Uncertainty, Price Stabilization, and Welfare

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ABSTRACT

This paper investigates whether a small country facing foreign price instability benefits from active stabilization of the domestic price of the importable. For example, the European Community can be treated as a small open economy facing price instability of agricultural products originating in the United States. A tariff is out of the question because it is not optimal for a small open economy. However, the European Community may stabilize the domestic price of the importable. It is shown that, if the random tariff revenue is rebated ex post, domestic price stabilization increases income instability and nonintervention is optimal.

If an ex ante rebating scheme is employed, a small country can benefit from domestic price stabilization and there exists a partial stabilization policy that dominates free trade. Partial stabilization of the domestic price with the ex ante rebate requires a variable import levy inversely related to the foreign price of the importable. However, complete stabilization of domestic price, which requires setting a target price and a variable import levy as currently used in the European Community, is not optimal.

UNCERTAINTY, PRICE STABILIZATION, AND WELFARE

Foreign price instability can significantly affect the welfare of an open economy relying heavily on foreign trade. For instance, Japan is vulnerable to oil price increases because 99 percent of its oil is imported. Similarly, grain producers of many countries have advocated price stabilization and received protection from the risk of low foreign prices. Primary exporters are also concerned about foreign price instability because it contributes to export earnings instability.

Recently, Itagaki (1985) and Beladi and Samanta (1989) investigated the issue of optimal tariff when international trade is subject to price instability. Their analyses suggest that trade restrictions can improve the welfare of an open economy when international trade is carried out under price uncertainty. Although the literature on price stabilization policies for a closed economy is extensive, the implications of stabilization policies on an open economy facing foreign price instability have received little attention. This paper investigates whether a domestic price stabilization policy can improve the welfare of an open economy facing foreign price instability.

The welfare effects of price stabilization on a closed economy were investigated by Waugh (1944), Oi (1961), Massell (1969), and Newbery and Stiglitz (1979).[1] Among the contributions in this field, Gilbert's (1985) work on the consequences of international price stabilization for an open economy represents an important advance over models using aggregate social surplus. Using approximations of welfare gains, Gilbert suggested that a risk-averse country would benefit if the world price of a commodity were stabilized at the prestabilization mean by an (international) intervention authority.

Since a small country is a price taker, it cannot neutralize price instability originating in the world market. What is the optimal policy for a small open economy facing foreign price instability? Despite its well-known optimality, free trade is rarely practiced in small countries. As evidenced by

the Common Agricultural Policy (CAP) of the European Community (EC), commercial policies often take the form of domestic price stabilization rather than of outright tariffs or quotas. Using a variable import levy, these grain importing countries stabilize the domestic price at a target level. Similarly, domestic oil prices in oil importing less developed countries (LDCs) have been more stable than fluctuating world oil prices. Consumers in oil importing LDCs have complained about rigid domestic prices for extended periods and about the slow pace of domestic price adjustments after a continued decline in the world price of oil. Keynes (1980, 163) also recorded that violent fluctuations of world market prices for primary commodities are transmitted to consumers, but the fluctuations in consumer prices tended to be less frequent and not as wide.

In light of Gilbert's findings on potential gains from international price stabilization for small risks, two important questions arise regarding the benefits from price stabilization for an open economy. First, if price risks are large does a small country benefit from "passive" price stabilization, that is, if world price are stabilized at the mean by an international agency? Second, if stabilization of world prices—which requires international cooperation—cannot be implemented, does a small country benefit from "active" stabilization of the domestic price of a traded good?

The main purpose of this paper is to investigate whether active stabilization of the domestic price improves the welfare of a small open economy. As in the optimal tariff literature, we consider the welfare of the representative consumer and ignore the distributional issues. We first delineate the condition for benefits from passive foreign price stabilization in terms of the observable characteristics of the import demand function and risk attitude. We then investigate the optimality of domestic price stabilization by incorporating a feasibility condition developed earlier by Samuelson (1972).

Gains from Passive Price Stabilization

Pomery (1984) observed that in Walrasian international trade models uncertainty originates in the randomness of endowments, preferences, technology, or prices. For a closed economy, Massell (1969) demonstrated that whether instability originates in the demand or supply side, price

stabilization improves overall social welfare. For a small open economy, instability originates either in the domestic market or the world market. In this section we focus on the welfare of a small open economy facing foreign price instability. Randomness in foreign prices may have more fundamental sources, such as demand or supply side disturbances in the world market.[2] We first delineate the condition for positive gains from passive stabilization in terms of observable characteristics of the import demand function and risk attitude. This condition will then be used to find an optimal domestic price stabilization policy.

Consider a small open economy producing two goods. Let Z and Y denote the domestic production of the exportable and the importable, respectively. The domestic production possibility function is given by

$$Z = F(Y),\ F'(Y) < 0,\ F''(Y) < 0.$$

Producers are assumed to make output decisions after observing market prices. We assume that the price of the importable is subject to random fluctuations and that the price of the exportable is certain, equal to unity.[3] Let p and p* be the domestic price and the foreign price of the import good, respectively. At each realization of p, domestic producers maximize revenue, $\Pi = Z + pY$. Hence, optimal production satisfies the condition

$$p + F'(Y) = 0.$$

The domestic supply curve of the importable Y(p) is positively sloped because $dY/dp = -1/F'' > 0$. The maximized revenue, $\Pi(p) = F(Y(p)) + pY(p)$, is national income.

To focus on the overall welfare impacts of price instability, we assume that all agents have identical preferences in consumption. That is, although private agents may engage in different production activities, they have identical tastes in consumption. Preferences of the representative

consumer are characterized by a monotone increasing and concave von Neumann-Morgenstern utility function

$$u(C,X),$$

where C and X denote the domestic consumption of the exportable and the importable, respectively. The budget constraint of the consumer is

$$C + pX = I,$$

where I is national income in terms of the exportable.

Consumers are assumed to make consumption decisions ex post, that is, after domestic and foreign prices are known. Maximizing utility u(C,X) subject to the budget constraint yields demand functions, C(p,I) and X(p,I). The indirect utility function is given by

$$v(p,I) \equiv u[C(p,I),X(p,I)]. \tag{1}$$

The import demand function is

$$Q(p,I) = X(p,I) - Y(p), \tag{2}$$

which implies that $\partial Q/\partial I = \partial X/\partial I \equiv X_I$. In the absence of trade restrictions, foreign and domestic prices are equalized, that is, $p = p^*$. Hence, endogenous national income is

$$I(p) = F[Y(p)] + pY(p).$$

Indirect utility can then be expressed in terms of the domestic price only:

$$V(p) = v[p,I(p)]. \tag{3}$$

If the import price $p = p^*$ is random, the expected utility of the representative consumer is

$$EV(p) = Ev[p,F(Y(p)) + pY(p)].$$

Does a small country benefit from passive price stabilization, that is, if the world price p* of the importable were stabilized at the mean by an international intervention authority? Turnovsky, Shalit, and Schmitz (1980) analyzed whether the consumer with exogenous income benefits from price instability in a closed economy. They showed that consumer benefits from price instability depend upon risk attitude, budget share, and price and income elasticities of demand. We first investigate the welfare impact of price instability on an open economy by including the producer side to evaluate overall social benefits and losses.

To focus on import price instability, we consider a price distribution $H(p^*)$ such that the small country imports Y for all p^*.[4] With free trade, $p = p^*$. Consumer benefits from foreign import price instability ultimately depend upon the curvature of the indirect utility function V(p) in p. Differentiating V(p) with respect to p and using Roy's identity, $v_p = - v_I X$, we obtain

$$V'(p) = - v_I Q(p,I). \tag{4}$$

That is, a rise in the price of a traded good decreases (increases) domestic welfare if that good is imported (exported). Differentiating (4) further with respect to p and using $I'(p) = Y$ gives

$$V''(p) = - v_{Ip} Q - v_{II} QY - v_I (dQ/dp).$$

Using $v_{Ip} = - v_{II} X - v_I X_I$, we obtain

$$V''(p) = (\eta + \epsilon/s - R)Q^2 v_I/I, \tag{5}$$

where $\epsilon \equiv - (dQ/dp^*)(p^*/Q)$ is the price elasticity of import demand, $\eta \equiv (\partial Q/\partial I)(I/Q)$ is the income elasticity of import demand, $s \equiv pQ/I$ is the budget share of imports, and $R \equiv - I v_{II}/v_I$ is the Arrow-Pratt relative risk aversion. If $R \geq \eta + \epsilon/s$, then $V''(p) \leq 0$. On the other hand,

if $R < \eta + \epsilon/s$, then $V''(p)$ is positive, and by Jensen's inequality, $EV(p) > V(Ep)$. The following proposition delineates sufficient conditions for gains from passive stabilization in terms of observable characteristics of the import demand function and risk attitude.[5]

Proposition 1. Assume that a small country faces uncertainty in the world price p^* of the importable. Then the country gains (loses) when the foreign price is stabilized at the mean if $R \geq (\leq) \eta + \epsilon/s$ for all p^* and if the strict inequality holds for some p^*.

The idea for this proposition is originally due Gilbert (1985) and is related to two important findings in the literature: the Massell result that price stabilization improves overall social welfare, and Turnovsky, Shalit, and Schmitz's (1980, 143) Propositions 1 and 2 on consumer benefits in a closed economy with exogenous income. The representative consumer-producer in an open economy can benefit from foreign price instability if he or she is not excessively risk averse ($R \leq \eta + \epsilon/s$). For instance, if the consumer is risk neutral in income ($R = 0$), then $V(p)$ is convex in p for a normal import good, and hence the consumer benefits from foreign price instability originating in the world market.

Optimal Domestic Price Stabilization

If a small country faces price instability originating in the world market, what is the optimal trade policy? International cooperation for price stabilization is often difficult to achieve. In this situation a small country can insulate its domestic economy from foreign price shocks by stabilizing domestic prices. Thus, we will investigate whether a small country with risk-averse consumers can improve welfare by stabilizing the domestic price of the importable.

We consider domestic price stabilization using a variable import levy. The stable domestic price p will generally deviate from the random foreign price p^*. Thus, domestic price stabilization entails a variable import levy, $t = p - p^*$, and a random government revenue $G = (p - p^*)Q(p,I)$. We now

incorporate Samuelson's (1972) feasibility condition for price stabilization. For a domestic price stabilization program to be feasible, the country must bear the cost of stabilization. Thus, we assume that the tariff revenue (or loss) is rebated to consumers.

Domestic price stabilization can have different effects on welfare, depending upon how the tariff rebate is implemented. First, the government may employ a state-contingent rebate equal to the actual tariff revenue. Second, the government may rebate a fixed amount equal to the anticipated or expected tariff revenue, which is determined before p^* is known.[6] With an ex post rebate scheme, the stabilization agency always breaks even. However, the ex post rebate increases consumer income instability. With an ex ante rebate scheme, the income of the stabilization agency is unstable and surpluses or deficits occur in the short run. The agency breaks even, however, in the long run. Consumer income is more stable with an ex ante rebate than with an ex post rebate.

Domestic Price Stabilization with an Ex Post Rebate

We first consider the optimality of a domestic price stabilization policy with an ex post rebate of government revenue. Let p be the stable domestic price of the importable. If p^* is realized, the government collects $(p - p^*)$ per unit of imports, and hence total government revenue is $G = (p - p^*)Q$. If the government instantaneously rebates the actual revenue G to consumers, then the domestic price stabilization program simply amounts to a random tariff policy by which the tariff equals the variable import levy $t = p - p^*$. In this case, the optimal state-contingent tariff is zero, regardless of the realized value of p^*, since a small country cannot affect the terms of trade. That is, domestic price stabilization is not optimal under the ex post rebate scheme.

There is an important conceptual problem with the ex post rebate policy even when protection is chosen for noneconomic reasons or because of market failure. The ex post rebate defeats the very purpose of insulating the domestic economy from foreign disturbances. The intent of a variable import levy, $t = p^* - p$, is to stabilize the domestic price of the importable. The state-contingent rebate of government revenue, however, generates a corresponding income variation. Intuitively, the

agency is not assuming any risk if it rebates the entire tariff revenue to consumers each period. Domestic price stabilization then amounts to a random tax-and-subsidy scheme, which is inferior to the optimal state-contingent tariff that is zero.

Optimal Domestic Price Stabilization with an Ex Ante Rebate

Keynes originally suggested that a stabilization agency could use buffer stocks to stabilize the world prices of "key" commodities over the trade cycle. Such an agency would intervene at a price 10 percent above or below the fixed basic price (1980, 143), and would be expected to break even in the long run while realizing losses or profits in the short run. The buffer stock would not only stabilize prices but also preserve "some measure of stability of incomes in the producing centres" (1980, 155). If the cost of operating buffer stocks were zero, this policy would have the same effect on production as an equivalent tax-and-subsidy scheme analyzed below.

When comparing stable and unstable price situations in a two-period framework, Samuelson (1972) imposed the feasibility condition that the mean output under instability be equal to the output under price stability. With this condition Samuelson argued that a closed economy cannot "lift its welfare by its own bootstraps through manufactured instability" (476). Newbery and Stiglitz (1979) interpreted feasibility as "mean output" preserving price stabilization. Subsequently, for a stabilization agency incurring a deficit or surplus in the short run, Gilbert (1985) broadened the feasibility condition to include stabilization policies for which expected consumption equals expected production. In the same spirit we consider "feasible" domestic price stabilization with a realistic rebate scheme; the amount of the rebate is equal to expected government revenue and is determined ex ante.[7]

When the ex ante rebate scheme is employed, the agency stabilizes consumer income and experiences a deficit or a surplus in the short run—as it often does with buffer stocks—but breaks even on the average, hence making domestic price stabilization feasible in the long run.[8] With this scheme, the government provides income insurance against high foreign prices. Let

$$p(\alpha) = \mu + \alpha(p^* - \mu) \tag{6}$$

be the domestic price of the importable, where α is a decision variable and $\mu \equiv Ep^*$ is the expected foreign price. If $\alpha = 0$, the policy reduces to complete stabilization of the domestic price at $p = \mu$. Alternatively, $\alpha = 1$ represents free trade, or nonintervention. The domestic price p is more (less) stable than the foreign price p^* if α is less (greater) than unity. The government revenue is given by

$$G(\alpha) = [p(\alpha) - p^*]Q(p,I) = (\alpha - 1)(p^* - \mu)Q. \tag{7}$$

If a partial stabilization policy with an ex ante rebate is employed, the expected government revenue is

$$EG(\alpha) = (\alpha - 1) \cdot E[(p^* - \mu)Q(p,I)] = (\alpha - 1) \cdot Cov(p^*,Q), \tag{8}$$

where Cov denotes the covariance operator. In the absence of intervention, $\alpha = 1$, and $EG(1) = 0$. If the domestic price is completely stabilized ($\alpha = 0$), expected government revenue reduces to $EG(0) = - E[(p^* - \mu)Q]$. Consequently, income $I(0) = F(Y(\mu)) + \mu Y + EG(0)$ and import demand $Q(\mu,I(0))$ are both constant. This implies that the expected tariff revenue under complete stabilization is zero, that is, $EG(0) = - Q(\mu,I(0))E(p^* - \mu) = 0$. Thus, the ex ante rebate to the consumer is zero whether α is 0 or 1.

What is the sign of the ex ante rebate $EG(\alpha)$ under partial stabilization, that is, when α lies between 0 and 1? Note that, when the rebate is determined ex ante,

$$dQ/dp^* = \alpha[\partial Q/\partial p + (\partial Q/\partial I)Y] = \alpha[\partial X^u/\partial p - QX_I - dY/dp] \tag{9}$$

is negative if the importable is a normal good ($X_I \geq 0$), where $\partial X^u/\partial p = \partial X/\partial p + XX_I$ is the slope of the compensated demand curve. Thus, $Cov(p^*,Q)$ is negative and $EG(\alpha)$ is positive. That is, if the import good is normal, then the ex ante rebate to the consumer is positive under partial stabilization.

Expected utility of the consumer is

$$EV(p^*,\mu) = Ev\{p,F(Y(p)) + pY + E[(p - p^*)Q(p,I)]\}, \tag{10}$$

where $p(\alpha)$ is given by (6). Differentiating (10) with respect to α and using Roy's identity gives

$$\begin{aligned} EV_\alpha &= E\{v_p(p^* - \mu) + v_I(p^* - \mu)Y\} \\ &\quad + Ev_I \cdot \{E[(p^* - \mu)Q] + (\alpha - 1)E[(p^* - \mu)^2(dQ/dp)]\} \\ &= E[-v_I(p^* - \mu)Q] + Ev_I \cdot E[(p^* - \mu)Q] + (\alpha - 1)Ev_I \cdot E[(p^* - \mu)^2(dQ/dp)]. \end{aligned} \tag{11}$$

First, we evaluate EV_α at $\alpha = 0$ to demonstrate the nonoptimality of complete domestic price stabilization. Recall that, under complete stabilization, $EG(0) = - E[(p^* - \mu)Q] = 0$, and hence the second term on the right side of (11) is zero. Moreover, income $I(0)$ and import demand $Q(\mu,I(0))$ are both constant, and the first term is also zero. When evaluated at $\alpha = 0$, $dQ/dp = dQ/d\mu = (\partial X^u/\partial\mu) - X_I Q(\mu,I(0)) - dY/d\mu$ is negative for a normal good. This implies that the last term on the right side of (11) is positive and hence EV_α is positive at $\alpha = 0$. Thus, complete stabilization of the domestic price ($\alpha = 0$) is not optimal, and the optimal value of α is positive.

Second, we evaluate EV_α at $\alpha = 1$ in order to find conditions under which partial stabilization ($0 < \alpha < 1$) is optimal. Using (4), the first term on the right side of (11) can be written

$$E[-v_I Q(p^* - \mu)] = Cov(p^*,V'(p)).$$

If $V(p)$ is concave in p ($R \geq \eta + \epsilon/s$), then $Cov(p^*,V') \leq 0$. Next, note that $E[(p^* - \mu)Q] = Cov(p^*,Q)$ and that under nonintervention dQ/dp^* is negative for a normal good by (9). Thus, the second term on the right side of (11) is negative. The last term in (11) vanishes at $\alpha = 1$. Hence, $R \geq \eta + \epsilon/s$ is a sufficient condition for EV_α to be negative at $\alpha = 1$, in which case the optimal value of α is less than unity.

Proposition 2. Consider the domestic price stabilization policy represented by $p(\alpha) = \mu + \alpha(p^* - \mu)$ for a small country that imports Y for all p^*. If the importable is normal and if the consumer receives an ex ante rebate, equal to the expected tariff revenue, then

1. Complete stabilization of the domestic price ($\alpha = 0$) is not optimal, regardless of risk aversion, and
2. If $R \geq \eta + \epsilon/s$, partial stabilization ($0 < \alpha < 1$) is optimal.

This proposition has two important policy implications. First, complete stabilization and nonintervention are both feasible but they are not desirable, regardless of risk aversion, because a reduction in price instability beyond a certain point increases income instability. Second, if the country is sufficiently risk averse to benefit from passive price stabilization ($R \geq \eta + \epsilon/s$), then there exists a partial stabilization policy ($\alpha < 1$) that dominates free trade ($\alpha = 1$). If passive price stabilization is beneficial but cannot be implemented, Proposition 2 suggests that the country should still pursue active partial stabilization of the domestic price because such a policy is superior to free trade. The optimality of domestic price stabilization arises from the fact that the government can act as a risk-neutral agent and provide consumers with insurance against high foreign prices. Samuelson's feasibility condition is invoked as an ex ante restriction while the government stabilizes income ex post acting as an insurance agent.

The variable import levy for optimal price stabilization is

$$t = (\alpha - 1)(p^* - \mu). \tag{12}$$

Since α is less than unity, t is positive (negative) when p^* falls below (rises above) the mean price μ. That is, an optimal stabilization policy requires a variable import levy that is inversely related to the foreign price, rather than a positive ad valorem tariff extensively analyzed in the literature. Even if the consumer is not sufficiently risk averse ($R < \eta + \epsilon/s$) and α exceeds unity, the optimal policy

requires a system of ad valorem tariffs when the foreign price p* is above the mean price μ and ad valorem subsidies when p* is below μ. This result implies that an unconditional positive ad valorem tariff is not optimal.

It should be noted that the variable tariff in (12) equalizes consumer and producer prices. If the prices to consumers and producers are not constrained to be equal, an alternative policy of using a tariff and a production subsidy may lead to further gains by allowing producer prices to vary while stabilizing consumer prices and the consumption bundle.[9] However, it may be difficult for a small country to implement and coordinate separate price stabilization policies.

Concluding Remarks

The main result of this paper is that a small country can benefit from active domestic price stabilization if the condition for benefits from passive price stabilization is met. If this condition is satisfied, there exists a partial domestic price stabilization policy that dominates free trade. Thus, when international commodity agreements are difficult to achieve, a small country can reduce the impact of external shocks by pursuing domestic price stabilization independently. Interestingly, a partial stabilization policy with the ex ante rebate requires a variable import levy inversely related to the foreign price, rather than a positive ad valorem tariff. Moreover, complete stabilization of the domestic price of imports is never optimal, regardless of risk aversion.

Many LDCs and international organizations such as UNCTAD, FAO, and the World Bank are concerned about the instability of the world prices of commodity exports. With some simple changes in the definitions of variables, similar conclusions regarding the benefits of domestic price stabilization for a small open economy facing export price instability can also be obtained.

ENDNOTES

1. Welfare analyses have been made in terms of expected consumer and producer surpluses. Turnovsky, Shalit, and Schmitz (1980), however, showed that expected consumer surplus is not a valid welfare criterion except when relative risk aversion equals the income elasticity of demand. Choi and Johnson (1987) showed that expected equivalent variation is a valid welfare criterion for risk-neutral consumers and provides a lower bound for benefits from price stabilization for risk-averse consumers.

2. Pomery (1984) observed that small-country models that impose randomness in prices directly, as opposed to models with induced random prices derived from a more fundamental source, implicitly use a partial equilibrium approach. Here we employ the conventional assumption that policy actions of a small country do not affect the price distributions of traded goods. For a large country, policy impacts on the price distributions of traded goods should also be incorporated.

3. To investigate gains from price stabilization when the export price is random, the (negative) quantity of trade Q can be treated as export, and the analysis is repetitive. In the certainty-uncertainty comparison with random relative price, the choice of certainty price given by the arithmetic mean depends upon the numeraire.

4. Of course, with a very volatile price distribution a trade reversal can occur, i.e., with p^A denoting the autarky price, $Q > 0$ for $p < p^A$, $Q < 0$ for $p <\rightarrow> p^A$, and $Q = 0$ at p^A.

5. Gilbert (1985) defined equivalent conditions for gains from foreign price stabilization in terms of Frish elasticity and other parameters. This is accomplished by decomposing import and using separate elasticities of consumption and production.

6. The distinction between ex post and ex ante rebate rules depends on whether the amount of the rebate is known before or after the foreign price p^* is realized. If the agency does not break even each period, as in the most likely scenario, it is using the ex ante rebate rule.

7. The amount of the ex ante rebate is not permanently fixed. Because it is equal to expected tariff revenue, it depends upon the distribution $H(p^*)$ each period. It does not, however, depend upon the specific value of p^*, which is realized ex post.

8. Of course, if the imported good is subsidized (taxed), the short-run deficit (surplus) is financed (lent) in the world market. If the government finances the deficit by either taxing consumers or borrowing from them (Ricardian equivalence), this action defeats the very purpose of stabilization policies.

9. Since the distortion (instability) originates from the foreign market, no ex ante production subsidy is optimal. However, it can be shown that if the slope of the supply curve is nonrandom, a positive ad valorem production subsidy is optimal. The authors are indebted to the anonymous referee for this point.

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