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A Public Choice Analysis of U.S. Producer Price Support in Wheat and Corn: Implications for Agricultural Trade and Policy

by

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1. Introduction

In many countries, government market intervention in agriculture is pervasive. In developing countries, agriculture tends to be taxed and in high income countries it is usually subsidized. In some countries, such as Britain, agricultural subsidization has a long history while other countries, such as Korea and Taiwan, have switched more recently from taxing agriculture to subsidizing it. In the United States, agricultural producer price support is now almost 60 years old. Regardless of its direction and form, government market intervention in agriculture leads to economic distortions and adverse distributive effects and, therefore, it is frequently criticized by economists in academia. However, policy makers usually remain untouched by this criticism and do not tend to change policies in response to it.

Public choice theory suggests that this phenomenon can be explained by doing away with the assumption of altruistic agents involved in policy decision making and by applying central concepts of economic theory to the analysis of policy decisions. In essence, public choice theory stipulates that policy makers maximize their own utility rather than some social welfare function typically used in economic analysis, and that they face constraints not accounted for in traditional economic analysis.

The analysis of the determinants of agricultural and trade policy decisions has increasingly attracted the scholarly attention of agricultural economists (e.g., Honma and Hayami, 1986).[1] While many of the empirically tested models are of the reduced form type (e.g., de Gorter and Tsur, 1991; von Witzke, 1990; Riethmuller and Roe, 1986; Young, 1987; Marchant, 1989), some models also capture essential elements of the structure of agricultural and trade policy decision making (e.g., Gardner, 1987; Paarlberg, 1983; Gallagher, 1988).

In this paper, we will develop a time series model of the determinants of U.S. agricultural producer price support in corn and wheat and test the model empirically. This will allow insights into some of the dynamics of agricultural policy decisions. Moreover, this will allow us to derive implications for agricultural trade and policy when policy decisions are endogenous.

Public choice theory is still largely domestic in character. International aspects of policy decisions and the international interdependence of policy decisions are still rarely dealt with (Frey, 1984). The same is true for agriculture (McCalla, 1993), although there is an emerging core of research that addresses international aspects of domestic agricultural and trade policy decisions (Young, Merchant and McCalla, 1991). Both the corn and the wheat industry are very export-oriented. Therefore, a better understanding of the determinants of wheat and corn price decisions should also contribute to deeper insights into the international dimensions of U.S. agricultural policy making.

In the remainder of this paper we will, first, develop a supply side model of endogenous agricultural policy that is based on the political economic calculus of the policy decision maker. We will test the model in time series analyses of U.S. wheat and corn producer price support.

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[1]For a systematic analysis of different approaches to the analysis of endogenous agricultural and trade policy see Rausser (1982); Young, Marchant and McCalla (1991).

Then we will discuss the implications of the results for international agricultural policy interdependence, and for agricultural policy analysis. We will also revisit the "agricultural treadmill" postulated by Willard W. Cochrane (1958) and reinterpret this phenomenon in light of the insights of public choice analysis.

2. Theoretical Framework

Agricultural policy in the United States has changed quite remarkably over time (e.g., Cochrane and Runge, 1992). However, the principle of the almost sixty-year old policy has not changed, namely to provide income support to farmers by supporting agricultural producer prices above international levels. For a long time, the loan rate represented a central element of U.S. agricultural income support in wheat and corn. Beginning in the early 1960s, the loan rate was reduced to a level close to the world market price and it was supplemented by direct payments. In 1974/75, a deficiency payment system was introduced, whereby the deficiency payment per unit produced was initially determined as the difference between the target price, and the loan rate or the world market price, whichever was higher. In the 1980s, the deficiency payment system was modified and other instruments of agricultural income support were employed on a larger scale as well. In this paper, we focus on the U.S. producer price support in wheat and corn.[2] As will be discussed in more detail later, this will restrict the empirical analysis to the period during which the producer support price was decoupled from the consumer price and was the central element of agricultural policy in these two markets.

Under such a system of agricultural income support, producers are the beneficiaries while

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[2]We use the term producer support price to refer to the loan rate or world market price plus direct payments (1963/64-1973/74) and the target price after 1973/74.

consumers are not directly affected, and taxpayers are saddled with the budgetary expenditures of this policy. Obviously, an increase in the minimum producer price results in growing political support from farmers and declining support from taxpayers and vice versa. Political support can be thought of as votes, whereby votes can be generated (or lost) directly as a consequence of a change in the welfare position of producers and/or taxpayers, or they can be generated indirectly by other means such as campaign contributions.

To model the political decision on a minimum producer price assume one agricultural good and a single agricultural policy decision maker who has preferences over producers and taxpayers which can be represented by a utility function. The policy maker's constrained maximization problem is:

$$\max \quad u(x_1, x_2) \tag{1}$$

$$\text{s.t.} \quad c_1(x_3) \geq x_1 \tag{2}$$

$$c_2(x_3) \geq x_2 \tag{3}$$

where

$x_1 \equiv$ producer income

$x_2 \equiv$ budgetary expenditures caused by price policy

$x_3 \equiv$ minimum producer price (target price)

The utility function (eq. 1) is assumed to be concave and continuous while the political economic constraints are assumed to be linear and continuous. In eqs. (2) and (3) the producer support price as well as the budgetary expenditures are functions of the minimum price. The policy maker chooses the producer support price (x_3) to maximize utility. The optimum condition of this maximization problem is:[3]

$$(4) \qquad \frac{\partial u}{\partial x_1} \cdot \frac{\partial c_1}{\partial x_3} + \frac{\partial u}{\partial x_2} \cdot \frac{\partial c_2}{\partial x_3} = 0$$

Eq. (4) has an obvious political economic interpretation. The policymaker sets the producer support price such that the marginal political economic benefits (via growing political support from farmers) equal the marginal political economic costs (via reduced support from taxpayers) resulting from an increase in the minimum price.

As the policy maker's utility function is assumed to be strictly concave and the constraints to be linear, it follows from the implicit function theorem that there is a solution for x_3.[4] Therefore, the producer support price (x_3) can be expressed as a function of x_1 and x_2. However, unless the functional forms of eqs. (1), (2) and (3) are known, the form of this function can only be determined empirically. Let the solution be linear, then

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[3]See the appendix for the derivation of the optimum condition.

[4]See the appendix for details.

(5) $x^0_{3t} = \alpha_0 + \alpha_1 x_{1t} + \alpha_2 x_{2t}$

where x^0_{3t} denotes the optimum price in period t.

In the real world, policymakers face various contractual constraints in adjusting a government regulated price over time. Usually, decisions on the price level involve time cost which tend to increase with increasing extent of price adjustments. Major price changes may even require special legislation. Often, policy decision makers are also constrained by bills which contain guidelines for price adjustments over time. U.S. farm bills represent examples of this kind of constraints. Farm bills outline policy principles for a five-year period while limited adjustments of these policies can be decided on a year-to-year basis.

A very common and rather convenient way to account for such constraints is the Nerlovian partial adjustment hypothesis (Nerlove, 1958). Its central assumption is that the actual change in the decision variable between two periods is a constant fraction of the difference between the optimal and the past value. For our problem the Nerlovian partial adjustment hypothesis implies:

(6) $x_{3t} - x_{3t-1} = \gamma(x^o_{3t} - x_{3t-1}) + \Theta_t$

where

$0 < \gamma \leq 1$

$\Theta_t \equiv$ error term (NID)

Combining Equations (5) and (6) yields:

(7) $x_{3t} = \beta_0 + \beta_3 x_{3t-1} + \beta_1 x_{1t} + \beta_2 x_{2t} + \Theta_t$

where

$\beta_0 = \gamma\alpha_0$

$\beta_3 = 1 - \gamma$

$\beta_1 = \gamma\alpha_1$

$\beta_2 = \gamma\alpha_2$

3. <u>Empirical Analysis</u>

In eq. (7), the producer price for t is determined by the agricultural policymaker at some time prior to t. Let this be at $t-i$, $i \geq 1$. At this time neither x_{1t} nor x_{2t} are known. Hence, x_{1t} and x_{2t} have to be substituted by their respective expected values $x_{1t}*$ and $x_{2t}*$. Economic theory suggests that rational economic agents form expectations based on the available information at the time of the decision. This is commonly denoted as:

(8) $x_{1t}* = E\,(x_{1t} \mid I_{t-i})$

(9) $x_{2t}* = E\,(x_{2t} \mid I_{t-i})$

$x_{1t}*$ = expected value of producer income in t

$x_{2t}*$ = expected value of budgetary expenditures in t

I_{t-i} = Information set of policy makers at the time of decision in t-i

Moreover,

(10) $x_{1t} = x_{1t}* + v_t$

(11) $x_{2t} = x_{2t}* + w_t$

Where v_t and w_t are error terms which are NID.

Substituting eqs. (10) and (11) into eq. (7) yields:

(12) $x_{3t} = \beta_0 + \beta_3 x_{3t-i} + \beta_1 x_{1t}^* + \beta_2 x_{2t}^* + \epsilon_t$

ϵ_t = error term

We are now in a position to discuss the expected signs of the parameters. Based on the theoretical analysis the sign of β_0 can not be determined a priori. As $0 < \gamma \leq 1$ and $\beta_3 = 1 - \gamma$, it follows $0 \leq \beta_3 < 1$. In the United States as well as in other countries in which agriculture is subsidized, one would expect the signs of both β_1 and β_2 to be negative. That is, a relatively low (high) expected agricultural income or relatively low (high) expected budgetary expenditures lead to a relatively high (low) producer support price.

The error term in eq. (12) requires further discussion. When exogenous variables have to be substituted by their expectations the nature of the error term is such that OLS regressions would yield inconsistent estimates (Nelson, 1975). From eqs. (7), (10) and (11) it follows that this is, in fact, the case here, as $\epsilon_t = \Theta_t + \beta_1 v_t + \beta_2 w_t$. To solve this problem, suitable instrument variables for the anticipations have to be used (for details see Wallis, 1980; McCallum, 1976).

The empirical analysis covers the time period 1963/64 to 1983/84. The data used are from USDA (1984, 1989) publications. All monetary variables have been deflated by the CPI. Detailed information on the income situation of U.S. wheat and corn farmers is not available. As policymakers do not have such information either, the use of a proxy is appropriate and does not involve a major risk of biased estimates. A number of different proxies for x_1 could be used in principle, such as overall farm income or farm income in major grain producing states. We have elected to use the U.S. share in world wheat and corn exports. The U.S. grain sector was very export oriented during the time period analyzed here, and the U.S. share in world exports is commonly perceived as a good indicator of the income situation of wheat and corn producing farmers.

The instruments for the anticipations x_{1t}* and x_{2t}* have been estimated via autoregressions. The time lag was chosen for each time series based on the significance of the coefficients. The results are summarized in the appendix. The superscripts w and c denote wheat and corn respectively. The empirical test of eq. (12) yielded the following results:[5]

$$(13) \quad x^{w}_{3t} = \underset{(2.90)}{4.207} + \underset{(5.21)}{.6362}x^{w}_{3t-1} - \underset{(-2.73)}{.0808}x^{w}_{1t}* - \underset{(-2.59)}{.6049}x^{w}_{2t}*$$

$\bar{R}^2 = .853$
$\rho = -.291\ (-1.16)$

$$(14) \quad x^{c}_{3t} = \underset{(3.09)}{1.023} + \underset{(7.62)}{.9313}\ x^{c}_{3t-1} - \underset{(-3.04)}{.0090}\ x^{c}_{1t}* - \underset{(-2.74)}{.2898}\ x^{c}_{2t}*$$

$\bar{R}^2 = .801$
$\rho = -.175\ (-.696)$

The results of the regression analyses do not allow rejection of the central hypotheses developed in this paper. All coefficients have the expected signs and are highly significant. The coefficients for x_{3t-1} are positive and in the expected range; and those for x_{1t}* and x_{2t}* are negative in both equations. This is, a relatively low (high) expected share in world exports or relatively low (high) budgetary expenditures result in a comparatively high (low) producer support price, ceteris paribus. These results are similar to those obtained in time series analyses of the determinants of agricultural price support in other developed countries such as the

[5] t- values are in parentheses. The support price is in $ per bushel; budgetary expenditures are in $1,000; the U.S. share in world exports is in percent; and ρ represents the estimated parameter correcting for first order autocorrelation of the residuals.

European Community or Japan (e.g., Riethmuller and Roe, 1986). This suggests that in developed countries fluctuations in agricultural price support over time are to a large extent determined by producer incomes and budgetary expenditures caused by price policy.

4. Implications for Domestic and International Agricultural Trade Policy Reform: International Interdependence

The endogenous nature of agricultural producer price support has some immediate implications for domestic as well as for international agricultural and trade policy reform. As discussed above, the results presented in this paper can be generalized. In other developed countries which subsidize agriculture, policy decisions show a similar pattern. For instance, much like in the United States, agricultural price support in the European Community provided under the Common Agricultural Policy is, to a large extent, determined by agricultural producer incomes and price policy related budgetary expenditures (von Witzke, 1986).

Agricultural and trade policy tends to be pervasive in both developed and developing countries alike (Olson, 1986). Until the Uruguay Round, agriculture was largely excluded from the provisions of the General Agreement on Tariffs and Trade (GATT). This was the result of a waiver obtained by the United States in 1955 which paved the way for agricultural protectionism in industrialized countries. For a variety of reasons, agricultural trade and policy was not considered a major issue in many countries at that time. In fact, until the early 1960s it was not un-common to analyze agricultural policy issues in the United States in a closed economy framework. Agriculture in the United States produced largely for a stagnant domestic market; exports as well as imports were considered to be residual in character (Cochrane, 1965). Moreover, budgetary expenditures caused by agricultural price support were at levels which were not considered to be very burdensome politically. In fact, in some countries, such as in the European Community, agricultural trade policy used to be a source of government revenue.[6]

Since the GATT waiver this changed completely. International agricultural trade grew at rapid rates (e.g., FAO, 1990). Moreover, agricultural protectionism began to become more expensive due to agricultural productivity growth and the long-run trend of declining real world prices of agricultural commodities (e.g., Tyers and Anderson, 1992). In the 1980s, budgetary expenditures caused by agricultural and trade policy grew tremendously in both the United States and in the European Community, the two most important food and agricultural commodity trading countries (e.g., EC Commission, 1990).

The rapidly growing budgetary burden of agricultural and trade policy put pressure on many governments to significantly reform existing farm programs. However, the growing internationalization of agriculture through trade together with the endogenous nature of policy decisions had resulted in international agricultural and trade policy interdependence and, therefore, had made unilateral policy reform a politically unattractive option. Under these conditions policy makers are faced with a classical Prisoners' Dilemma, as they have to expect that unilateral policy liberalization would be counteracted by other countries' endogenous policy adjustments. As a consequence, agriculture was put on the agenda and it became pivotal in the Uruguay Round of multilateral trade negotiations under the GATT.

To illustrate the political economic problems of unilateral agricultural and trade policy

[6]The EC used to be a net importer of many important agricultural commodities, including wheat. Under this condition the Common Agricultural Policy is a source of revenue. However, in the late 1970s the EC began becoming a net exporter on many markets and the Common Agricultural Policy increasingly became a drain on EC finances.

liberalization consider a world of two large countries, the European Community and the United States, and a passive rest-of-the-world. Assume further that the United States would discontinue price support in wheat. The resulting decline in U.S. production and exports would increase the world market price. As mentioned earlier, agricultural price support in the European Community is to a large extent determined by the same variables as U.S. producer price support, namely agricultural incomes and budgetary expenditures. Given the principle design of the Common Agricultural Policy and the existing EC surplus production in wheat, an increasing world price would act to reduce EC budgetary expenditures.[7] This, in turn, would lead to a higher support price there and thus increased EC exports and a declining world price. Compared to a situation without this endogenous adjustment of the Common Agricultural Policy, U.S. producers would have to bear higher cost of adjustment to the unilateral policy change.

In fact, price policy interdependence could be observed in the past under comparable circumstances. In the early 1980s, the European Community was expected by many to face financial collapse unless the level of price support was reduced significantly. For a number of reasons, two of which are linked to macro-economic and agricultural policy decisions in the United States, this did not happen, however, until the late 1980s. In the first half of the 1980s, the value of the U.S. dollar steadily increased against the currencies that form the European Currency Unit (ECU). This acted to reduce the difference between EC support prices and world market prices in terms of the ECU. It also reduced the export subsidies per unit and, thus, total budgetary expenditures which, in turn, allowed the Community to maintain relatively higher

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[7]At given levels of price support an increase in the world market price reduces the EC export restitution per unit exported, and consequently it also reduces budgetary expenditures of price policy.

support prices. In the same time period, budgetary expenditures of agricultural price support in the United States had reached levels that were politically no longer tolerable. As reductions in real support prices to an extent that would significantly reduce budgetary expenditures were politically not feasible at that time, acreage reduction programs were introduced. These programs together with unfavorable weather conditions in the United States reduced agricultural production and thus U.S. exports, again increasing world prices and contributing to relatively higher price support levels in the European Community. However, when the value of the U.S. dollar began to decline in the second half of the 1980s and continued to do so during the early 1990s the Common Agricultural Policy was turned around. The declining value of the U.S. dollar relative to the ECU contributed markedly to the increase in agricultural price policy related budgetary expenditures in the European Community and the real level of price support began to decline significantly.

5. Implications for Policy Analysis: Myth and Reality of Agricultural Producer Price Support Programs

In his book, Farm Prices: Myth and Reality, Cochrane (1958) characterizes the economic mechanism that underlies the long-term adjustment processes of agriculture in developed countries. His "treadmill" theory, which is formulated in a closed economy framework, is based on the observation that in developed countries, agricultural supply growth tends to exceed the growth in demand. Hayami and Ruttan (1985), and Tyers and Anderson (1992) demonstrate that this phenomenon is observable on the global scale as well: agricultural supply growth outstrips the increase in demand; food becomes more abundant; and the long-term trend of real world market prices is negative.

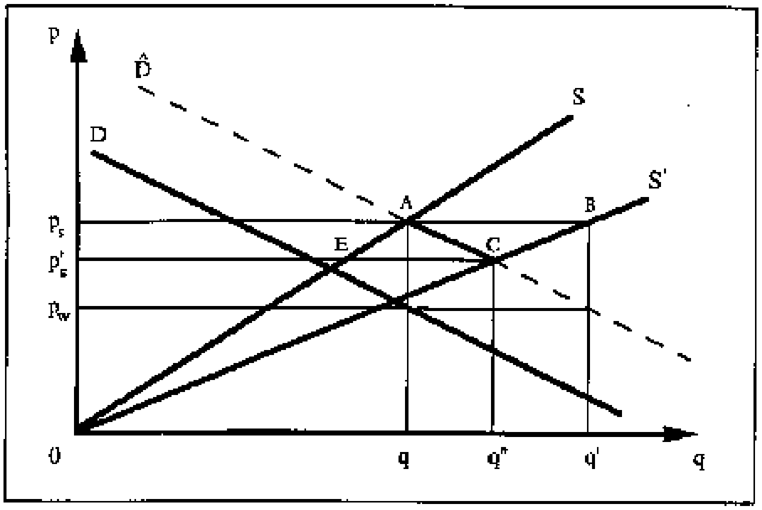
In the United States and in other countries, minimum producer prices have been established in an attempt to eliminate, or at least to alleviate, the persistent income and adjustment problems resulting from the agricultural treadmill. Without government market intervention, an increase in the supply of an agricultural commodity causes the market price to decline, where the price decline is determined by the extent of the supply growth and the price elasticity of demand, all other things being equal. The minimum price acts to change the effective price elasticity of demand to infinite. No matter what the domestic supply, farmers will always receive the government set minimum price as long as the world price is lower. This is the myth of farm programs which is typically reflected in analyses of the trade and social welfare effects of minimum producer price programs in which a shift in the supply curve does not affect the producer price, all other things being equal, and the resulting change in producer surplus is unambiguously positive. This is illustrated graphically in Figure 1 for the small country case. A shift in the supply curve from S to S' at a given support price (P_s) increases the producer surplus by the area OAB.

As discussed in this paper, not everything remains the same. Important variables change when there is a supply growth in agriculture, as this will increase farm incomes as well as government expenditures. Both changes induce the government to reduce the agricultural producer support price. This is shown in Figure 1 where the support price declines from P_s to P_s' . The effective demand faced by producers when policy decisions are endogenous is not perfectly elastic. Rather it is characterized by the movement from A to C which is extrapolated in Figure 1 to $\hat{D}$. Compared to an unchanged support price the producer surplus is smaller by P_sBCP_s' . The new producer surplus $OP_s'C$ may be larger, equal, or smaller than the original producer surplus OP_sA depending on whether

$P_sAEP_s \gtrless$ OEC.

As we have seen, the introduction of a minimum producer price does not render the agricultural treadmill dysfunctional. What minimum price programs do, is to create temporary rents for landowners (be they farmers or not) which are eroded in subsequent periods via the endogenous adjustments of support prices, while the social welfare losses and adverse distributive effects continue for as long as the programs are in place. Obviously, the process discussed here can be offset when the political power of agricultural interest groups increases over time such that the minimum price would

Figure 1. The "Agricultural Treadmill" when Price Policy is Endogenous



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increase at any given level of agricultural income and budgetary expenditures. This is a phenomenon that has been observed in the course of economic development in many countries, and it explains part of the decline in real agricultural world market prices that has occurred in the last few decades (Honma and Hayami, 1986; Tyers and Anderson, 1992). However, once agriculture has undergone major structural adjustments and it has become a small industry, the political power of agricultural interest groups does not grow much over time anymore. Consequently, the reality of farm programs sets in, producer price support declines, and the agricultural treadmill begins to function again.

To illustrate the effects of the agricultural treadmill with government market intervention at given levels of political influence of agricultural interest groups, consider the empirical results of this study and assume an exogenous and permanent increase in U.S. production each of corn and wheat. This will increase both x_1 and x_2 and will, thus, lead to a lower price in subsequent periods. Obviously, the dynamic nature of eqs. (13) and (14) implies that it may take several periods until the support price converges at its new equilibrium level. In addition to the parameters of the regressions in eqs. (13) and (14), the extent of the producer support price reduction on each market depends on the domestic supply elasticity, international price transmission elasticities, the world market price elasticity of demand faced by the United States, policy adjustments in other countries, as well as changes in production and consumption in other countries.

Of course, the extent of the changes in producer support prices depends on the particular scenarios analyzed and on the magnitude of the aforementioned parameters. For most of these parameters there exist econometric estimates on which a simulation of the effects of a growth in U.S. production on producer price support can be based. For many of these parameters, such as the U.S. price elasticities of demand for wheat and corn, there is even considerable consensus in our profession about the order of magnitude.

Table 1 exhibits the results of simulations of an exogenous and permanent five percent increase in the U.S. production of wheat and corn respectively for the small and the large country case. Of course, the United States is a large country in both the wheat and the corn market. However, we have elected to analyze the small country case also, because only one additional parameter is needed for each commodity (the U.S. supply elasticity), and there is some consensus about its order of magnitude. For the analysis of the producer support price changes resulting from an increase in production in the large country case, some additional assumptions and parameters are required. They are discussed in the Appendix. As indicated by Table 1, both scenarios resulted in similar reductions of the producer support prices.

In view of the nature of the empirical model and the variables used, it is not very surprising that the results of the large country scenario do not differ much from the small country case. Any given growth in production results in a relatively larger increase in budgetary expenditure in the large country case. This partial effect reduces the support price more than in the small country case. However, a growing production in the large country case reduces the world market price and thus stimulates domestic demand such that U.S. exports increase less than in the small country case. Both partial effects happen to be about the same in the scenarios analyzed here and therefore the large country scenario leads to results which are very close to the small country case.

Table 1. The Effect of a Five Percent Increase in U.S. Wheat and Corn Production on the Real U.S. Producer Support Prices in Wheat and Corn.[1]

Crop[2]	**Wheat**	**Corn**
x_{3t}	1.44	.94
(small country assumption)		
x_{3t+1}	1.36	.91
x_{3t+5}	1.38	.83
percent change $_{t, t+5}$	–4.2	–11.7
(large country assumption)		
x_{3t+1}	1.37	.91
x_{3t+5}	1.38	.82
percent change $_{t, t+5}$	–4.2	–11.7

Source: Own computation based on USDA (1984, 1989) and eqs. (13) and (14). For details, see the appendix.

[1] x_3 is the real producer support price deflated by the CPI; x_{3t} is the price in the base period.

[2] Base year t is 1983/84 for wheat and 1984/85 for corn.

Given the dynamic nature of eqs. (13) and (14) we have reported the support prices for periods t+1 and t+5. Generally, the support price converged rather quickly. The changes in x_3 between t+4 and t+5 were below .001$/bushel for wheat and below .005$/bushel for corn. The price changes reported in Table 1 are in the expected direction. An increase in production reduces the producer support price for each commodity, as it acts to increase both support price determining variables x_1 and x_2. The extent of price reductions is reasonable; the resulting effective price elasticities actually faced by producers when U.S. price support is endogenous was –1.19 for wheat and –0.43 for corn. These numbers are smaller (more elastic) than those reported for domestic U.S. demand for wheat and corn, which typically are between –0.2 and –0.3.[8] At first glance one, therefore, might be tempted to conclude that U.S. producer price support in wheat and corn during the time period analyzed here actually ameliorated the price effects of a production growth on producer prices. However, one must not overlook that the United States is an open economy. Both the U.S. wheat and corn industries export a large portion of domestic production. Therefore, what really matters in this regard is the world market demand faced by U.S. wheat and corn producers. Estimates of these elasticities vary over a rather wide range. For instance, a review of concepts of analysis and estimates of U.S. export demand elasticities reveals a range of –0.1 to –3.1 for wheat and –0.17 to –0.6 for corn (Gardiner and Dixit, 1986). McCalla, Abbott and Paarlberg (1986) estimate the export demand elasticity faced by the United States to be between –1.33 and –0.97 for wheat and between –1.75 and –1.55 for coarse grains. Our estimates of the effective price elasticities when support prices

[8]In USDA's "Embargo Study," McCalla, Abbott, and Paarlberg (1986) report a U.S. demand elasticity of –0.2 for wheat and –0.3 for corn. More recently, Tyers and Anderson (1992) report demand elasticities of –0.12 and –0.20 for wheat and corn respectively.

are

endogenous are close to estimates reported in the literature for the effective world price demand elasticities faced by the United States.

To our knowledge, our estimates of the extent of endogenous support price changes when there is an increase in production are the first of its kind. Further attempts at quantifying the effective producer price elasticity when price support is endogenous may result in estimates that differ from ours, depending on theoretical concepts used, time periods analyzed, or scenarios simulated. In view of the fact that the analysis of the quantitative reaction of price support to changes in production is more complex than the more traditional analysis of supply or demand elasticities, it is likely that the range of estimates will be rather wide. Therefore, one must resist the temptation to overinterpret the results reported in Table 1. Nevertheless, it is clear that during the time period analyzed here, the agricultural treadmill has been functional in U.S. wheat and corn production: An increase in production acts to reduce the level of producer price support and the price reduction is in the range to be expected without government market intervention.

6. Summary and Conclusions

In this paper, we have developed a time series model of endogenous U.S. producer price support in wheat and corn. The results of our analysis suggest that producer support prices for these commodities during the time period analyzed are determined to a large extent by the expectations of policy decision makers about the economic situation of producers and budgetary expenditures caused by price policy.

These results, which are consistent with those found for the determinants of agricultural producer price support in other countries, have implications for domestic and for international agricultural and trade policy reform. The endogeneity of agricultural producer support prices implies that domestic agricultural and trade policy decisions are internationally interdependent. While still being technically possible, domestic agricultural and trade policy liberalization without coordination with other countries is politically less feasible when domestic policies of two or more countries are interdependent, as other countries would be free-riding on one country's unilateral trade liberalization.

The results of the analysis in this paper also have implications for policy analysis. The myth of agricultural price support programs is that they can alleviate the persistent agricultural income problem of agriculture in developed countries. Economic analysis has dealt this myth a few blows already by demonstrating that producer price support causes social welfare losses, that it tends to be capitalized into land values, and that most of the benefits go to relatively wealthy farmers. The analysis in this paper adds to shattering the myth of agricultural price support programs by revealing their political economic reality. Minimum producer prices can be held constant or they can even increase for some period of time. But the growth in production will eventually lead to a decline in the support price. Much like without producer price support, farmers again face an effective demand which is far less than perfectly elastic.

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APPENDIX

I. The Derivation of the Reduced Form Public Choice Model of U.S. Producer Support Price Determination in Wheat and Corn

The policymaker's constrained maximization problem is

(A1) $\max u(x_1, x_2)$

(A2) s.t. $c_1(x_3) \geq x_1$

(A3) $c_2(x_3) \geq x_2$

where

$x_1 \equiv$ producer income

$x_2 \equiv$ budgetary expenditure

$x_3 \equiv$ target price (minimum producer price)

It is assumed that $u: R^2 \rightarrow R$ is twice differentiable and strictly concave, and that the underlying preferences are locally nonsatiated. Both constraints are assumed to be continuously differentiable and linear. Given the strict concavity of the objective function and the linear constraints, we know that if there exists an x^0 that locally maximizes u(x) s.t. $c_j(x) \geq 0$ (j = 1, 2, and $x \in R^3$) then x^0 also globally maximizes u(x) s.t. $c_j(x) \geq 0$. Furthermore, since preferences are locally nonsatiated, eqs. (A2) and (A3) hold with equality; that is, we have an equality constrained maximization problem. Since the rank condition is satisfied, i.e., rank [D c(x)] = 2, we can apply Lagrange's Theorem. Define the Lagrangian $L: R^3 \times R^2 \rightarrow R$ by

(A4) $L(x, \lambda) = u(x_1, x_2) - \lambda_1[c_1(x_3) - x_1] - \lambda_2[c_2(x_3) - x_2]$

The first-order derivative of the Lagrangian with respect to x and λ provides the FONCs for x^0 being a local (and global) maximizer of u(x) s.t. c(x) = 0:

(A5) $D\,L(x^0, \lambda^0) = 0$

(A5.1) x_1: $\partial u/\partial x_1\,(x^0) + \lambda_1^0 = 0$

(A5.2) x_2: $\partial u/\partial x_2\,(x^0) + \lambda_1^0 = 0$

(A5.3) x_3: $-\lambda_1^0\,(\partial c_1/\partial x_3)\,(x^0) - \lambda_2^0\,(\partial c_2/\partial x_3)\,(x^0) = 0$

(A5.4) λ_1: $-c_1(x_3^0) + x_1^0 = 0$

(A5.5) λ_2: $-c_2(x_3^0) + x_2^0 = 0$

Combining eqs. (A5.1) and (A5.2) yields the equilibrium condition for a government controlled producer support price:

(A6) $$\frac{\partial u/\partial x_1}{\partial u/\partial x_2}(x^0) = -\,\frac{\partial c_2/\partial x_3}{\partial c_1/\partial x_3}(x^0)$$

That is, the agricultural policymaker sets the minimum producer price x_3 , such that the ratio of marginal political benefits equals minus the reverse ratio of marginal costs.

Assuming that $D^2u(x)$ is negative definite for all $x \in R^2$ (which is sufficient for u to be strictly concave in R^2), that is, assuming that

(A7.1) $\partial^2 u/\partial x_1^2\,(x) < 0$

(A7.2) $\partial^2 u/\partial x_2^2\,(x) < 0$

(A7.3) $[\partial^2 u/\partial x_1^2\,(x)]\,[\partial^2 u/\partial x_2^2\,(x)] - [\partial^2 u/(\partial x_1 \partial x_2)\,(x)]^2 > 0$

and assuming that

(A7.4) $\partial u/\partial x_1\,(x) > 0$

(A7.5) $\partial u/\partial x_2\,(x) < 0$

(A7.6) $\partial c_1/\partial x_3(x) > 0$

(A7.7) $\partial c_2/\partial x_3\,(x) > 0$

(A7.8) $\partial^2 c_1/\partial x_3^2(x) = \partial^2 c_2/\partial x_3^2\,(x) = 0$

(A7.9) $\partial^2 u/(\partial x_1 \partial x_2)(x) = \partial^2 u/(\partial x_2 \partial x_1)(x) < 0$

for all $x \in R^3$

guarantees that the determinant of the second derivative of L with respect to x_3, and λ is strictly negative,

(A8) $\det\,[D^2L(x^0, \lambda^0)] < 0$

that is, $D^2L(x^0, \lambda^0)$ is nonsingular.

The assumptions formulated in eqs. (A7.1) through (A7.9) are consequences of basic economic considerations about marginal returns, the strict concavity of the objective function, the linear constraints, and Young's Theorem. Albeit somewhat restrictive, they constitute an economically plausible theoretical framework. An increase (decrease) in producer income, at the margin, increases (decreases) the policymaker's utility, that is, political support, eq. (A7.4), whereas an increase (decrease) in budgetary expenditures leads to a decrease (increase) in utility, eq. (A7.5). The equalities in eq. (A7.8) are a consequence of the linear constraints. The second order cross partial derivatives of the objective function eq. (A7.9) are assumed to be negative: given that an increase in political support (utility) based on an increase in producer income (x_1) occurred, a subsequent increase in budgetary expenditures (x_2) (via an increase in support prices set by the policymaker), decreases the policy maker's utility. Hence, there is a trade off between increasing support form producers and decreasing support from taxpayers. The equality in eq. (A7.9) is guaranteed by Young's Theorem.

Since for (x^0, λ^0), D $L(x^0, \lambda^0) = 0$, and $D^2L(x^0, \lambda^0)$ is nonsingular, by the Implicit Function Theorem (IFT), the FONCs described by eq. (A6) determine x_3^0 (locally) as a function of x_1^0 and x_2^0. That is, there exists a neighborhood V of (x_1^0 and x_2^0) in R^2, and a neighborhood U of x_3^0 in R, and a unique continuously differentiable function g: $V \rightarrow U$ such that

(A9) $$x_3^0 = g(x_1^0, x_2^0)$$

Given the constrained maximization problem in which the policymaker's control variable is the minimum producer price, x_3, and the assumptions listed above, the IFT guarantees a solution x_3^0 functionally depending on x_1^0 and x_2^0, producer incomes and budgetary expenditures; this is, the solution to the maximization problem can be approximated by the statistical model described in eq. 5 (Section 2).

II. Estimates of the Instrument Variables

(A10) $X^{w}_{1t} = 23.09 + .4385\ X^{w}_{1t-1}$
(2.79) (2.21)

$\bar{R}^2 = .151$

(A11) $X^{w}_{2t} = 204{,}233 + 448.93\ X^{w}_{2t-1}$
(1.88) (1.98)

$\bar{R}^2 = .123$

(A12) $X^{c}_{1t} = 23.66 + .6398\ X^{c}_{1t-2}$
(2.21) (3.68)

$\bar{R}^2 = .374$

(A13) $X^{c}_{2t} = 949{,}233 + 318.6\ X^{c}_{2t-1}$
(2.94) (1.46)

$\bar{R}^2 = .096$

III. Simulation of Support Price Adjustments Resulting from Production Growth

The simulation of the small country case requires just one additional parameter for each commodity and this is the U.S. supply elasticity (e_1). We chose $e_1 = 0.5$ for both crops. This is well within the range reported in the literature. For instance, Tyers and Anderson (1992) report e_1 to be between 0.45 and 0.80 for wheat and between 0.40 and 0.75 for coarse grain.

The simulation of the large country case requires several additional parameters and behavioral assumptions, which conceivably may have a significant impact on the result of the simulation. It turned out, however, that this was not the case here, and the results of the simulations were rather stable when alternative sets of parameters were used. The additional parameters for the large country case are for each market the price elasticity of demand (e_2), the elasticity of transmission of the world market price to the domestic consumer price (e_3), and the export price elasticity of demand faced by the United States (e_4). The following values for e_2, e_3 and e_4 were used for each market:

$e_2 = -0.2$

$e_3 = 1.0$

$e_4 = -1.65$

There appears to be general consensus about the magnitude of the price elasticity of demand while estimates of price transmission and export demand elasticities vary over a relatively wide range. During the time period analyzed here, the loan rate tended to follow the world market price fairly closely, so $e_3 = 1$ is plausible, while the export demand elasticity (e_4) used here is within the range reported in the literature for the time period analyzed here (McCalla, Abbott and Paarlberg, 1986; Gardiner and Dixit, 1986). An additional assumption is required regarding the reaction of other countries to the change in world market prices. To quantify their reaction would require a rather disaggregated model of international trade in wheat and corn with endogenous adjustments of the foreign countries' policies. This would clearly be beyond the scope of this study and would require more space than is available here. Therefore, it is assumed that foreign exports remain constant and the U.S. share in world exports changes only with U.S. exports. Given the small impact the large country assumption has on the results of the simulation, this assumption does not appear to be critical. If foreign countries' exports of wheat and corn would decline as a consequence of a declining world market price, the large country effect would even be less pronounced than in the simulations reported here.