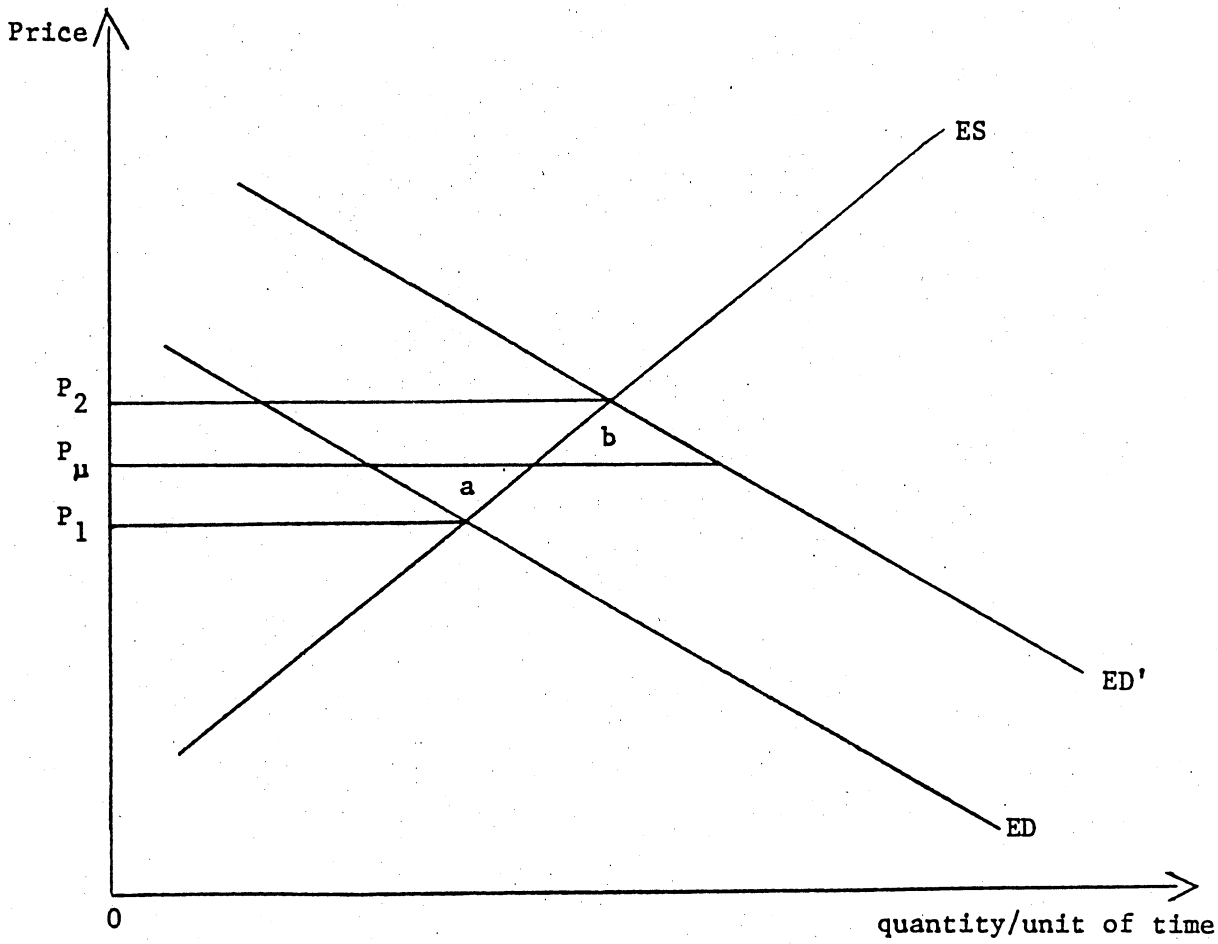
Newbery rigorously derives results for the nonlinear optimal stock rule for a monopolist. He shows that: (1) a monopoly stocking rule leads to larger storage than under competition; (2) a monopolist facing a stable linear demand schedule will undertake more price stabilization through storage activities than a competitive market producing the same average supply (this result does not hold for all demand schedules); and (3) if an international buffer agency is set up and instructed to maintain prices within a price band, then a monopolist will be able to speculate against the agency. However, under a competitive rule this would not happen.

B.5 International Trade Cases

The earlier competitive models were first applied to international trade by Hueth and Schmitz. Trade occurs between countries that face excess demand and supply of a commodity. Using this framework, Hueth and Schmitz show that with trade countries on aggregate prefer price stability. In Figure B.1, the excess supply curve for a given good is ES (i.e., the amount exported at various prices), while the excess demand curves for two periods are ED and ED'. In this case, the exporter loses from stability while the importer gains. However, if the instability was due to a stochastic supply system, the exporter would gain from stability while the importer would lose.

The model raises an interesting issue regarding who should hold reserves to bring about stability. In the first case, the importer should hold the

FIGURE B.1: Price Stabilization with Trade



largest percentage of reserves; in the second, it is the exporter. On the basis of this model, cooperation in setting up an international reserve pool is difficult since gains from cooperation will not be shared equally between the participating countries.[9]

Nichols and Zeckhauser develop an international, countervailing price stabilization model. They consider large competitive consuming nations facing an export cartel and show that it would generally pay the consuming nations to build up a strategic stockpile. This stockpile would suppress price in future periods even when the supply conditions of the producing cartel were non-random and stationary. Schmitz, Shalit and Turnovsky contend that importers exert monopsony power through such devices as optimal tariffs and, as a solution, they propose pricing and storage strategies to deal with these distortions.

The above framework has also been used by Bieri and Schmitz to incorporate tariff policies. It was shown that, in the optimal tariff case, an importer no longer prefers instability even when the source of the instability is external (i.e., caused by shifts in the excess supply curve in Figure B.1). In this model, the importer will impose tariffs along with positive storage.

In summary, in an international trade context, the welfare of all countries taken together is increased by the use of storage (i.e., what the gainers gain is more than what the losers lose). However, even though this is true, some countries may actually lose from stability due to storage. In this type of model, the distributional effects critically depend upon such

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[9] Hueth and Schmitz also show that both producers and consumers in an importing country may prefer instability to stability when the source of the disturbances are external to the country.

factors as the source of the instability (i.e., whether it is generated from without or within a country) and the height of the tariffs.

A version of the Bieri-Schmitz optimal tariff model was tested by Carter and Schmitz for U.S. and Canada wheat exports to the EC and Japan, and by Sampson and Snape who included feed grains in addition to wheat.[10] It was found that those importing nations do, in fact, pursue a tariff policy that is welfare improving for importers such that there is a substantial income transfer from the major grain exporters to the EC as a result of the combined tariffs and instability.

Often overlooked in the literature is the idea that the degree of trade liberalization can affect the magnitude of price instability and, hence, the need for buffer stocks. As Newbery and Stiglitz show, by reducing price instability, international trade has similar effects to a buffer stock scheme and may be a cheaper substitute, even though, as shown earlier, storage can yield added gains compared to the free trade no storage model. The proposition that freer trade results in greater price stability was also shown by Sarris and Taylor, and by Bigman.

The effects of buffer stocks depend on the degree and type of market distortions present. Newbery and Stiglitz show that, if nonlinear trade policies (e.g., quotas) are used, price stabilization will generally yield larger benefits than if such trade distortions are absent.

B.6 Nonlinearity and Multiplicative Disturbances

The above framework is based on linear supply and demand relationships and additive disturbances (i.e., parallel shifts in supply and demand

[10]These studies are reviewed in detail in Schmitz, Shalit and Turnovsky.

schedules). If the linearity assumption is relaxed and if the demand curve is convex, then, as Johnson and Gray (FAO) point out, the consumers' interests are enhanced because accumulated reserves will put downward pressure on prices. As a result, the notion that stock acquisition is done for the benefit of producers needs to be reconsidered.

Another important issue in the stabilization literature is whether the form of the disturbance is additive or multiplicative. The analysis incorporating both nonlinear demand relationships and multiplicative disturbances was carried out in a free trade context by Just and Hallam and in a trade distorted world by Just et al. (1977). The interesting result in both of these papers is that producers in exporting countries prefer instability but consumers in importing countries gain from stabilization. As a result, exporting countries are generally worse off and importing countries better off with stabilization. However, as with all of the studies surveyed to this point, with appropriate compensation, the world as a whole can actually gain from stabilization. Interestingly, the degree of curvature of the excess demand curve, in a sense, substitutes for the source of the instability as a major determinant of the distributional effects of price stabilization. Producers in both importing and exporting countries prefer instability, while consumers in both prefer stability.

B.7 Public Storage, Private Storage and Futures Markets

In the previous models, it is implicitly understood that governments do the actual storing. However, Gustafson, Gardner, Newbery and Stiglitz, and Lutz point to a finding that has significant implications for public policy. This finding is that private storage which involves many traders could result in socially optimal stocks and that, in the presence of private storage, public stocking intervention will be completely ineffective. Only in the presence of a less than one-to-one tradeoff of private for public stocks can the case for public intervention be made. The related issue of the reaction by the private trade to government stockpiling appears to be unresolved (e.g., see Stein, Keeler and Smith). But if the private trade reduces carry-over stocks by as much as the public authority's stockpile, there is no extra price stability induced by government intervention.[11]

Helmberger and Weaver develop a model which incorporates private storage activities. In their model, production and storage decisions respond to rational expectations with uncertain prices. They assume a competitive storage industry and show how benefits and costs to various groups are affected by alternative programs. To find the competitive level of storage, they derive a supply and demand function for storage (competition pushes storage to the level where expected economic profit is driven to zero).[12] The conclusions are: (1) a competitive storage industry does not prevent large swings in grain prices; (2) differences between expected and actual prices are much greater in the absence of competitive storage; (3) producers may gain from the existence of a competitive storage industry, although this

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[11]It was shown earlier that the issue of which agents hold stocks can have a markedly different effect on income variability even though their effect on price stabilization may be the same, an important point which seems to have been neglected in the literature. Private stockholding by producers will tend to bring about both price and producer income stability. On the other hand, government stockholding by itself will bring about price stability, but income instability can result. This may be greater than if no storage was undertaken by the public and/or private sectors.

[12]Economic profit is the profit accumulated after the opportunity costs of capital have been covered.

may not necessarily be so; and (4) buyers may or may not gain from competitive storage.[13]

Helmberger and Weaver show the effects of three different government stabilization programs: (1) complete price stabilization, (2) partial price stabilization, and (3) stabilization of quantity purchased. In comparing complete price stabilization by government versus competitive storage, they show that the transfer to producers from buyers can be quite significant. For partial stabilization, producers gain, consumers lose and economic efficiency is decreased. In addition, they show that quantity stabilization schemes may not be feasible in a free market economy. The study concludes that competitive storage leads to the maximization of net benefits but that it is consistent with wide price fluctuations and significant differences between expected and realized prices. Therefore, market failure might provide a rationale for government intervention to stabilize prices. However, as they point out, this argument has not been used by others to justify a price stabilization policy.

B.8 Price Uncertainty

B.8.1 Physical Storage

In much of the previous analysis on gainers and losers from instability, it was assumed that instantaneous adjustments were allowed. For example, in the Oi analysis, producers were allowed to produce the highest output at the highest price; thus, it is clear why, in this case, producers prefer instability. However, in reality high prices correspond to low output, not the other way around. It is easy to make money in the Oi situation because

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[13] Points (3) and (4) are with reference to zero storage levels.

of perfect information, just like it is to "buy low and sell high". The problem in reality, however, is running the risk of "buying high and selling low".

This strong assumption motivated Van Kooten and Schmitz to deal with the distributional impacts from price stabilization using a price uncertainty framework. In the analysis, producer planned production is in response to expected prices. Ex ante decisions are viewed differently than ex post outcomes, contrary to the standard literature where expectations at the time of decision making and actual outcomes coincide.

Using a price uncertainty framework, Van Kooten and Schmitz show that not only does society prefer price stabilization but that it may be Pareto superior. In this case, the introduction of a stabilization policy can make one group better off without making anyone worse off.

B.8.2 Non-Storable Goods

The major emphasis in the stabilization literature is on storable commodities. However, stabilization schemes through the use of buffer fund mechanisms also exist in various parts of the world for non-storable goods, especially in the production of red meats. Unlike the physical storage case, Van Kooten, Schmitz and Furtan have shown that there is no net gain to society by introducing price stabilization schemes through buffer fund mechanisms. In addition, these schemes generally involve a transfer of income from taxpayers to producers. It follows that, if a commodity can be stored, price stabilization brought about via storage is socially preferred to achieving stabilization through a buffer fund.

B.9 Supply Response and Risk Preferences

In the models reviewed, the assumption of risk neutrality is made. But what if producers are risk averse and they face uncertainty? It is argued that, if price stability can be attained generally, risk can be greatly reduced. As risk is reduced, risk-responsive producers may increase supply; as a result, both producer and consumer welfare may increase by more than the standard Massell risk-neutrality assumptions would indicate. Once risk is taken into account, estimates of gains from stabilization may be seriously biased and any efforts to determine an optimal stabilization policy--for example, a normal price about which to stabilize--may be in vain.

The topic of welfare measurement for producers operating with risk has been addressed in the context of stabilization policy by Just (1974, 1975) and by Just and Hallam. Changes in welfare are adequately reflected by changes in the area above the supply curve and below price if a producer's economic welfare depends linearly on expected profits and the variance of profits. With risk, however, the relevant supply curve depends on expected price (possibly a function of lagged prices) and the subjective variance of price (also possibly determined by previous experience).[14] Specifically, consider the risk-neutral supply curve or certainty supply curve S in Figure B.2. Now suppose that the introduction of a given amount of price risk causes the producer to contract production so that supply shifts to S^*. The results by Just and Hallam show that the appropriate curve to use in

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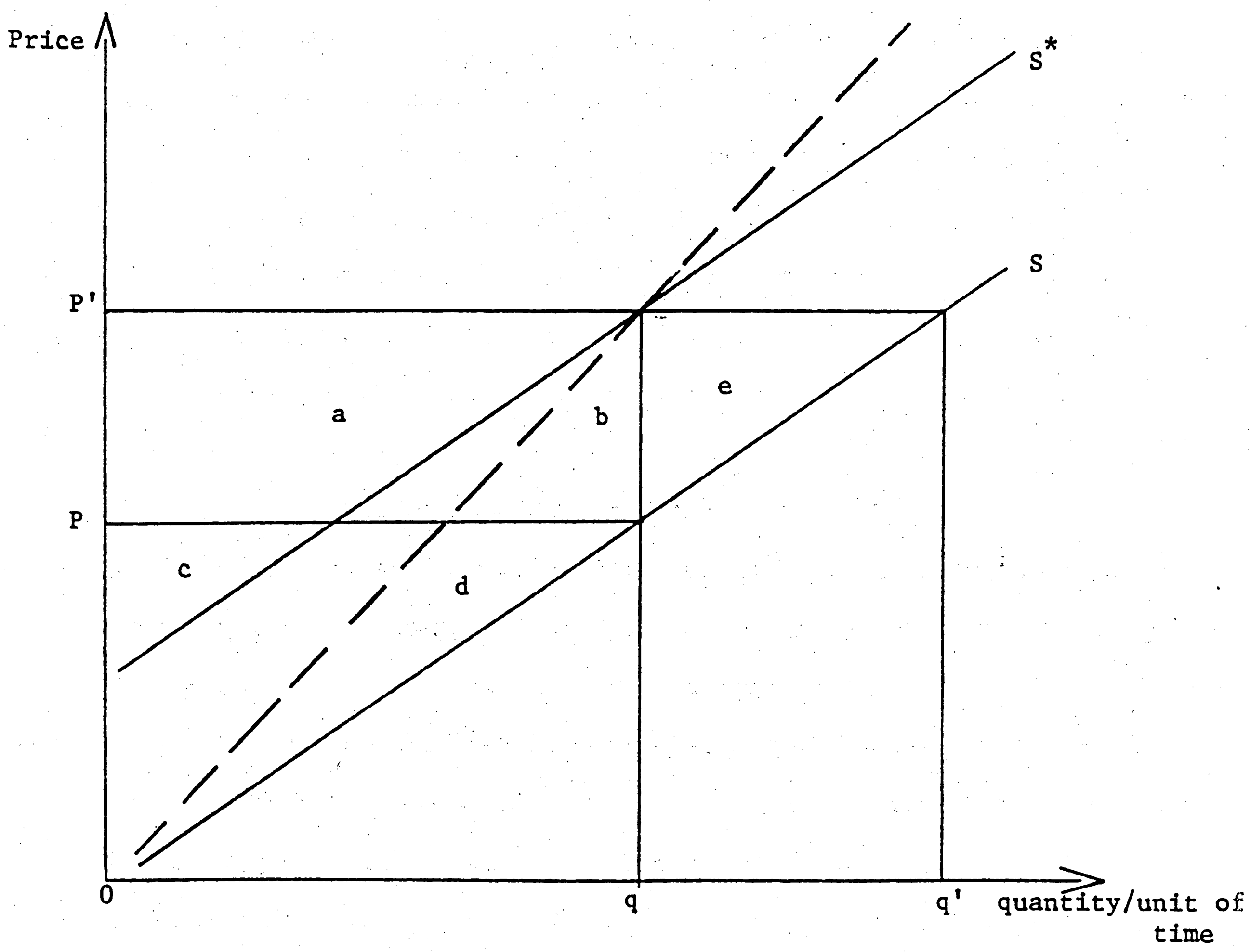
[14]Alternatively, in the case of grain supply, acreage can be specified as depending on the subjective mean and variance of returns per acre. Such a specification automatically corrects for any correlation between prices and yields which may otherwise have differing implications for income stability when price is stabilized. That is, due to negative correlation between price and average yield, price stability may actually destabilize income; if so, this would be appropriately reflected by returns per acre.

FIGURE B.2: Measuring Welfare Effects Given Producer Risk Aversion



measuring economic welfare effects for the producer is the curve S^* which holds the amount of risk constant. Thus, the surplus area which reflects economic welfare under risk is area (a + c) at expected price p′. Under risk neutrality or certainty at p′, the supply curve S would imply real income of area (a + b - c + d + e) so that the real income loss associated with price uncertainty is area (b + d + e). Of course, if the risk response from q to q′ associated with price stabilization is ignored, then the associated real income benefits of area (b + d + e) would be ignored. Thus, Just and Hallam argue that the identification of significant risk preferences, as evidenced by the risk-responsive decision, may be crucial in justifying a price-stabilization policy.

B.10 Multiple Policy Instruments

A shortcoming of many of the stabilization studies is that stabilization policy is compared to no policies. In reality, many policy instruments are already in place. When governments use multiple policy instruments, the initial goals of the policy become modified and change over time. The initial goal of stabilizing prices or producers' incomes is superceded by the objective of supporting farm incomes, or by the need to minimize budget costs. The former leads to stocks which are too large and which are acquired at too high a price; the latter to a preference for production controls (Gardner, p. 159).

When one analyzes the effects of combined price supports and storage (e.g., the U.S. Food and Agriculture Act of 1977 had as its cornerstone a "loan rate" coupled with a "farmer-owned reserve"), farm groups generally prefer price instability to stability for reasons in addition to those provided by the Oi-Massell results. Price supports or some such device are used along with storage not merely to stabilize income but to actually enhance producer income.

In analyzing the 1981 and 1985 U.S. Farm Bills, it is apparent that the excess stocks held by the United States result partly because producer prices are set too high relative to the loan rate—that is, the world market floor price. Alternatively, the loan rate is set too high relative to target or producer price guarantees because income support measures do not allow markets to clear. Actual stocks are a consequence of other policy instruments.

B.11 Instability, Storage and the Pure Theory of Trade[15]

An important and growing literature has devoted attention to the more general incorporation of uncertainty into gains from trade theory and how to optimally deal with the uncertainty. Ruffin has investigated the case of a small trading country experiencing large fluctuations in the terms of trade as a result of uncertain transaction costs and/or of erratic movements in spot exchange rates. The following nonautarky theorem was derived: Given trade uncertainty (and excluding "pathological" distortions), autarky will not be optimal regardless of variations in the terms of trade. Similarly, by introducing forward markets into the analysis, it was shown that, in the long run, autarky cannot be optimal regardless of the variations in terms of trade and the level of forward prices.

Batra and Russell considered the effects of increasing uncertainty of world prices on the social welfare of a trading nation and demonstrated that

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[15]A more detailed summary is contained in Letiche, Chambers and Schmitz.

it would bring about a reduction in expected utility. Under conditions of uncertainty, therefore, free trade may not be an optimal policy. To reduce the effects of uncertainty and to increase the potential gains from trade, the authors considered various government policies designed to minimize the cost to consumers.

In effect, the introduction of uncertainty is shown to have important consequences for standard trade theory. Contrary to the standard Heckscher-Ohlin conclusion, given constant commodity prices and the customary assumptions regarding homogeneity when uncertainty is added to the model, changes in factor endowments do affect relative factor prices. Still, the following related theorems remain in tact: (1) the Stolper-Samuelson theorem, which demonstrates that a tariff increases the return to factors used intensively in the import-competing industry; (2) the Samuelson theorem on the one-to-one correspondence between international commodity-price ratios and factor-price ratios; and (3) the celebrated Rybczynski theorem that, at constant commodity prices, accumulation of a factor increases the output of the commodity that uses that factor intensively and reduces the output of the other commodity. However, the Heckscher-Ohlin theorem can be valid for conditions of uncertainty if factor abundance is defined in physical terms. Under certain specifications of risk aversion, complete factor-price equalization is ruled out, but the weak factor-equalization theorem (i.e., the existence of a tendency toward factor-price equalization) remains. However, it is conclusively demonstrated that the volume of trade and the gains from trade are smaller under uncertainty than under certainty.

Several authors have formulated trading models in which both price uncertainty and storage activities were included. For example, Feder, Just and Schmitz show that, with non-increasing risk aversion but increased price uncertainty, both importers and exporters of the stored commodity tend to reduce the volume of trade and, at the limit, would be better off not trading. Further, as uncertainty increases, importers store relatively more of the uncertain good.

In view of the above results, it is questionable whether many of the food importers face uncertainty as the vast majority of grain stocks, which are in excess supply, are held in the United States--the largest grain exporter. Uncertainty is also lessened because long-term hedges can be placed on the Chicago Futures Market. In addition, in view of the distribution of the level of stocks held by world grain trading nations, market power appears to reside in the hands of grain importers.

B.12 Impact of Alternative Specifications of Expectations

The above models generally assume that producers' ex ante price and quantity expectations are actually realized. This essentially assumes that they have perfect foresight. Turnovsky relaxed this assumption and analyzed the effects of price stabilization for two different price expectation formulations, namely, adaptive and rational expectations.[16]

Using an adaptive expectations framework, Turnovsky showed that, as with the previous models, overall welfare is increased with stabilization even though one group may be hurt. However, the Oi conclusions that producers prefer price instability due to demand fluctuations no longer holds. Whether they prefer price stability depends on the relative slopes of the demand and supply schedules, on the autoregressive properties of the random disturbance

[16] See Section 2 above and Turnovsky (pp. 119-48).

and on the length of lag in the formation of expectations. However, the Waugh proposition that consumers are hurt by having prices stabilized in the face of supply fluctuations still applies.

From the rational expeactations formulation, Turnovsky derived qualitative conclusions similar to the Massell's perfect flexibility model.

1. The total gains from price stability are always positive.
2. Consumers lose from price stabilization if the source of the instability is due to supply shifts.
3. Producers lose from price stabilization if the source of the instability is random shifts in demand provided that these random disturbances are autocorrelated.

Also using a rational expectations framework, Subotnik and Houck compared the benefits from mean price stabilization to those of alternative schemes that stabilize production and consumption at their respective means. Depending on certain parameters, the expected total gains from supply stabilization may be greater or less than those from price stabilization. In either case, the gains exceed those from demand stabilization. They also consider the variance of changes in government stocks associated with each of three different schemes. The larger the variance in stocks, the more the government must hold in order to operate the buffer stock. For each scheme, the variance of the change in government stocks is proportional to expected social gains. Subotnik and Houck show that the storage costs involved can be ranked in the same order as the expected gains from the various stabilization schemes. Thus, the more beneficial the scheme the higher is the cost.

In a separate analysis, Wright examines the welfare effects of output instability and its elimination. Stabilization of the production disturbance causes a long-run output response which, in turn, affects the distribution of gains from price stabilization. Assuming Muthian rationality, Wright also shows that the distribution of the net welfare gain from stability is generally more even handed than indicated in previous expectational studies. Thus, the common perception of a severe conflict between the interests of producers and consumers with respect to stabilization may be greatly exaggerated.

Wright and Williams examine the important interactions among production, price expectations and storage. They show that the welfare effects of introducing storage into a market with stochastic supply when rational expectations prevail are the net result of the initial increase in demand for stock holding and the partial and asymmetric reduction in the dispersion of consumption due to storage. The distributional impacts depend on information available to producers before storage is introduced, the elasticity of supply, the nature of demand and the cost of storage.

B.13 Optimal Stockpiling of Grains in Trade Models

The following studies focus on the optimal stockpiling of storable commodities. Studies which have been done on quantifying the distributional impacts are not included here, nor are those which empirically estimate the trade-off between public and private stockholding. According to Gardner, "optimal stockpiling is holding quantities back from current consumption such that expected welfare, as measured by an objective function, is maximized given the current state of the world. An optimal stockpiling policy is a set of rules which specifies optimal stocks for every possible state of the world" (p. 3).

Gardner calculated the optimal U.S. wheat storage policy using simulation techniques. His results are consistent with other studies on this subject with respect to the amounts of grain the U.S. actually stores. He concludes that, generally, U.S. stock levels are too high—mean socially optimal U.S. wheat stocks should be put at 550 to 600 million bushels.

Among the most sophisticated storage models of the U.S. wheat economy is that developed by Burt, Koo and Dudley.[17] The empirical results obtained by these researchers provide evidence both on the distributional impacts of storage and the optimal storage capacity needed. In their model, domestic producers gain from a storage program while domestic and foreign consumers lose. They conclude that the U.S. storage capacity for wheat is substantially above that which can be economically justified. They show that the marginal value of capacity beyond 2.5 billion bushels is near zero, even when fixed costs are ignored and they show that the gain in going from one to two billion bushel capacity is near optimum. Under the domestic criterion, the gain is $300 million annually; the comparable figure for the world criterion is $190 million.

Cochrane and Danin specify a world model of wheat, coarse grains, rice and all grains, and a U.S. model for wheat to evaluate several stock decision rules. The focus is on stock size relative to price stabilization associated with a specific probability of success. The optimal rule generates stock changes to minimize price instability. They conclude that a world stock reserve of 38 to 57 million metric tons of all grain would keep prices within 10 percent of the target price level four years out of five. To reduce

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[17]The researchers use a dynamic optimal control model.

variation by more than that provided for by a 10 percent price band requires that the government stocks be very large.

Analyses by Johnson and Sumner (1976, 1978) show that grain reserves are desirable chiefly because there is no free trade in grains. Trade clearly reduces optimal stock sizes. As an example, in the Far East for a given year, stocks would be 7.5 million metric tonnes under free trade. This compares to 22.5 million metric tonnes with no intraregional trade and each nation doing its own stockpiling.

Zwart and Meilke estimate an econometric model of the wheat economies of Canada and rest of the world. They test several variations of three grain reserve storage rules by simulation experiments. The storage rules tested differed more in their impact on price stability and consumer welfare than on producer welfare. For the model as a whole, producer reserves are stabilized more by a price-stabilizing storage scheme than by a quantity stabilizing scheme. However, the most stability for consumers comes from storage rules that combine price and quantity triggers. They conclude that mixed rules seem to yield the best overall results.

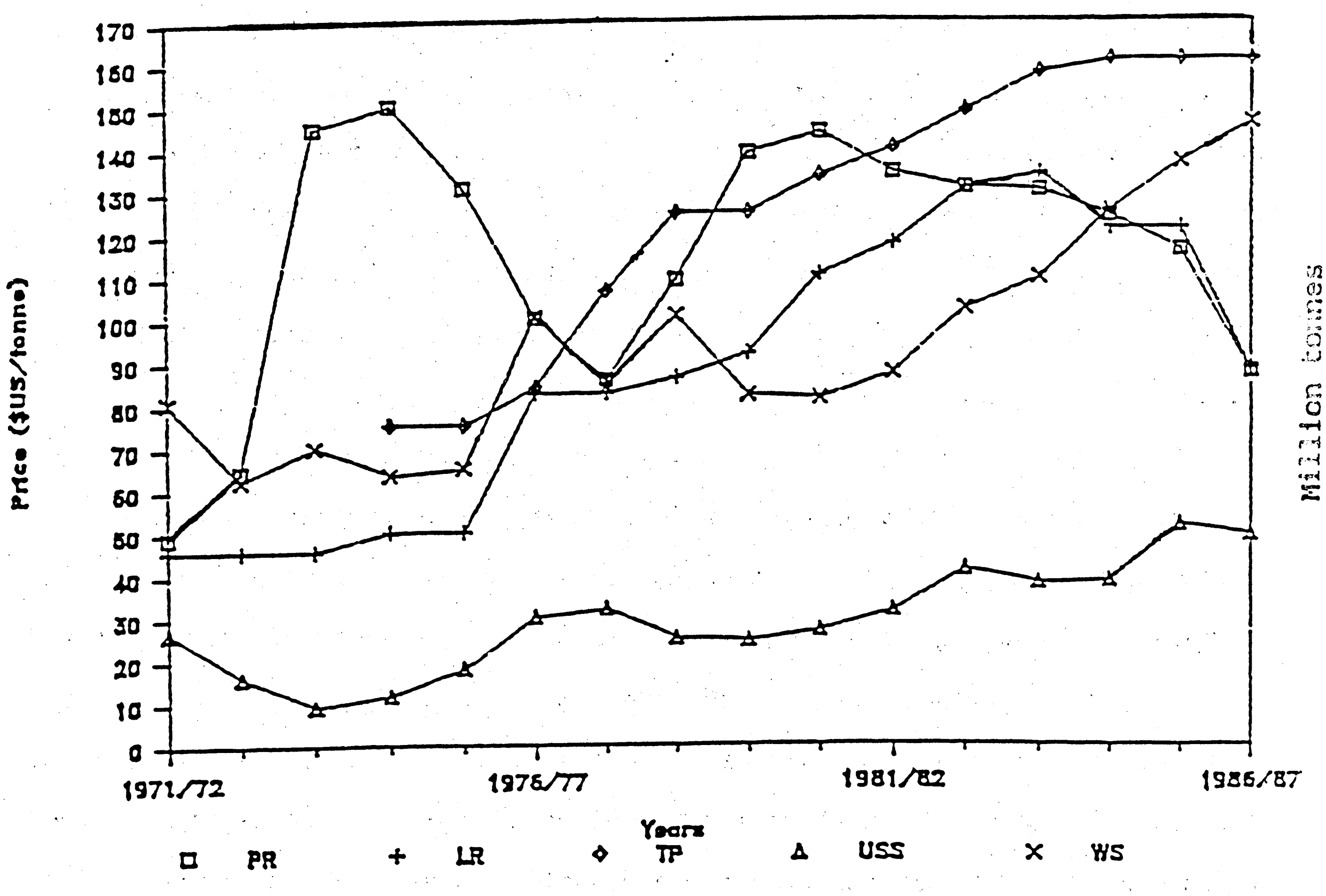
B.14 Discussion

The reality of many international commodity markets is that stocks are excessive. The world wheat market is an illustration of this over-supply phenomenon. In 1987, world wheat prices, in real terms, were at an all time low, even below the levels during the Great Depression, while both world and U.S. wheat and feed grain stocks were at an all time high (Figure 2.5). U.S. stocks are at least 50 percent higher than the optimal levels suggested by the empirical studies reviewed earlier.

Why are stocks so high and prices so low? In terms of the standard theory reviewed, this would not happen if policies were adjusted over time in order to let market forces operate. However, if markets are not allowed to function efficiently, then, as some of the models indicate, excessive stocks result. A major policy targeted at wheat is the United States' 1985 Farm Bill, which sets a target price for producers well above the loan rate. These two sets of prices are plotted in Figure B.3. In the early 1970s, stocks were low and prices received by U.S. farmers were well above both the loan rate and the target price. By the early 1980s, market prices were at the loan rate and, hence, below the target price. Throughout most of the 1980s, market prices equalled the loan rate. Production responded not to market prices but, rather, to the target price which, together with world wide production expansion, caused excess stocks to accumulate. Indeed, as shown in Section 2.3, market prices would likely be higher than current stabilizing prices. For wheat, U.S. stocks have both been growing and in excess each year beginning in 1981 (Figure B.3). Policy makers contended that, even prior to passing the 1985 Farm Bill, the U.S. loan rate was set too high for there to be an optimal stock policy. It was only in the 1985 Farm Bill that the U.S. loan rate was lowered to allow for a reduction of stocks.

Much of the theory assumes efficient markets and the empirical work reviewed indicates levels of optimal storage for efficient markets and flexible policies. The excess stock situation is a result of inflexible agricultural policies in both the U.S. and around the world. An example of an importer which uses inflexible policies to create excess world stocks is Japan. The wheat price paid by Japanese millers is fixed by the Japanese

FIGURE B.3: Wheat Stocks and Prices, 1971/2 to 1986/7



Notes:

- PR Prices received by the farmers
- LR Loan Rate
- TP Target Price
- USS US Stocks
- WS World Stocks

Sources: (1) USDA, ERS. Wheat: Background for 1985 Farm Legislation. Ag. Information Bulletin No.467.
(2) USDA, FAS. World Grain Situation and Outlook. FG-9-87.

Food Agency and does not drop in response to a fall in U.S. wheat export prices. As a result, markets are not allowed to function efficiently. Optimal stabilization policy generally implies that governments have an optimal storage policy. However, in view of reality and the nature of the policy process, it appears that neither importing nor exporting countries have an explicit stock policy. Rather, stocks are the outcome of overall agricultural policy, where other instruments (e.g., target prices and income supports) dominate.

In terms of the current study, it is not clear from both a theoretical and empirical point of view what effect price stabilization will have on supply. The results are sensitive to (1) assumptions regarding expectations formation, (2) assumptions regarding the risk attitude of producers and whether or not they are a homogeneous group (unlikely), (3) the specific structure of the model (e.g., autarky versus trade), and (4) whether or not the model is dynamic. One question raised with respect to the last-mentioned is that of utility maximization in a dynamic context. Mossin, Spense and Zeckhauser, Kreps and Porteus, and Zacharias all point out that expected utility maximization may no longer be possible in dynamic models as the (risk) utility function disappears.[18] Thus if one assumes dynamic utility maximization it may not be possible to determine the impact of reduced risk on supply response.

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[18]Thus, models such as those of Just (1974, 1975) may simply be inappropriate, not on grounds that they use a naive formulation for expectations, but because expected utility for a risk averse individual does not exist over time.

APPENDIX C: MEASURING THE DISTORTIONARY IMPACTS OF SUBSIDIES

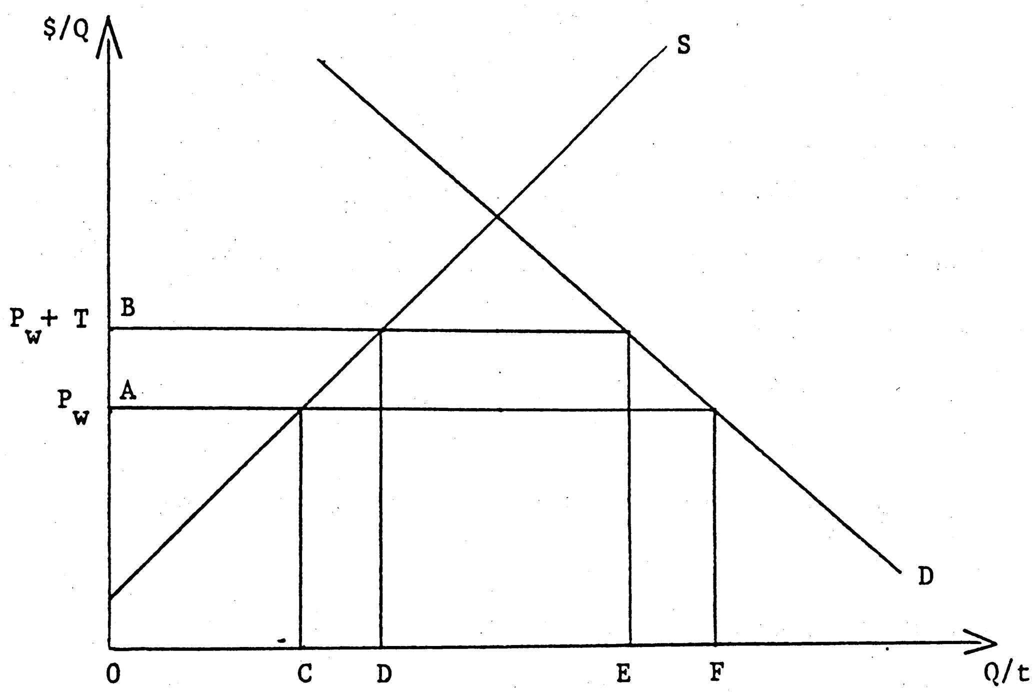
There are a number of alternative methods that have been suggested in the literature for measuring the effects of subsidies. The purpose of this section is to review these various methods. The initial impetus for obtaining such measures was to get a quantitative assessment of the domestic effects of protection. More recently, in the light of recent international trade negotiations, the impetus for such measures has been to assess the international effects of protection.

C.1 Measuring the Domestic Effects of Agricultural Protection

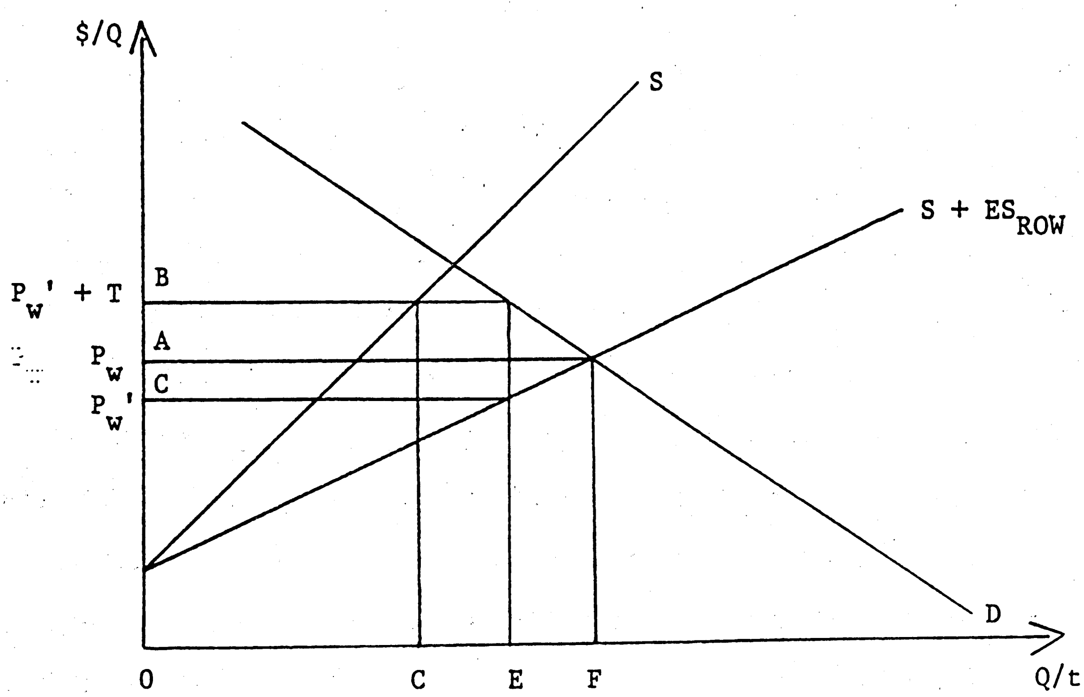
C.1.1 Nominal Rate of Protection

The nominal rate of protection (NRP) is a measure of the amount of protection which is provided to the final or finished product. It is defined as the ratio of the domestic product price to the free-market world price minus one. For example, assume that a small country initially produces and imports a product in the presence of free trade. Thus, the domestic price coincides with the world price at P_w. Now the country imposes a fixed tariff on imports, thus raising the domestic price (P_f) above P_w by the amount of the tariff, T. The nominal rate of protection is then equal to T/P_w. This can alternatively be expressed as $(P_f - P_w)/Pw$ or $P_f/P_w - 1$. If one is prepared to ignore the general equilibrium effects of protection, the NRP can be represented graphically using a partial equilibrium framework. This measure can be seen graphically in Figures C.1(a) and C.1(b) which show the small-country and large-country cases, respectively. In both cases, prior to the protection, the country produced OC and consumed OF. The difference was imported from the rest of the world. With the introduction of the tariff,

FIGURE C.1: Nominal Rate of Protection



(a) Small Country Case, NRP = AB/OP



(b) Large Country Case, NRP = AB/OA

the domestic price increases above the world price level. As a result, domestic production increases to OD and domestic consumption reduces to OE. This results in a reduction of imports from CF to DE. In the small-country case, the introduction of protection has no effect on the world price. However, in the large-country case, world price falls from P_w to P_w'. The NRP in both cases is AB/OA. Note that from an empirical perspective, it is relatively more difficult to calculate the NRP for the large-country case since P_w (the free-market price) cannot be directly observed.

This type of analysis may be used for measuring the effects of many types of protection in addition to the import tariff. These include import subsidies, quotas, domestic content regulations, export subsidies and export taxes. Where the measure results in a decrease in domestic price and production, it is called negative protection.

Associated with the NRP is another concept: the nominal protection coefficient (NPC). This measures the gap between domestic output prices and border prices. It thus ignores the general equilibrium effects and assumes the small-country case. Its main advantage is that it is relatively simple to calculate in a partial equilibrium framework. This has been used extensively in the measurement of the effects of protection (e.g. Balassa; Bale and Lutz). In the study by Bale and Lutz, the NPC is given by $P_f/(r\ P_b)$ where r is the equilibrium exchange rate, P_f is the domestic price and P_b is the border price. Note that the exchange rate is the shadow exchange rate, which is the official rate adjusted where appropriate for over-valuation. The authors justify the use of border prices on the grounds that they represent the opportunity cost of the traded good. Using assumed values for the elasticities of demand and supply, the authors estimate the trade impacts of the distortions as the difference between the production and consumption effects in each country.

More recently, the Bureau of Agricultural Economics in Australia has suggested a measure of protection which is essentially the same as the NPC. It is called the price adjustment gap (see, for example, Miller) and is the ratio of domestic administered price of a commodity to its border price.

C.1.2 Effective Rate of Protection

The price of a traded good can be thought as comprising the sum of the returns to the various factors of production. Given an arbitrary increase in this price, due to the introduction of protection, the benefits of this protection will be distributed among the various factors. Likewise, the introduction of protection on one of the factors of production may impose a cost (i.e., negative protection) on the final product. The effective rate of protection is a measure of the flow-through of the benefits (or costs) of protection on one segment of the marketing chain to another vertical segment.

Consider, for example, the effects of protection of a final good on domestic inputs used in the production of that commodity. Suppose there are two inputs: a freely-trade resource and a non-traded processing service. Since the resource is freely traded at its international price, there is no flow-through of the benefit of protection to domestic suppliers of the resource. All of the benefit will flow through to the non-traded processing service. Relative to the value added by this service the protection given to the processing sector will be higher than that suggested by the NRP on the final good. To get a measure of the effects of protection on the various vertical segments of the marketing chain, Corden introduced the notion of the effective rate of protection (ERP). It is the ratio of the value added by the marketing segment expressed in domestic prices to the value added in the presence of free trade (minus 1).

Consider a simplified numerical example. Suppose that a bag of flour is priced at $3 with $1 representing the value added by wheat, the freely-traded input, and $2 representing the value added by the processing service. If a tariff of $1 per bag is levied on flour imports this involves a nominal protection on domestic flour of 33 percent ($1/$3). Since wheat is freely traded, its price will not increase and all of the resulting flour price increase will flow through to the processing sector. Thus, the return to processing is increased by $1 per bag and the effective rate of protection is 50 percent ($1/$2).

We can develop the concept using both algebraic and graphical analysis. Suppose that the final product (Q_f) is the result of an input (Q_r) which is freely traded at its international price and a processing service (Q_p) which is not. Providing protection on the final product will have very different effects on the domestic input and processing sectors. Suppose that, prior to the introduction of protection on the final product, the price of processing was P_p and the world price of the input was P_r. Thus, $P_f\, Q_f = P_p\, Q_p + P_r\, Q_r$. This yields $P_f = Pp\, W_p + P_r\, W_r$, where W_p and W_r are, respectively, the ratios of Q_p and Q_r to Q_f. Now, with the introduction of protection, the final product price increases to $(P_f + T)$. Since the input is traded at the world price, its price is unaffected. However, the price of processing increases to $P_p{}^* = ((P_f + T) - P_r\, W_r)/W_p = P_p + T/W_p$. The effective rate of protection is given by:

$$ERP = (P_p{}^* - P_p)/P_p = T/(W_p\, P_p).$$

It can be shown that the ERP on the processing sector is higher than the NRP on the final product. Note that ERP/NRP = $(T/(W_p\ P_p))\ (P_f/T) = P_f/(P_p\ W_p)$. Since $P_f > P_p$, while $0 < W_p < 1$, ERP > NRP.

Assuming no general equilibrium effects, the effective rate of protection can be demonstrated using partial equilibrium analysis. The example involves a protected final good, a freely-trade resource and a non-traded processing service and is shown graphically in Figure C.2.[19] For both the traded resource and the traded final good, a small-country case is assumed. In Figure C.2, the NRP is given by AB/OA in panel (a), while the ERP on processing is given by DE/OD in panel (b). The ERP on the internationally traded input is zero.

Associated with the ERP is another measure, namely, the effective protection coefficient (EPC). The relationship between the ERP and the EPC is analogous to that existing between the NRP and the NPC. The EPC is the ratio of value added expressed in domestic market prices to the value added expressed in border prices. The main advantage of using this measure over the ERP is that it is relatively simple to calculate since one uses border prices instead of free market prices. Given protection of one vertical market segment, an analysis similar to that done by Bale and Lutz could be used to obtain the trade effects on the other vertical market segments.

4.1.3 Producer Subsidy Equivalents and Consumer Subsidy Equivalents

These measures were first used by Josling (1975) to compare the susidies (net of indirect taxes) to agricultural producers across six countries. The

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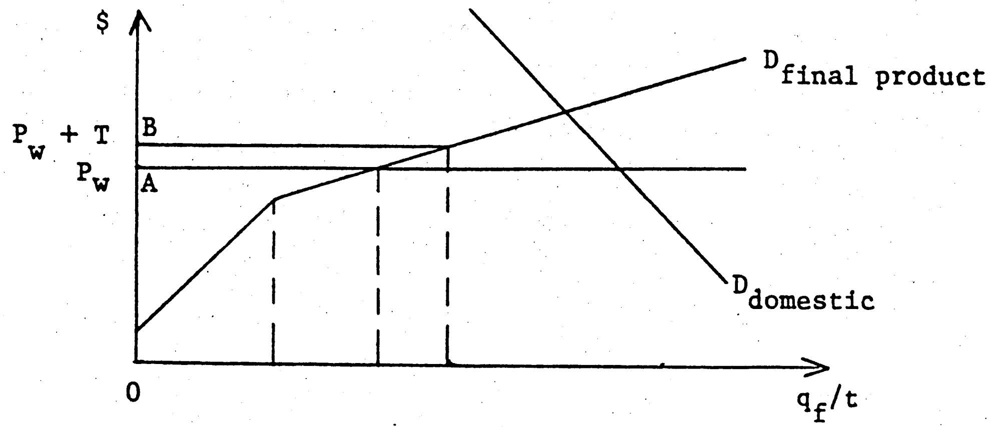
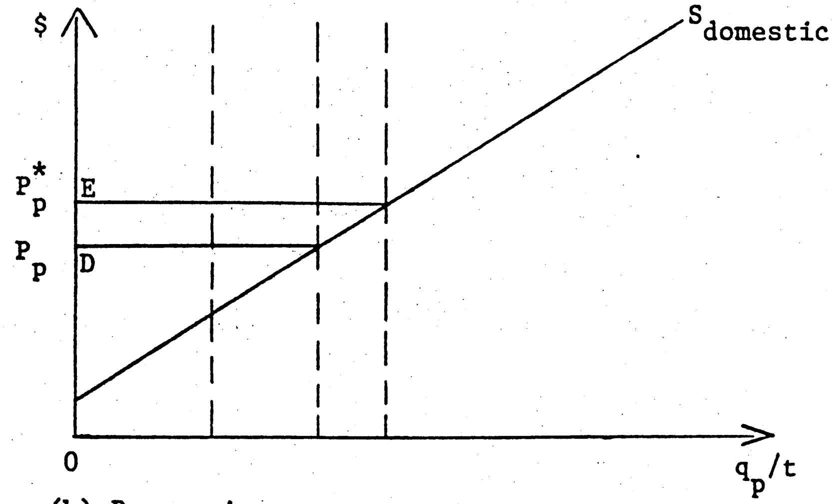
[19] For diagrammatical purposes, fixed proportions between stages is assumed.

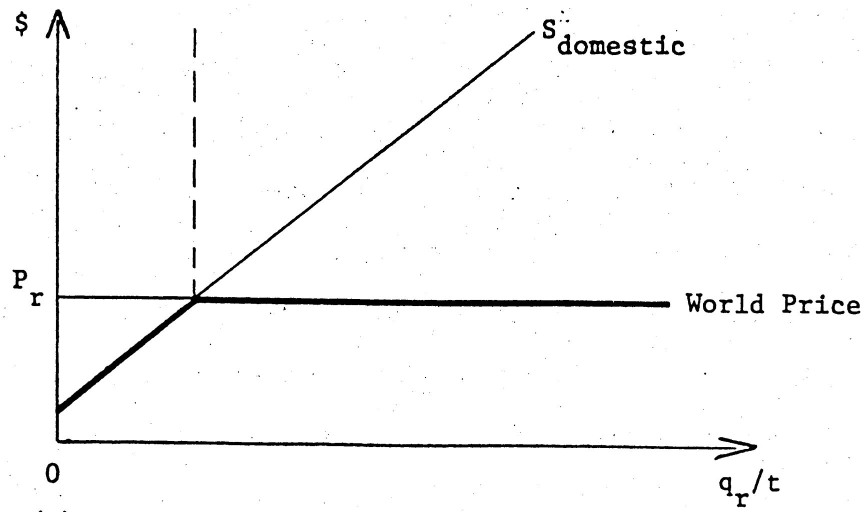
FIGURE C.2: Effective Rate of Protection



(a) Final Product



(b) Processing



(c) Input

producer subsidy equivalent (PSE) is defined as the payment that would be required to compensate farmers of a particular commodity for the loss of income resulting from the removal of support policies for that commodity. The policies include both price supports and budget payments (both direct and implicit). Thus the PSE for a commodity is given algebraically as:

$$PSE = Q_f (P_f - P_w) + D - L + B,$$

where Q_f = level of production;

P_f = domestic producer price;

P_w = border price;

D = direct payments;

L = producer levies and fees; and

B = other budget payments.

The consumer subsidy equivalent (CSE) is defined as the implicit tax on consumers resulting from support policies for a particular commodity plus any subsidies to consumption. Thus, the CSE for a commodity is given algebraically as:

$$CSE = -C_f (P_f - P_w) + G,$$

where C_f = level of domestic consumption, and

G = budget payments to consumers.

The PSEs and CSEs are measured as close as possible to the producer and consumer levels, respectively, and attempt to capture those forms of assistance which subsidize producers or consumers directly or indirectly. The PSEs are of particular interest as a measure of the effects of agricultural protection on production and trade. The PSEs are a broader measure of assistance than the nominal or effective rates of protection in that they include a broader range of policies and assistance. They are a narrower measure than the effective rate of protection because they take no account of protection of other vertical segments of the marketing chain (e.g. agricultural inputs).

The PSE measure is useful for indicating a country's contribution to global assistance. However, it is not useful as a measure for comparing levels of assistance between different-sized countries. One way to obtain such a measure is to calculate the per unit PSE, given by PSE/Q_f. One can also obtain a unit-free measure by expressing the PSE as a percentage of the value of production. The value of production is determined at domestic prices and includes any direct payments. Thus, the percentage PSE measure (PPSE) is given by:

$$PPSE = 100 \; PSE \,/\, (Q_f \, P_f + D - L).$$

The PPSE has been widely used as a measure to compare the levels of assistance provided to the agricultural sector across countries. The recent OECD Trade Mandate Study represented a major effort to do this. The basic problem addressed in this study was that agricultural policies in various countries had contributed to a global surplus of agricultural production relative to effective demand (at current prices). One major dilemma encountered in addressing this problem was the existence of many different types of assistance. This made the job of comparison very difficult. The basic idea was to arrive at a single overall measure to compare the levels of assistance across countries. It was hoped that this might provide a framework for reducing assistance multilaterally. The measure chosen was the PPSE. As a result of the Trade Mandate Study, the PPSE measure has attracted considerable attention in the context of the current round of multilateral trade negotiations in Uruguay. These negotiations are focusing on ways to gain agreement among countries to reduce the trade distorting impacts of domestic agricultural policies. The Trade Mandate Study has served an important role in developing this focus and in developing some consensus for the use of a universal measure as the basis for negotiation. This is opposed to the traditional 'request and offer' basis for negotiations which offers only the prospect of marginal gains. The universal measure is the PPSE.

There are defects with the use of the PPSE as a measure of the trade distorting effects of agricultural protection. McClatchy cites seven problems associated with this measure.

(1) PSEs are a farm income distortion measure, not a volume distortion measure and are, therefore, a poor proxy for trade distortions.

(2) A country's PSE can fluctuate because of such uncontrollable variables as world prices, exchange rates and the policy measures of other countries. Therefore, countries would find themselves continually adjusting their level of assistance in order to maintain a certain internationally agreed-upon level. This would lead to an unstable environment for the farming community.

(3) Using the world price as the reference price could lead to a very different PSE than one calculated on the basis of the 'free-trade' price.

(4) The PSE does not take into consideration the indirect effects other policies have on a farmer's cost structure.

(5) It would be difficult to get countries to agree on a number of the elements of the PSE such as what policies to include, what commodities to include, the base period, and the reference price and its domestic equivalent (i.e., taking into account differences for marketing margin and quality).

(6) The PSE is sensitive to the unstable nature of the agricultural environment and could be expected to change markedly from year to year. This would require continual updating to monitor changes in the PSE level. One approach to the instability of the PSE would be to calculate it as a moving average of several years. Presumably the choice of moving average would also be subject to debate.

(7) The question arises whether the PSE for each country would be calculated for each commodity or if it would be some weighted average. If it is the latter, there is room for debate over the choice of a weighting scheme.

McClatchy's first point is the most damaging for the use of the PSE measure as a measure of trade distortion. It simply was not designed for this task, and, consequently, it is not surprising that it does not perform this task very well. The PSE is a measure of subsidy levels in a country. However, two countries can have policies that provide the same level of subsidy to agriculture yet have very different effects on production and trade. For example, a domestic price support policy in country A may have a considerable export-enhancing effect, while in country B a deficiency payment program tied to production controls may have no trade-distorting effect. Even two countries with the same policy (and same PPSE) may experience very different trade effects depending on differences in the relevant elasticities of supply and demand. Because of this major defect with the PPSE, other approaches have been suggested for determining a universal measure of the trade-distorting effects of domestic support programs. It is to these that we now turn.

C.2 Measuring the Trade-Distortion Effects of Agricultural Policies

C.2.1 The Trade Volume Effect

The trade volume effect (TVE) is the additional volume of a commodity which would have been imported or the reduction in the volume exported in a given year if the price policies and market policies had not existed. One of the earlier uses of the TVE is found in a 1973 FAO study of the domestic and international effects of agricultural protection (Josling, 1973). This study calculated PSEs and CSEs for particular agricultural commodities. These measures were then combined by using assumed elasticities of demand and supply to arrive at the trade volume implications. The TVE was measured as the sum of the effects on the level of production and consumption when the intervention was removed. This approach is similar to that later used by Bale and Lutz to measure the trade effects of agricultural protection. The difference is that, whereas the former used the PSE and CSE measures, the latter used the NPC measure which is less general.

A negative value for the TVE implies that the existing policy is export-enhancing or import-restricting and that removing the policy would result in a reduction of exports or an expansion of imports.

C.2.2 Trade Distortion Effect

The trade distortion effect (TDE) was developed by McClatchy. It is essentially the same as the TVE measure already described. It is given by:

$$TDE = PPSE\ E_s - PCSE\ E_d$$

where E_s and E_d are respectively the elasticities of supply and demand. McClatchy suggests this formula could be modified to take into account any production restricting policies by reducing the corresponding supply elasticity to zero. Land set-aside programs could be incorporated by including a negative (supply-shifting) element in the first term of the above equation. He suggests that the cross-commodity impacts be taken into account by the use of a suggested OECD mathematical, multi-commodity model. This measure should give an indication of a country's contribution to the overall distortion in world prices. The OECD model assumes that policies in all other countries remain in a static state and that the reference point is the set of existing (distorted) world prices. Going one step further, McClatchy suggests the ideal would be to use undistorted 'free trade' prices, but he recognizes this would require extensive estimation.

To obtain a unit-free measure, McClatchy suggests expressing the TDE as a ratio to either: (1) the level of net trade in the absence of distortion; (2) the level of domestic consumption in the absence of distortion; or (3) the level of domestic production in the absence of distortion.

C.2.3 Adjusted Producer Subsidy Equivalents

The TVE and TDE measures both combine the subsidy equivalent measures (PSEs and CSEs) with elasticities of supply and demand to measure the trade effects of domestic agricultural policies. However, while there is a growing consensus on how to measure PSEs and CSEs, there is no consensus on what constitutes appropriate elasticity values. Indeed, in the context of international negotiations, it may well prove impossible to agree on precise values for the various commodities in the various countries. As a result, it has been suggested that the problem be simplified by calculating an adjusted producer subsidy equivalent (APSE) for each commodity. This would be the PSE except that it would only include certain assistance measures which would be designated as significantly trade-distorting. The other assistance measures would be designated as non-trade-distorting and, hence, omitted from the calculations.

C.2.4 Tariff Equivalent

This is defined as the ad valorem tariff which would have the same TVE as the existing policy. Hence, this measure attempts to translate the measure of trade volume distortion to one of trade price distortion. In the context of the multilateral trade negotiations, this may have some appeal in that negotiators are familiar with the notion of tariff reductions, since previous rounds of the GATT negotiations have focused on the idea of tariff reductions. However, it is essentially the same concept as the PPSE and so is subject to the same limitations as that concept.

C.2.4 Rate of Price Distortion

The rate of price distortion (RPD) of world prices was a concept developed by de Gorter as an alternative criterion for measuring the international effects of domestic policies. He defines this indicator as "the proportional change in the world free trade price that finally results from a particular country's policy instrument or set of instruments, ... assuming no trade-affecting policy measures in place in all other countries" (p. 4). By way of illustration, consider again Figure 4.1(b). The RPD for the tariff applied by the large country is given by -AC/OA. It is thus the opposite of the NPC. While the RPD measures the impact of domestic policies on the world (free-trade) price, the NPC measures the impact on domestic price. Recall that with respect to Figure 4.1(b) the NPC is AB/OA. This measure depends on the level and method of intervention, the economic characteristics of the commodity sector under examination and the size of that country's market relative to the total world market. Policies included in this measure are those which place a wedge between the excess supply and demand curves and between the domestic supply and demand curves, thereby creating a difference between the import and export price and the domestic supply and demand price, respectively.

The data and estimation requirements for this measure are considerable. The problems alluded to earlier, namely, the estimation of elasticities and free (non-distorted) prices, are likely to preclude the RPD from being implemented as a universal measure of trade distortion in any negotiating forum.

C.3 Implications for Canada's Stabilization Programs

Canada's stabilization programs may affect the supply curve in one of two ways. Firstly, it may shift the supply curve to the right because it results in a reduction in one of the costs of production (i.e., risk). Secondly, it may result in a movement up along the supply curve because of the price (or income) enhancement effect.

In the context of the current international negotiations, there are two possible rationales for attempting to measure the distortionary effects. The first is to use such measures as the basis for negotiating reductions in the trade-distorting impacts. The second is to derive possible models for providing assistance which are not significantly distortionary.

With respect to the first rationale, it is extremely doubtful that the supply-shifting effects of domestic programs will be included in any basis for negotiations. This is because of the difficulties in measurement, and because there is no strong sentiment that this is quantitatively very significant. With respect to upward movement along the supply curve, there is general consensus that this is central to the international problem of oversupply (at current prices). We have discussed various measures that have attempted to measure this effect (generally based on elasticity estimates). It is still not clear that empirical estimates of the elasticities will be accepted in any universal measure to be used as a basis for negotiations. It may well be that use of an APSE measure is as far as we get. The implication of this would be that programs, like WGSA, which may not be very distortionary will be treated the same as the EC price support programs which may be very distortionary. However, in negotiations, anything may happen and so there is still merit in attempting to estimate movement along the supply curve. The measures which would seem to be most useful would be the TVE measure or the TVE per unit of value of assistance.

Apart from the direct context of international negotiations, there is likely to be a demand for models which provide a practical means of transmitting assistance to agriculture which are not trade-distortionary. In this context, research is warranted which is much broader in scope than that involved in arriving at a 'universal measure' of trade distortions. We need to consider not only shifts in supply curves and movements along supply curves but also the dynamics of assistance. With respect to the question of dynamic effcts, it may be argued that policies such as Canada's WGSA provide dynamic stability to the international market, while policies such as the EC's CAP 'export' bring instability to the international market. As such, the WGSA may be more defensible than the CAP.

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Table 3.2: Simulation Results Under Alternative Price Stabilization Rules and Autarky: elasticity of demand = -0.5 [a]

	Quantity Produced	Consumer Price	Producer Price	Producer Revenue [b]	Income Transfer
A. LINEAR DEMAND					
		(elasticity of supply = 0.5)			
no rule	699 (69)	3.76 (.74)	3.76 (.74)	2578 (261)	--
rule 1	700 (69)	3.75 (.74)	3.76 (.00)	2634 (261)	61 (518)
rule 2	700 (73)	3.75 (.78)	3.76 (.27)	2638 (378)	70 (633)
rule 3	708 (71)	3.67 (.76)	3.69 (.30)	2818 (214)	275 (411)
		(elasticity of supply = 1.0)			
no rule	699 (69)	3.76 (.74)	3.76 (.74)	2578 (261)	--
rule 1	701 (69)	3.74 (.74)	3.76 (.00)	2638 (261)	69 (520)
rule 2	700 (82)	3.75 (.88)	3.76 (.25)	2641 (429)	90 (728)
rule 3	712 (73)	3.62 (.78)	3.65 (.29)	2813 (225)	292 (444)
		(elasticity of supply = 1.5)			
no rule	699 (69)	3.76 (.74)	3.76 (.74)	2578 (261)	--
rule 1	702 (69)	3.72 (.74)	3.76 (.00)	2643 (261)	78 (522)
rule 2	700 (98)	3.75 (1.0)	3.75 (.25)	2646 (508)	125 (876)
rule 3	715 (75)	3.59 (.81)	3.62 (.28)	2812 (236)	306 (478)
B. NONLINEAR DEMAND					
		(elasticity of supply = 0.5)			
no rule	699 (69)	3.88 (.83)	3.88 (.83)	2657 (275)	--
rule 1	711 (69)	3.74 (.79)	3.88 (.00)	2761 (269)	151 (533)
rule 2	706 (74)	3.82 (.88)	3.82 (.30)	2705 (410)	71 (675)
rule 3	711 (71)	3.75 (.82)	3.76 (.31)	2894 (268)	282 (385)
		(elasticity of supply = 1.0)			
no rule	699 (69)	3.88 (.83)	3.88 (.83)	2657 (275)	--
rule 1	723 (69)	3.61 (.74)	3.88 (.00)	2808 (269)	244 (523)
rule 2	710 (87)	3.83 (1.1)	3.81 (.29)	2724 (489)	94 (818)
rule 3	717 (75)	3.70 (.83)	3.70 (.29)	2884 (279)	291 (409)
		(elasticity of supply = 1.5)			
no rule	699 (69)	3.88 (.83)	3.88 (.83)	2657 (275)	--
rule 1	735 (69)	3.49 (.70)	3.88 (.00)	2857 (269)	336 (515)
rule 2	(explosive model)				
rule 3	720 (78)	3.68 (.85)	3.66 (.28)	2881 (293)	299 (434)

[a] Mean values with standard deviations in parentheses
[b] Includes government payments and levies

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