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# Fixed price controls and ad valorem distortions in an open economy

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**Abstract**

This paper compares the welfare effects of ad valorem and fixed-price distortions for an open economy. In the case of export protection, domestic factor growth is much more likely to be immiserizing when fixed-price distortions are used. In contrast, fixed price protection to an import-substitute is less likely to induce immiserization via factor growth than ad valorem protection.

## 1. Introduction

The study of trade distortions has traditionally focussed on ad valorem import tariffs (or export taxes) and on fixed quantitative restrictions [Ramaswami and Srinivasan (1968), Bertrand and Vanek (1971), Hatta (1977), Lloyd (1974), Kimbrough (1985), Djajic (1987), Falvey (1988), and López and Panagariya (1992)]. While many real-world policy distortions are ad valorem in nature, many important policy distortions are not. Governments also routinely intervene in trade through fixed-price distortions. Maintaining a fixed real price for a tradable commodity necessitates either a complementary variable levy or a complementary adjustable import (export) quota. So, unlike the ad valorem tax and fixed quantitative restriction cases, where trade interventions are government determined and domestic prices adjust endogenously, trade quotas or import levies are endogenous, while domestic prices are government determined. Although one can always define equivalent ad valorem tariffs or quantitative trade restrictions ex post that yield the same market solution as fixed-price distortions, ex ante these mechanisms are distinct because they impinge upon economic agents in different ways.

The most notorious fixed-price distortions are the agricultural price-support systems of the European Economic Community (EEC), the United States, Japan, and Korea. Each of these countries subsidizes domestic farm producers while using controlled trade flows to clear domestic markets. The EEC uses variable levies (variable import duties or export subsidies) to support domestic producer prices. The United States, on the other hand, uses an adjustable quota to maintain its sugar loan program. Expenditures on these support programs are not trivial. Recent OECD estimates indicate that the average EEC citizen pays farmers over $400 a year, Japanese citizens pay more than $500, and U.S. citizens spend more than $300 per annum (*The Economist*, 11–17 July, 1992).

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Developing countries also use fixed-price distortions. For example, Mexico has traditionally protected its domestic grain prices through variable quotas. Indonesia has pursued a similar policy to protect rice production, while India routinely fixes domestic prices for both agricultural and non-agricultural commodities. Fixed-price intervention, therefore, is an important component of trade policy in both developed and developing economies. [1]

Because fixed-price distortions and ad valorem systems operate in fundamentally different fashions, the welfare effects of changes in domestic and external conditions may differ significantly across these regimes. But to our knowledge, no attention has been given to this distinction in the theoretical trade literature. Accordingly, this paper initiates that study by analyzing the welfare consequences of internal factor growth and changes in international demand conditions under both fixed-price distortions and ad valorem trade taxes. Because quota restrictions can always be translated into equivalent ad valorem trade taxes, we do not compare quotas and fixed-price distortions directly. Our results indicate fundamentally different responses depending upon which protection device is employed.

We first introduce the model in section 2. Then in section 3 we compare the welfare consequences of factor growth under the two regimes. Section 4 compares the welfare consequences of additive shifts in world demand for the two regimes. Section 5 concludes.

## 2. The model

Consider a simple open economy with one variable factor of production and two products. The variable factor is labor while the products are an agricultural good and a non-agricultural good. Production of the agricultural good is governed by the concave, strictly increasing, constant returns to scale production function:

$$y_a = f(K, L_a) .$$

Here $K$ is the fixed factor specific to the production of the agricultural commodity, $L_a$ is the amount of labor devoted to agricultural production and $y_a$ is the agricultural output. Assume $f_{KL} > 0$, where subscripts denote derivatives. Production of the non-agricultural commodity is governed by a concave, strictly increasing, constant returns to scale production function:

$$y_n = g(L_n) .$$

Fixed factors specific to the non-agricultural commodity are suppressed notationally, $y_n$ is the amount of the non-agricultural commodity produced, and $L_n$ is the amount of labor devoted to the non-agricultural commodity.

Normalizing by the price of the non-agricultural commodity and assuming all producers are price takers, there exists a dual GNP function:

$$R(p; K, L) = \max_{L_a, L_n} \{ pf(K, L_a) + g(L_n) : L_a + L_n \leq L \} . \tag{1}$$

[1] The United States, the EEC and Japan are major market participants for many of the agricultural commodities that they protect. Moreover, because the international market for many agricultural commodities is quite thin, even mid-size countries can influence world prices through their policies. For example, during the early 1980s Indonesia was the largest importer of rice in the world, accounting for more than 25% of world trade.

Here $p$ denotes the normalized price of the agricultural commodity and $L$ denotes the labor endowment.

Consumer preferences are represented by the dual expenditure function, $e(p, 1, u)$, where $u$ is the aggregate welfare indicator. International demand conditions are summarized by the terms of trade function for the agricultural commodity:

$$p^* = D(y_a - e_1(p, 1, u)) , \tag{2}$$

where $p^*$ is the international terms of trade and $D$ is a strictly decreasing function. Hotelling's lemma implies

$$y_a = R_1(p; K, L) .$$

Price intervention takes the general form:

$$p = \alpha p_f + (1 - \alpha)(1 + t)p^* , \tag{3}$$

where $p$ is the internal price of the commodity, $p_f$ is a fixed price level, $t$ is an ad valorem rate, and $\alpha$ is a policy parameter. When $\alpha$ equals one, the trade intervention is a pure variable levy. When $\alpha$ equals zero, the trade intervention is pure ad valorem. To be able to compare the two schemes assume initially that $p_f = (1 + t)p^*$, implying that $p = (1 + t)p^*$.

The economy's budget constraint is

$$e(p, 1, u) = R(p; K, L) - (p - p^*)[R_1(p; K, L) - e_1(p, 1, u)] . \tag{4}$$

## 3. Domestic factor growth and immiserization

This section compares the potential for immiserization from capital ($K$) growth in the protected sector (agriculture) under the two protective schemes. Totally differentiating (2)–(4) with respect to $K$ gives

$$\phi \, du = \left\{ R_K + \frac{R_{1K}}{\Delta}[XD'(\cdot) - (p - p^*)(1 - \Delta)] - (p - p^*)R_{1K} \right\} dK , \tag{5}$$

where

$$\phi \equiv e_u - e_{1u}\left\{ p - p^* + \frac{D'}{\Delta}[X + (p - p^*)(R_{11} - e_{11})(1 + t)(1 - \alpha)] \right\} ,$$

$$\Delta \equiv 1 - D'(R_{11} - e_{11})(1 + t)(1 - \alpha) \geq 1 ,$$

and

$$X \equiv R_1 - e_1 .$$

Given normality, the linear homogeneity of $e(\cdot)$ implies that $\phi > 0$. To see this, note that using the definition of $\Delta$, $p - p^* = tp^*$, $\phi$ can be rewritten, assuming that $p^* = 1$ initially: [2]

[2] Because the comparative-static expressions are evaluated at the pre-shock values of the variables, this assumption involves no loss in generality.

$$\phi = e_u - te_{1u}\left[\frac{1 + D'X/t}{\Delta}\right].$$

Because $D' < 0$ and $\Delta \geq 1$ the term in square brackets is smaller than one. Homogeneity implies that $e_u - te_{1u} = e_{1u} + e_{2u} > 0$. Hence $\phi > 0$.

By the envelope theorem,

$$R_{1K} = \frac{R_K}{1+t} + (1+t)f_{KL}\frac{dL_a}{dp} > 0.$$

This fact and (5) imply

$$\phi du = \left\{\frac{R_K}{\eta - (1-\alpha)\epsilon}[\eta - (1-\alpha)(1+t)\epsilon + 1] - (1+t)f_{KL}\frac{dL_a}{dp}\right\}dK, \tag{6}$$

where $\eta \equiv p^*/D'X$ is the excess-demand elasticity faced by the country and $\epsilon \equiv (R_{11} - e_{11})[p^*(1+\epsilon)/X]$ is the elasticity of export supply.

Consider first the case of a fixed-price distortion, i.e. $\alpha = 1$, for an exporter of the protected commodity. Because the second right-hand term in (6) is negative, factor growth is immiserizing if the square bracketed term on the right of (6) is positive. Thus if $\alpha = 1$, growth in $K$ is immiserizing for an exporter of the protected commodity if $\eta \geq -1$. That is, immiserization occurs if the excess demand faced by an exporter is inelastic.

When $\alpha = 0$ (trade intervention is only ad valorem), a sufficient condition for immiserization is

$$\eta \geq (1+t)\epsilon - 1.$$

With ad valorem taxes, unlike with fixed-price distortions, an inelastic demand for an exporter is no longer sufficient for immiserization. Furthermore, an elastic export supply response ($\epsilon \geq 1$) now completely eliminates the possibility of immiserization. Hence, the two trade regimes are clearly distinct. Under appropriate circumstances one permits immiserization while the other does not. To gain some empirical feel for the relevance of this last condition, notice that estimates of export supply available for several developing countries suggest elastic responses. Moran (1988), for example, found that countries facing relatively inelastic demand from the rest of the world tend to exhibit high export supply elasticities ranging between 2.2 and 2.6.

These results are explained as follows. Increasing $K$ causes agricultural output to increase. This has three effects. First, agricultural revenue increases. Second, the production distortion associated with the price intervention is exacerbated: expanding agricultural capital increases the marginal-value product of agricultural labor leading agriculture to absorb even more labor. This second effect is negative and its incidence depends on the level of the original distortion ($t$). The third effect is a terms of trade effect: expanding agricultural production increases net exports of the agricultural commodity and depresses $p^*$. As $p^*$ falls, presuming the home country is initially a net exporter of the protected commodity, domestic income and, hence, welfare falls. While an ad valorem distortion transmits this latter ameliorating price fall-back to the domestic economy, a fixed-price system does not. Hence, in the ad valorem case the world-price fall is not as pronounced as with a fixed-price distortion because domestic agricultural production increases less and domestic demand increases more than in the fixed-price case. So because the fixed-price regime insulates domestic markets from world-price changes, the export supply elasticity only plays a role in determining whether immiserization occurs in the ad valorem case but not in the fixed-price case.

If the country instead protects an import substitution sector, factor growth in the protected sector is less likely to induce immiserization under fixed-price distortion than ad valorem trade distortions. The reason is that factor growth now causes a terms of trade improvement which reinforces rather than offsets the direct (positive) revenue effect of the factor growth. Immiserization is still possible, however, because of the aggravation of the original trade distortion. The positive terms of trade effect is stronger in the fixed-price case than in the ad valorem case. In fact, it can be shown that a sufficient condition to rule out immiserization under fixed-price supports is that the external supply elasticity of the imported good faced by the country be less than unity. While the world-price fall does not affect imports in the fixed-price case, imports in the ad valorem case do adjust and, hence, the terms of trade effect is smaller.

## 4. Additive world demand shocks

This section compares the welfare implications of world-demand shocks under the ad valorem and fixed-price schemes. Rewrite the terms of trade expression (2):

$$p^* = D[R_1(\cdot) - e_1(\cdot)] + \beta\,, \tag{2'}$$

where $\beta$ is an additive demand shifter.

Totally differentiating (2'), (3) and (4) with respect to $\beta$ gives

$$\phi \frac{\mathrm{d}\mu}{\mathrm{d}\beta} = \frac{1}{\Delta}[X - (R_{11} - e_{11})(1+t)(1-\alpha)(p-p^*)]\,. \tag{7}$$

The first term in the square brackets captures the terms of trade effect which, presuming the domestic economy is a net exporter of the protected commodity, is positive. The second term in square brackets reflects the domestic response to the world-demand shift. This latter effect, which is negative, depends on the degree to which international price changes are transmitted to the domestic economy, as reflected by $1-\alpha$. In the fixed-price distortion case ($\alpha = 1$), the latter effect disappears, leaving only the terms of trade effect. Thus, for a country protecting one of its sectors with a variable levy, a growth in world demand *always* benefits the country if it is an exporter and hurts the country if it is an importer of the commodity.

In the ad valorem case, however, the net effect for an exporter is ambiguous. What happens is that the world demand shift now induces an expansion of the protected sector and a further increase in exports. Since initially the protected sector was already overexporting (underimporting) because of the distortion, the world-demand shift aggravates the initial distortion. The magnification of the original distortion has a negative impact on welfare that can more than offset the positive terms of trade effect. In fact, some manipulation of (6) reveals that a world-demand increase is immiserizing in the ad valorem case, presuming the country is an exporter of the protected commodity, if and only if $\epsilon > 1/t$. If the protected sector is an import-substitution sector, a world-demand shock always reduces welfare.

## 5. Conclusion

Prior research has ignored the differences between ad valorem and fixed-price intervention. Thus, the welfare consequences of fixed-price distortions have not been systematically studied in a general-equilibrium context. We find important differences between the welfare incidence of ad

valorem interventions and fixed-price export protection interventions. In particular, domestic factor growth is much more likely to be immiserizing in the case of fixed-price distortions than with ad valorem intervention. And conditions under which immiserization is impossible with ad valorem intervention are easily identified. In contrast, fixed-price protection to an import-substitute is much less likely to induce immiserization via factor growth than ad valorem protection. On the other hand, immiserizing growth in world demand is virtually impossible for an exporter using fixed-price intervention but is a distinct possibility with ad valorem intervention.

This paper is a first attempt at the theoretical evaluation of fixed-price trade intervention schemes. Additional research is needed on the implications of these schemes for other international trade and finance theorems.

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