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Intervention bias in agricultural policy

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ABSTRACT

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This paper re-examines the motivation for government intervention in agriculture to support farm prices and incomes. A model is outlined in which the government has a preference for higher farm incomes but fails to provide farmers with the socially optimal level of price support, even when one accepts the government's income redistribution goals as a valid reflection of social preference. It is shown that agricultural policy has an intervention bias: government price supports generally are higher than would be socially optimal. The source of the intervention bias is a time inconsistency in optimal agricultural policy formation, caused by the government's inability to precommit to a rule for setting future price support levels. Simulation results indicate that in some circumstances the intervention bias in agricultural policy can be substantial.

INTRODUCTION

Governments of many developed countries provide substantial subsidies to their agricultural sectors. The U.S. and the European Community are prime examples; but other countries, such as Canada and Australia, also protect agriculture to various degrees. The primary purpose of this support seems to be redistribution of income from taxpayers and consumers to farmers, in order to attain political objectives. There have been attempts to rationalize agricultural subsidies on economic efficiency grounds, but generally these have fallen short and it is widely perceived that government support for agriculture aims at income redistribution for political purposes.

In response, economists have begun to model government income redistribution goals via a political objective function which weights the different

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interests of producers, consumers and taxpayers (Gardner, 1983, 1987; Oehmke and Yao, 1990). Implicit in this approach is that government support for agriculture is socially optimal, provided one accepts the government's income redistribution goals as a valid reflection of social preferences.

The purpose of this paper is to highlight an important problem with the government objective function approach to modeling intervention in the agricultural sector: the problem of time inconsistency in agricultural policy formation. A model is outlined in which the government wants to redistribute income from taxpayers to farmers but fails to provide the socially optimal level of price support, even when the government's own political objective function is accepted as a valid social welfare indicator. It is shown that agricultural policy has an intervention bias: government price supports generally are higher than would be socially optimal.

The source of the intervention bias is that unanticipated increases in government price supports lead to greater gains in farm income than do anticipated price support increases of the same magnitude. The income effects of surprise support accrue directly to farmers in the form of economic rent. However, when price supports are anticipated the prices of factors of production are bid up and part of the benefit accrues to off-farm resource owners. Thus, a government that wants to transfer income from taxpayers to farmers, but not off-farm resource owners, has an incentive to surprise farmers by providing more support than was previously expected. Nevertheless, the government cannot continually surprise farmers with more support than they expect. Farmers eventually will realize that announcements of low price support levels are not credible because the government has an incentive to surprise them by increasing the level of support. If the government cannot commit credibly to a preannounced price support level, then the outcome is an equilibrium in which farmers expect socially excessive levels of support and the government provides them.

This intervention bias occurs not because the government is being myopic or irrational in its choice of price support level. In fact, the government always responds optimally given the current expectations of farmers. Rather, the intervention bias occurs because institutional arrangements preclude credible commitment to specific levels of price support over long time horizons. Instead, the government relies on discretionary policy through which price support levels can be adjusted continually in response to changing economic circumstances and farmer expectations.

The intervention bias equilibrium is time consistent because the government is maximizing its political objective function given the actions and expectations of farmers. However, it will be shown that the socially optimal

policy of lowering support levels is time inconsistent, because if farmers come to expect the lower support levels then it is optimal for the government to surprise them by setting higher ones. This time inconsistency in optimal agricultural policy formation is the direct cause of the intervention bias [see Kydland and Prescott (1977) for a seminal discussion of time inconsistency].

The model in this paper is related to the literature on time inconsistent monetary policy (Kydland and Prescott, 1977; Barro and Gordon, 1983; Backus and Driffill, 1985; Blackburn and Christenson, 1989). However, the current model differs from these monetary models in an important way. The socially optimal (but time inconsistent) monetary policy is a zero inflation rule because (in these models) unanticipated inflation increases output and employment but anticipated inflation has no real effects on the economy. In the case of agricultural policy, however, both anticipated and unanticipated farm price supports will increase farm income. Thus, some degree of price support will always be optimal, provided the government has a preference for higher farm incomes. But when surprise increases in price supports cause bigger increases in farm incomes than anticipated price support increases of the same magnitude, then the government has an incentive to expand support beyond the socially optimal level and an intervention bias results.

The remainder of the paper analyzes the intervention bias in agricultural policy in detail. In the next section, a simple model of agricultural policy formation is provided. The equilibrium price support level is characterized assuming the government has discretion to alter price support levels after farmers have allocated some resources to the production process. Next the model is extended to the case where the government can precommit to a fixed support level before farmers make any resource allocation decisions. The two equilibria are then compared and it is shown that the precommitment equilibrium is socially optimal and the discretionary equilibrium has an intervention bias with price supports set above the socially optimal level. Simulation results provide information on the size of the intervention bias in agricultural policy under alternative model assumptions. Finally, there are concluding comments.

AGRICULTURAL POLICY FORMATION UNDER DISCRETION

The intervention bias in agricultural policy is examined using the simplest possible model of farmer and government behavior. The goal is to provide a basic understanding of the main features causing the intervention bias in the context of a simple stylized model; not to analyze any actual agricultural policy problem in a realistic way.

There are n identical farmers producing a single output, food, using two inputs, land and labor. The food production technology is represented by a production possibilities set T which is a subset of the three-dimensional space of real numbers R^3 . Positive elements of T represent the output food and negative elements represent the inputs land and labor. The set T gives all of the feasible production plans that can be undertaken with existing technology. The government engages in income redistribution by setting a support price, p , for food. The support price is the market price plus government payments to farmers per unit of output.

Government payments to farmers can be interpreted in a number of ways. For example, p might be a target price with the difference between p and the market price consisting of a deficiency payment (subsidy) to farmers. Or the government may purchase and store food in order to boost current demand and price. In this case, p is the price received by farmers and government payments entail expenditures on output. Finally, p could be the market price plus disaster payments to farmers to offset unusually challenging economic circumstances (e.g. drought). Each of these types of support have been a feature of agricultural policies in developed countries.

The timing of farmer and government decisions is crucial to the analysis. The government sets price supports early enough so that farmers can delay their labor allocation until after the price support level has been observed. On the other hand, the land allocation decision must be made prior to the government setting a support level. This models the situation in agriculture where policymakers have discretion to adjust support levels on a year-to-year basis. Some inputs, such as hired labor, fuel, fertilizer, etc. can be allocated after support levels for the year have been set. But others, such as land and machinery, are durable and investments in durable assets are long-run decisions that depend on expectations of prices many years into the future. There may be scope for re-allocating existing land and machinery investments across enterprises after the level of government price support for the year have been set. However, it seems fair to say that, in the short run, there is generally much less flexibility in re-allocating land, machinery and other capital assets in response to government price support decisions than there is in re-allocating variable inputs such as labor, fuel, fertilizer etc. It therefore makes sense to think of investment in these durable assets as occurring prior to farmers observing actual levels of government support.

Even though farm input allocation decisions are made sequentially (land first then labor), the optimal sequential allocation rule is equivalent to an optimal simultaneous rule (land and labor chosen simultaneously) as long as farmers have perfect foresight. Thus, if farmers have perfect foresight and maximize profits then the farm profit function can be defined:

$$\pi(p, w, r) = \max\{pq - wx - rz \mid (q, -x, -z) \in T\} \quad (1)$$

where q is quantity of food produced; x is labor input; z is land input; w is the wage rate; and r is the rental price of land. It is assumed there is free entry and exit so that $\pi(p, w, r)$ is zero in long-run equilibrium.

The supply of labor to agriculture is assumed perfectly elastic at the equilibrium wage, w . This assumption is for convenience only. Relaxing it would not change the nature of the intervention bias because the labor allocation decision is always made after price supports have been set. The supply of land to agriculture is represented by a monotonically increasing aggregate supply function, $s(r)$. Thus, the equilibrium land price is defined implicitly by using Hotelling's lemma and equating demand and supply for land:

$$-\pi_r[p, w, r(p, w)] = s[r(p, w)]/n \quad (2)$$

where n is the number of farms; subscripts indicate partial differentiation; and $r(p, w)$ is an implicit pricing function that maps output prices and wage rates into equilibrium land prices.

The level of farm income depends on two factors. First, the economic profit from running the farm operation, $\pi(p, w, r)$, accrues directly to farmers as managerial rent. The higher the profit the higher will be farm incomes. Second, the rents accruing to land and labor owned directly by farmers also contribute to farm income. The income of a representative farmer therefore can be expressed;

$$y = \pi(p, w, r) + w\bar{x} + r\bar{z} \quad (3)$$

where y is farm income and \bar{x} and \bar{z} are the farmer's endowments of labor and land, respectively.

The government is assumed to have an objective function $g(y, p)$ which is increasing in farm income, decreasing in the support price, and concave in both arguments. The government has a preference for higher farm income but the marginal benefit falls as income gets higher. On the other hand, the government dislikes paying for price supports; and the marginal costs increase as the support price rises. These costs might include a loss in consumer welfare resulting from higher food prices, as well as the budgetary cost of maintaining the price support. The income of off-farm resource owners is assumed not to enter the government's objective function, although including it would not substantially alter the analysis which follows, as long as it has a smaller weight than farmer income.

The government cannot precommit to a given support price level and chooses the support price after farmers have allocated land to the production process. Thus, the government is assumed to take prior land allocation decisions, and the land rental price, as given when choosing an optimal

support level. Differentiating (3) holding r fixed leads to the following first-order condition for the government's problem:

$$g_y(y, p) \pi_p(p, w, r) + g_p(y, p) = 0 \quad (4)$$

Because the supply of labor is perfectly elastic, and the land rental price is given, a marginal increase in price support raises farm income by exactly the quantity supplied by farmers, $\pi_p(p, w, r)$. In this case, the government treats price support increases as if they were unanticipated and all of the gains accrue directly to farmers in the form of higher economic profit.

A perfect foresight equilibrium can now be defined for agricultural policy formation under discretion.

Definition 1

A discretionary equilibrium in the model of agricultural policy formation is a support level p^ and a pricing function $r(p^*, w)$ that satisfy:*

$$g_y(y^*, p^*) \pi_p[p^*, w, r(p^*, w)] + g_p(y^*, p^*) = 0 \quad (5)$$

where $y^* = \pi[p^*, w, r(p^*, w)] + w\bar{x} + r(p^*, w)\bar{z}$

Because the government is assumed to have discretion to change price support levels after farmers have allocated land, and the land rental price has been determined, any attempt by the government to announce a price support other than p^* will not be viewed credibly by farmers. The reason is that the government can increase the value of its objective function by renegeing on any announced level of support (other than p^*).

AGRICULTURAL POLICY FORMATION UNDER PRECOMMITMENT

In this section, the model of agricultural policy formation is revised to allow the government to make binding commitments to future support levels. In this case, the government has already committed to a future support price when farmers make their land allocation decision. Thus, the government is assumed to set the support level before any inputs are allocated by farmers. The resulting equilibrium is called the precommitment equilibrium.

Under precommitment (discretion), farmers choose their land input after (before) the government has set price supports. Nevertheless, if farmers are competitive and have perfect foresight then the representative farmer's decision rules are the same in both cases, because farmers always know the support level that will be forthcoming. Thus the farm profit function, equilibrium in the land market, and farm income are still charac-

terized by equations (1), (2) and (3), respectively, in the precommitment equilibrium.

On the other hand, precommitment alters significantly the nature of the government's decision problem. The government's choice of a support level is now conditioned by the knowledge that farmers choose all inputs *after* the support level has been set. In these circumstances, the government no longer takes land rental prices as given and acknowledges that changes in the support price will affect the equilibrium land rental price. Using the equilibrium pricing function for land rents, the first-order condition for the government's decision problem therefore is now:

$$g_y(y, p) \pi_p(p, w, r) + g_p(y, p) - h(p, w) = 0 \quad (6)$$

where $h(p, w) = g_y(y, p) \{-\pi_r[p, w, r(p, w)] - \bar{z}\} r_p(p, w)$.

The difference between (6) and the corresponding first-order condition under discretion is the term $h(p, w)$. This term accounts for the fact that, under precommitment, a marginal increase in the support price reduces economic profits by raising the rental price which farmers must pay for land. But it also increases farmer land rents by increasing the rental price that farmers receive for the land that they own. From Hotelling's lemma, $-\pi_r(p, w, r)$ represents the demand for land. Thus, $h(p, w)$ will be zero if the total demand for land equals the farmer's endowment (all land is owned by farmers). In this case, all of the increased rental charges paid by the farm firm accrue to the farmer as an owner of land. However, when the representative farmer rents some land from off-farm landowners then part of the increased rental charges accrue to them; and the government is assumed to take this effect into account when choosing the optimal support price.

A perfect foresight equilibrium can now be defined for agricultural policy formation under precommitment.

Definition 2

A precommitment equilibrium in the model of agricultural policy formation is a support level p^0 and a pricing function $r(p^0, w)$ that satisfy:

$$g_y(y^0, p^0) \pi_p[p^0, w, r(p^0, w)] + g_p(y^0, p^0) - h(p^0, w) = 0 \quad (7)$$

where $y^0 = \pi[p^0, w, r(p^0, w)] + w\bar{x} + r(p^0, w)\bar{z}$

Under precommitment, the government can make a credible announcement of any desired level of farm price support.

COMPARING THE EQUILIBRIA

The discretionary equilibrium is now compared to the precommitment equilibrium in terms of: (a) the price support level provided to farmers; (b) the level of the government's objective function; and (c) the level of farm incomes. Results are summarized in the following three propositions.

Proposition 1

If farmers rent some land from off-farm resource owners then the price support level is higher under discretion than under precommitment ($p^ > p^0$)*

Proof. From (5) and (6), the first derivative of the government's objective function under precommitment, evaluated at the optimal discretionary price support level, is just $-h(p^*, w)$. If $h(p^*, w)$ is positive then the slope of the government's precommitment objective function at p^* is negative. And since the objective function is concave, this means the optimal precommitment price support, p^0 , must be less than p^* . It remains to show that $h(p^*, w)$ is positive. From the definition of $h(p, w)$ then:

$$h(p^*, w) = g_y(y^*, p^*) \{ -\pi_r[p^*, w, r(p^*, w)] - \bar{z} \} r_p(p^*, w) \quad (8)$$

The first term, $g_y(y^*, p^*)$, is positive because g is increasing in y . The second term, $-\pi_r[p^*, w, r(p^*, w)] - \bar{z}$, is positive by hypothesis because it is the amount of farm land owned by off-farm resource owners. The last term, $r_p(p^*, w)$ is positive because an increase in food price shifts the nonpositively sloped demand for land outward, and the supply of land is increasing in the land rental price. Thus, $h(p^*, w)$ is positive and p^* is greater than p^0 .

Proposition 2

The value of the government's objective function is lower under discretion than under precommitment [$g(y^, p^*) < g(y^0, p^0)$]*

Proof. Farmers have perfect foresight in both the discretionary and precommitment equilibria. Thus, in both cases the government's choice of a support price influences the rental price of land. In the discretionary equilibrium this effect on land rents is not taken into account when choosing optimal policy, because the land rental price is assumed to have already been determined when the price supports are set. In the precommitment equilibrium, the effect on land rents is taken into account explicitly. Thus, the precommitment equilibrium is a global optimum and must lead to a higher value for the government objective function than the discretionary equilibrium.

Proposition 3

If farmers own some land then farm incomes are higher under discretion than under precommitment ($y^ > y^0$)*

Proof. From (3), farm incomes are comprised of economic profits from farming and rents to factors owned by farmers. With perfect foresight and free entry and exit, economic profits will be zero in both equilibria. Thus, farm incomes depend on rents to factors. Land rents will be higher in the discretionary equilibrium because, from Proposition 1, price supports are higher and land rents increase monotonically with output prices.

Together, these propositions characterize the intervention bias in discretionary agricultural policy. When the government has discretion to alter price supports after farmers have allocated some resources to the production process (and some of these resources are rented or purchased from off-farm resource owners), then the equilibrium level of support is higher than under precommitment, and the equilibrium value of the government's objective function is lower. Taking the government's political objective function as a valid social welfare indicator, this means that the discretionary equilibrium is not socially optimal. Social welfare could be increased if farm price supports were lowered. Clearly, this argument does not rest on a social welfare function based solely on an economic efficiency criterion. There is still an intervention bias even if one accepts that the government's redistribution objectives are socially desirable.

The intuition for these results is straightforward. Higher anticipated support prices have a positive effect on farm incomes as rents on land owned by farmers are bid up. However, when some land is owned by off-farm resource owners then part of the gain accrues to them instead of farmers. In the precommitment equilibrium, the government takes this transfer to non-farm resource owners into account and sets the globally optimal support level. In the discretionary equilibrium, the government responds to a given land price, thus rationally ignoring the transfer to non-farm resource owners. In this case, the government behaves as if increases in support prices are unanticipated (in which case all of the gains accrue to farmers as economic profit), even though farmers are adept at discovering the decision rule actually being used. This does not occur because the government is being short sighted or irrational. Rather, it is because the institutional arrangements are such that credible commitment to a path of future support levels is not possible.

Even though the government's objective function is lower under discretion, farm incomes are higher. Thus, a move from the discretionary equilibrium to the precommitment equilibrium would make the govern-

ment (society) better off but farmers worse off. This occurs because, with free entry and exit, economic profits to farmers are zero in both equilibria. But because price supports are lower in the precommitment equilibrium then rents to land owned by farmers are also lower.

It is natural to ask how a government might overcome the intervention bias and move agricultural policy towards the precommitment equilibrium. One possible solution is legislative reform. The government might promote legislation which forces it to commit to a rule for setting future support levels. This would remove the government's discretionary powers and allow a move towards the precommitment equilibrium. Note, however, that there is no incentive for farmers to participate in any form of cooperative solution that lowers price supports, because their incomes are higher under the discretionary policy.

Another approach to overcoming the intervention bias is reputation building. Suppose a new government comes to power and announces that, from now on, it and all future governments will set price supports according to a specified set of rules. Farmers will initially be wary because the government generally has an incentive to renege on the promise. However, if the government sticks to using these rules then, over time, it may gain a reputation for being dependable, thus moving the outcome towards the precommitment equilibrium. The problem, of course, is that both farmers and the government may be worse off during the period of reputation building, which is a strong disincentive for attempting this strategy.

SIMULATION RESULTS

The size of the intervention bias depends on the strength of the government's preference for higher farm incomes, the amount of land owned by farmers, the supply elasticity of land, and the characteristics of the food production technology. To investigate the size of the intervention bias, and explore how changes in these attributes intensify or diminish the bias, the model of the previous section was specialized and simulated over a range of parameter values. Results indicate that agricultural policy can have a substantial intervention bias over a plausible range of parameter values.

Government preferences are assumed to be represented by the simple objective function:

$$g(y, p) = \alpha y - 0.5(1 - \alpha)(p - m)^2 \quad (9)$$

where m is the market price that would occur without any government price support and $\alpha \in [0, 1]$ is a weighting factor on farm income in the government's objective function. If $\alpha = 0$ then the government does not care about farm income and therefore does not intervene ($p = m$). If $\alpha = 1$

then the government cares only about farm income and the optimal support price is unbounded.

The food production technology is characterized by a constant returns to scale CES production function:

$$q = [\delta x^{-\rho} + (1 - \delta)z^{-\rho}]^{-1/\rho} \quad (10)$$

where $\delta \in [0, 1]$ is a measure of factor intensity and $\sigma = 1/(1 + \rho)$ is the constant elasticity of substitution between labor and land. The profit function is not well defined for this technology but it can be verified that the cost function is:

$$c(w, r, q) = q[\delta^\sigma w^{\rho\sigma} + (1 - \delta)^\sigma r^{\rho\sigma}]^{1/\rho\sigma} \quad (11)$$

The conditional factor demand for land can be derived using Shephard's lemma:

$$c_r(w, r, q) = (1 - \delta)^\sigma q r^{-\sigma} [\delta^\sigma w^{\rho\sigma} + (1 - \delta)^\sigma r^{\rho\sigma}]^{1/\rho} \quad (12)$$

The supply of labor is perfectly elastic at the market wage rate w . However, the supply of land is assumed to take the constant elasticity form:

$$s(r) = r^\xi \quad (13)$$

where ξ is the supply elasticity.

Given values for w and m , and the parameters $(\alpha, \delta, \rho, \xi)$, a discretionary equilibrium can be computed as a vector (r^*, p^*, q^*) that solves the nonlinear equation system:

$$p - [\delta^\sigma w^{\rho\sigma} + (1 - \delta)^\sigma r^{\rho\sigma}]^{1/\rho\sigma} = 0 \quad (14a)$$

$$c_r(w, r, q) - r^\xi = 0 \quad (14b)$$

$$\alpha q - (1 - \alpha)(p - m) = 0 \quad (14c)$$

where $c_r(w, r, q)$ is defined by (12). Equation (14a) is the first-order condition for profit maximization, (14b) imposes market clearing for land, and (14c) is the government's first-order condition under discretion.

Under precommitment, (14c) is replaced by:

$$\alpha q - (1 - \alpha)(p - m) - \alpha [c_r(w, r, q) - \bar{z}] r_p(p, w) = 0 \quad (14d)$$

where $r(p, w)$ is defined implicitly by (14a). Thus, a precommitment equilibrium is a vector (r^0, p^0, q^0) that solves equations (14a), (14b) and (14d). The nonlinear equation systems were solved using the NLSYS module of GAUSS.

Simulation results are summarized in Tables 1, 2 and 3. Table 1 contains parameter definitions and a range of parameter values over which the

TABLE 1
Parameter values

Parameter	Definition	Values
w	Wage rate	1.0
δ	Factor intensity of labor	0.5
σ	Elasticity of substitution between labor and land	0.5–1.5
ξ	Supply elasticity for land	0.0–0.4
γ	Proportion of farm land owned by farmers in the discretionary equilibrium	0.6–0.9
α	Weight on farm income in the government objective function	0.1–0.3

TABLE 2
Intervention bias under low elasticity of substitution between labor and land ($\sigma = 0.5$)

Parameter values ^a			% Subsidy ^b	% Change in output price ^c	% Change in farm income ^c	% Change in government objective function ^c
ξ	γ	α				
0.0	0.9	0.1	6.83	0.67	0.63	-0.04
0.0	0.9	0.2	16.31	1.56	1.46	-0.09
0.0	0.9	0.3	29.98	2.71	2.53	-0.16
0.0	0.6	0.1	6.83	2.70	1.90	-0.65
0.0	0.6	0.2	16.31	6.34	4.41	-1.54
0.0	0.6	0.3	29.98	11.27	7.76	-2.80
0.2	0.9	0.1	5.86	0.58	0.54	-0.03
0.2	0.9	0.2	14.35	1.37	1.28	-0.08
0.2	0.9	0.3	27.49	2.48	2.32	-0.14
0.2	0.6	0.1	5.86	2.32	1.65	-0.56
0.2	0.6	0.2	14.35	5.57	3.94	-1.37
0.2	0.6	0.3	27.49	10.31	7.22	-2.59
0.4	0.9	0.1	5.31	0.52	0.49	-0.03
0.4	0.9	0.2	13.35	1.27	1.19	-0.07
0.4	0.9	0.3	26.77	2.41	2.26	-0.14
0.4	0.6	0.1	5.31	2.10	1.51	-0.51
0.4	0.6	0.2	13.35	5.18	3.70	-1.28
0.4	0.6	0.3	26.77	10.00	7.08	-2.53

^a ξ is the supply elasticity for land; γ is the proportion of land owned by farmers in the discretionary equilibrium; and α is the weight on farm income in the government's objective function.

^b Percentage by which the discretionary support price level exceeds the free-market price that would have occurred without any government intervention.

^c Percentage difference between the discretionary and precommitment equilibria, with the precommitment equilibrium used as the base.

TABLE 3

Intervention bias under high elasticity of substitution between labor and land ($\sigma = 1.5$)

Parameter values ^a			% Subsidy ^b	% Change in output price ^c	% Change in farm income ^c	% Change in government objective function ^c
ξ	γ	α				
0.0	0.9	0.1	5.39	0.54	0.52	-0.03
0.0	0.9	0.2	13.24	1.37	1.29	-0.08
0.0	0.9	0.3	26.23	2.88	2.67	-0.17
0.0	0.6	0.1	5.39	2.17	1.65	-0.56
0.0	0.6	0.2	13.24	5.39	3.95	-1.39
0.0	0.6	0.3	26.23	11.04	7.55	-2.81
0.2	0.9	0.1	5.00	0.51	0.48	-0.03
0.2	0.9	0.2	12.63	1.31	1.23	-0.07
0.2	0.9	0.3	26.68	2.98	2.76	-0.17
0.2	0.6	0.1	5.00	2.01	1.52	-0.52
0.2	0.6	0.2	12.63	5.16	3.76	-1.33
0.2	0.6	0.3	26.68	11.34	7.66	-2.87
0.4	0.9	0.1	4.75	0.48	0.46	-0.03
0.4	0.9	0.2	12.36	1.28	1.21	-0.07
0.4	0.9	0.3	28.65	3.30	3.04	-0.19
0.4	0.6	0.1	4.75	1.91	1.44	-0.49
0.4	0.6	0.2	12.36	5.06	3.67	-1.30
0.4	0.6	0.3	28.65	12.35	8.17	-3.10

^a ξ is the supply elasticity for land; γ is the proportion of land owned by farmers in the discretionary equilibrium; and α is the weight on farm income in the government's objective function.

^b Percentage by which the discretionary support price level exceeds the free-market price that would have occurred without any government intervention.

^c Percentage difference between the discretionary and precommitment equilibria, with the precommitment equilibrium used as the base.

model was simulated. Table 2 compares the discretionary and precommitment equilibria when labor and land substitution is limited ($\sigma = 0.5$), but when other parameters are allowed to take on a range of different values. The column labeled '% subsidy' indicates the percentage by which the discretionary price support level exceeds the free-market price that would have occurred without any government price support.¹ Other results in the table are expressed as percentage differences between the discretionary and pre-commitment equilibria, with the precommitment equilibrium used as the base. Table 3 is similar to Table 2 except that labor and land are assumed to be more substitutable ($\sigma = 1.5$).

¹ Calculated by assuming a constant elasticity demand function for food with the elasticity set at -1.0 .

Comparing Tables 2 and 3, the intervention bias does not appear very sensitive to the elasticity of substitution between labor and land. While there are some differences between the two tables, these are quite small compared to the differences within each table as other parameters are varied.

Within each table, the intervention bias declines as the supply of land becomes more elastic. In fact, if the supply of land became perfectly elastic then the intervention bias would disappear because a change in the support price would not influence the price of land, irrespective of whether it was anticipated or not. Nevertheless, over the range of supply elasticities used in the simulation results, the intervention bias is not very sensitive to changes in this parameter.

The strongest influences on the size of the intervention bias are clearly the proportion of farmland owned by farmers and the weight on farm income in the government objective function. As the government's preference for higher farm income strengthens, then the degree of price subsidization increases and the intervention bias becomes more pronounced. Similarly, as the proportion of farmland owned by farmers declines, then more of the benefits from price support get transferred to non-farm resource owners and the intervention bias again becomes more pronounced. The intervention bias in agricultural policy can be quite substantial over a reasonable range of parameter values. For example, with a 26–30% price subsidy and 90% of farmland owned by farmers the support price in the discretionary equilibrium is 2–3% higher than the optimal support price in the precommitment equilibrium. If the percent of farmland owned by farmers decreases to 60% then the discretionary support price is as much as 10–11% higher than under precommitment.

CONCLUDING COMMENTS

Government assistance to agriculture in developed countries has grown substantially over the years and continues to be a significant budget item. This paper argues that part of this support may reflect an intervention bias in agricultural policy. Because farmer investments in durable productive assets are long run in nature, the government has ample discretion to adjust support levels in response to investment decisions made earlier by farmers. And while this behavior is optimal from the government's standpoint, it generally leads to higher price supports and a lower government objective function value than would occur if the government could credibly precommit to future support levels. Taking the government's income redistribution objectives as a valid reflection of social preferences, this means

that discretionary policy leads to farm price supports which are above the socially optimal level.

To overcome this intervention bias in agricultural policy, the discretionary powers of the government must be constrained or eliminated. That is, support levels in agriculture must be set according to *ex ante* rules that are known in advance by farmers, rather than by discretionary policies that respond to previous farm investment decisions. Just (1985) also makes a case for setting agricultural support levels according to rules rather than discretion. However, his argument rests on the government's inability to effectively administer discretionary policy: discretionary policy is too variable and too slow (or too fast) in responding to changing economic circumstances. The analysis here provides a further argument for rules rather than discretion, based on the idea that even optimally administered discretionary policy has an intervention bias.

It should be emphasized that the model used here to investigate the intervention bias in agricultural policy is simple and stylized, with just one output and two inputs. Furthermore, the existence of an intervention bias is sensitive to assumptions about off-farm ownership of durable farm assets; as well as the timing of input allocations and government decisions about the level of price support which will be offered. With these limitations in mind, the main goals of this paper have been to explain time inconsistency within the context of an agricultural policy problem, and to show how an intervention bias may arise under certain circumstances. A formal empirical investigation of the extent to which an intervention bias actually occurs in particular agricultural policy situations must await further research using a considerably more detailed model.

Even the simple model used here could be extended in a number of ways. Perhaps the most interesting would be to introduce farmer uncertainty and learning about the true nature of the government's preferences. In the literature on time-inconsistent monetary policy, agent uncertainty and learning about monetary authority preferences can lead to improved discretionary policy. The reason is that the monetary authority has an incentive to establish a reputation and this moves the discretionary outcome closer to the precommitment outcome (Backus and Driffill, 1985). It will be interesting to see whether similar results hold in the model of agricultural policy formation, and whether this learning behavior can help explain the observed time path of government support for agriculture.

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