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The Optimal Tariff, Time Consistency and Immiserising Growth in a Large Country

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Abstract

It is well-known that immiserising growth cannot occur in a large, non-distorted economy that employs its optimal tariff. However, if production decisions are made before tariffs are irrevocably set, then the conventional optimal tariff is not time-consistent. We show that if a large country employs its time-consistent optimal tariff, then ultra-import biased domestic growth can be immiserising both for the large country and for its foreign trading partners. We also show that if the large country employs its second-best domestic production tax on importables, then immiserising growth cannot occur.

I. Introduction

It is well-known that, under free trade, an outward shift in a large country's production possibility frontier can lead to *immiserising growth*. It is also clear that, in the presence of domestic distortions, *immiserising growth* can occur for a small country. Finally, we know that immiserising growth cannot arise if the large country utilizes its optimal tariff and is not subject to domestic distortions.

However, the determination of a large nation's optimal tariff, and the implications of economic growth for domestic welfare, are usually analyzed in an *atemporal* framework in which production, consumption (trade) and tariff decisions are all made simultaneously. In reality, most productive activities require time and hence a nation will usually have to precommit to production decisions before consumption decisions are made. In a perfect foresight world in which the country can also credibly precommit to its *optimal tariff*, this precommitment to production activities, in advance of consump-

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tion decisions, is irrelevant, However, if the country cannot credibly precommit to its optimal tariff, then the necessity to precommit to production decisions leads to a time inconsistency problem in that the tariff that is optimal from an *ex ante* perspective will not be optimal *ex post*.

This time inconsistency problem can be illustrated in the following way, The optimal tariff for a large country equals the reciprocal of the price elasticity of the foreign export supply curve. From an *ex ante* perspective, this elasticity depends upon the elasticity of foreign supply and demand curves. However, from an *ex post* perspective, production is given, and consequently the *ex post* export supply curve will be less elastic than the *ex ante* export supply curve. Thus, it is readily shown that, without credible precommitment to commercial policy, the large country will always have an *ex post* incentive to increase the tariff above the *ex ante* level of the optimal tariff. Elsewhere (Lapan, 1988) we have shown that the inability to precommit commercial policy leads to an equilibrium with higher tariff rates and lower welfare for both nations.

In this paper we shall show that the inability to precommit commercial policy also implies that immiserising growth can occur for the large nation (even though it imposes its *ex post* optimal tariff). Somewhat surprisingly, this phenomenon can only occur when the growth in the large country is *ultra-import-biased*—that is, if at unchanged domestic prices, output of importables rises (and that of exportables falls). However, we also show that immiserising growth cannot occur if the country uses both (*ex post*) commercial policy and (*ex ante*) production taxes / subsidies.

The plan of this paper is as follows. In Section II we formulate the basic model and briefly rederive the optimal tariff formulas with, and without, precommitment. In Section III we use this model to show how growth affects domestic and foreign welfare, assuming the nation cannot precommit to its optimal tariff.

II. The Basic Model

Our assumptions, which are standard, are as follows :

(i) there are two goods (M, F)

(ii) there are a large number of identical small countries which pursue free trade policies.

(iii) the domestic economy is large, in the sense (it recognizes) its trade decisions affect world prices.

(iv) agents in each country are identical, so their preferences can be represented by a well-behaved utility function.

(v) production opportunities in each country are represented by a well-behaved strictly concave production possibility frontier.

(vi) there is a time lag between production and consumption (trade) decisions.

(vii) under free trade, the (large) domestic economy would export good M and import F.

Economic decisions are made in the following sequence : (i) the large country sets its tariff rate and, if applicable, its tax on domestic production of importables ; (ii) next, producers in all countries make production decisions, given technology, based upon their expectations of producer prices ; (iii) given production decisions, the government may revise tariffs, and (iv) finally, consumption (trade) decisions are made. Throughout, all decisions are made under perfect information. The sequential nature of the decision process reflects the time-intensity of production activities. Note that the same basic sequencing of decisions would occur in an intertemporal model in which capital allocation decisions were made once, while labor was mobile in each period.

Clearly, the ability to (costlessly) revise tariffs in step (iii), after production decisions are made, renders the step (i) tariff-setting process irrelevant. Hence, the optimal *ex ante* (or precommitment) tariff is time-consistent only if it is infeasible to change tariffs in step (iii). Furthermore, note that revising the production tax in step (iii) would have no allocational impact since production decisions are (at that stage) pre-determined.

For simplicity, we let M be the numeraire ; thus $\overline{p}$ denotes the foreign relative price of F, and p the domestic relative (consumer) price of F. Furthermore, $\overline{p}^a$ denotes the relative price foreign producers expect to prevail when production decisions are made, (in step (ii)) and p_F^a denotes the relative price domestic producers of F expect to receive for their output. Naturally, in a perfect foresight equilibrium : $\overline{p}^a = \overline{p}$ and $p_F^a = p$ if the domestic economy does not utilize production tax / subsidies.

The (aggregate) foreign supply and demand functions are given by :

$$(1)\ \overline{Q}_i = \overline{S}_i(\overline{p}^a)\ ;\ i = M, F\ ;\ \overline{S}'_F > 0,\ \overline{S}'_M < 0$$

$$(2)\ \overline{C}_F = \overline{F}(\overline{y}, \overline{p})\ ;\ \overline{C}_M = \overline{M}(\overline{y}, \overline{p})$$

$$(3)\ \overline{y}(\overline{p}, \overline{p}^a) = \overline{Q}_M + \overline{p}\,\overline{Q}_F$$

where $\overline{Q}_i$ represents foreign production, $\overline{C}_i$ foreign consumption, and $\overline{y}$ foreign income, in numeraire units. The foreign export supply curve is given by :

$$(4)\ \bar{X}(\bar{p}, \bar{p}^a) \equiv \bar{S}_F(\bar{p}^a) - \bar{F}(\bar{y}, \bar{p})$$

For future reference, define :

$$(5)\ \bar{X}'(\bar{p}) = \frac{\partial \bar{X}}{\partial \bar{p}} + \frac{\partial \bar{X}}{\partial \bar{p}^a}, \text{ where :}$$

$$(6)\ \frac{\partial \bar{X}}{\partial \bar{p}} = -[\bar{F}_p + \bar{F}_y \cdot \bar{S}_F(\bar{p}^a)]$$

$$(7)\ \frac{\partial \bar{X}}{\partial \bar{p}^a} = \bar{S}_F' - \bar{F}_y[\bar{S}_M'(\bar{p}^a) + \bar{p}\,\bar{S}_F'(\bar{p}^a)] = \bar{S}_F' \text{ at } \bar{p}^a = \bar{p}.$$

In (6) and (7), $(\bar{F}_p, \bar{F}_y)$ denote partial differentiation of foreign demand. Thus, $\frac{\partial \bar{X}}{\partial \bar{p}}$ denotes the change in foreign exports due to a change in $\bar{p}$, given $\bar{p}^a$ (i.e., given production), whereas $\frac{\partial \bar{X}}{\partial \bar{p}^a}$ denotes the change in exports due to a change in $\bar{p}^a$ (in production), given $\bar{p}$. Hence, $\bar{X}'(\bar{p})$ -- which denotes the slope of the conventional export supply curve -- incorporates demand and production effects.

The domestic economy's production set is defined by :

$$(8)\ g(Q_F, Q_M ; \alpha) \geqslant 0 ; \frac{\partial g}{\partial Q_i} < 0, i = F, M$$

where g is a twice differentiable, strictly concave function of (Q_F, Q_M). The parameter α will be used subsequently to represent shifts in this production set. Assuming competitive domestic production, the associated domestic supply curves are :

$$(9)\ Q_i = S^i(p_F^a, \alpha),\ i = F, M ; S_p^F > 0, S_p^M < 0$$

where p_F^a denotes the anticipated relative producer price of F on domestic markets, and S_p^i denotes the partial derivative of the supply curves with respect to this price.

Domestic preferences are represented by the indirect utility function, V(y, p), where y denotes domestic income, in numeraire units. Using Roy's identity, the domestic demand for F is :

$$(10)\ C_F = -(V_p/V_y) \equiv F(y, p)$$

Finally, domestic income is given by :

$$(11)\ y = Q_M + p\,Q_F + (p - \bar{p})(C_F - Q_F) = Q_M + \bar{p}\,Q_M + (p - \bar{p})\,C_F$$

where the term $(p - \bar{p})(C_F - Q_F)$ denotes tariff revenue, which is rebated in a lump sum fashion to households.

Ex post equilibrium requires :

$$(12)\ C_F - Q_F = F(y,p) - S^F(p_F^a, \alpha) = \bar{X}(\bar{p}, \bar{p}^a)$$

The standard optimal tariff is derived by assuming the government can precommit to its optimal tariff (thus, no tariff revision in step (iii) is feasible). For this case, $\bar{p}_F^a \equiv \bar{p}$, and (assuming no domestic production taxes) $\bar{p}_F^a \equiv p$. Hence, using (11)−(12), the choice of an optimal tariff is equivalent to choosing $\bar{p}$ to maximize V(y, p).[1] Performing this optimization yields the familiar optimal tariff formula :[2]

$$(13)\ \frac{dV}{d\bar{p}}(y, p) = V_y[-\bar{X}(\bar{p}) + t \cdot \bar{X}'(\bar{p})] = 0 \ ; t \equiv (p - \bar{p})$$

where t denotes the (optimal) specific tariff.

Denote this optimal *ex ante* solution by $(p^*, \bar{p}^*)$. As noted earlier, this solution will not be time consistent if there are production lags and if the government can alter its tariff (in step (iii)) once production decisions are made since the *ex post* foreign offer curve will be less elastic than the *ex ante* offer curve. We have shown elsewhere (Lapan, 1988) that the time consistent equilibrium results in a higher tariff, lower world price and higher domestic price than would occur with precommitment. We have also shown that if the large country cannot precommit to its *ex ante* optimal tariff, then a tax on domestic production of importables will raise domestic (and foreign) welfare. These proofs are briefly repeated below to provide the basis for our results in Section Ⅲ.

More formally, the time consistent solution, without precommitment, is found by differentiating V(y, p) with respect to $\bar{p}$, treating $\bar{Q}_F$, Q_F (hence $\bar{p}^a$, p_F^a) as constants. From (11) and (12) we can express y and p as functions of $(\bar{p}, \bar{p}^a, p_F^a, \alpha)$:

$$(14)\ y \equiv \phi(\bar{p}, \bar{p}^a, p_F^a, \alpha) \ ; p = \sigma(\bar{p}, \bar{p}^a, p_F^a, \alpha)$$

1. Actually, there is no guarantee that the optimal tariff, τ^*, will result in a unique market equilibrium so that the choice of $\bar{p}$ is a (potentially) superior instrument. In essence, the large country announces the price it will pay for imports, thereby choosing a point on the foreign offer curve.

2. The second order condition is : $[-2\bar{X}' + \{\bar{X}''\bar{X}/(\bar{X}')\} + \bar{X}'\frac{dp}{d\bar{p}}] < 0$: sufficient second order conditions are that : (i) the domestic compensated import demand curve be negatively sloped (convex preferences and a concave PPF), which is also required to insure uniqueness of $p(\bar{p})$; and (ii) $[\bar{X}''\bar{X} - 2(\bar{X}')^2] < 0$, which is equivalent to assuming the foreign offer curve, $\bar{X}(\bar{I})$ is concave in $\bar{I}$, where $\bar{I}$ denotes foreign imports. Throughout we assume unique solutions to the first order conditions.

Thus, given $\overline{p}^a$, p_F^a (*i.e.*, given $\overline{Q}_F$, Q_F) :

$$(15)\ \frac{\partial V}{\partial \overline{p}} = (V_y \frac{\partial y}{\partial \overline{p}} + V_p \cdot \frac{\partial p}{\partial \overline{p}}) = V_y [\phi_1 - C_F \sigma_1]$$

where the notation $(\partial V / \partial \overline{p})$ is used to emphasize the fact that $\overline{p}^a$ $(\overline{Q}_F)$ is treated as predetermined, and (ϕ_1, σ_1) denote partial differentiation with respect to their first argument.

To facilitate our subsequent analysis, we totally differentiate (11) and (12) to yield :

$$(16)\ dy = [\{F_p b_1 + (F + tF_p) b_2\} / B] ; t \equiv (p - \overline{p})$$

$$(17)\ dp = [\{-F_y(b_1) + (1 - tF_y) b_2\} / B] ; B \equiv [F_p + F_y]$$

where F is domestic demand for importables, (F_p, F_y) are partial derivatives of domestic demand, and B (<0) is the slope of the compensated demand for importables. Also :

$$(18)\ b_1 = [-\overline{X} \cdot d\overline{p} + 0 \cdot d\overline{p}^a + (\overline{p} - p_F^a) S_p^F \cdot dp_F^a + (g_\alpha - tS_\alpha^F) d\alpha]$$

$$(19)\ b_2 = [\frac{\partial \overline{X}}{\partial \overline{p}} \cdot d\overline{p} + (\overline{S}_F' \cdot d\overline{p}^a) + S_p^F \cdot dp_F^a + (S_\alpha^F) d\alpha]$$

$$(20)\ S_\alpha^F = \frac{\partial S^F}{\partial \alpha} ; g_\alpha = [\frac{\partial S^M}{\partial \alpha} + p \cdot \frac{\partial S^F}{\partial \alpha}]$$

For subsequent purposes, note that g_α is a measure of economic growth since it reflects the change in the value of domestic output, evaluated at domestic (consumer) prices, due to the change in technology.

Using (15)−(19), we have :

$$(21)\ [dy - C_F dp] = [b_1 + tb_2] = \{d\overline{p} [-\overline{X} + t\frac{\partial \overline{X}}{\partial \overline{p}} + [t\overline{S}_F'] d\overline{p}^a + [p - p_F^a] S_P^F dp_F^a + g_\alpha \cdot d\alpha\}$$

Thus, returning to (15), the *ex post* optimal tariff is determined by :

$$(15')\ \frac{\partial V}{\partial \overline{p}} = V_y [-\overline{X}(\overline{p}, \overline{p}^a) = t \cdot \frac{\partial \overline{X}}{\partial \overline{p}}] = 0$$

Since $(\frac{\partial \overline{X}}{\partial \overline{p}}) < \overline{X}$ provided $\overline{S}_F' > 0$, it is apparent that $\frac{\partial V}{\partial \overline{p}} < 0$ when evaluated at ($\overline{p}^*$, p^*). This shows that world price will be lower (and domestic price higher) under the *ex post* tariff.[3] The time consistent, no precommitment, no production tax equilibrium is found using (11), (12) and (15′), assuming $\overline{p}^a=\overline{p}$, and $p_F^a = p$. Let us denote this solution by $(\overline{p}^N(\alpha), p^N(\alpha))$, where the notation depicts the fact that changes in (α) will alter this solution.

The preceding equilibrium results in less trade (and lower welfare) than the *ex ante* optimal tariff because foreign producers, fearful that the large country will exploit the reduced elasticity of the *ex post* offer curve, thereby reduce their (*ex ante*) production levels. Since production decisions are (assumed) made in advance of tariff decisions, one way the large country can induce foreign producers to expand output is by taxing (or restricting) domestic production of importables. Thus, while the large country cannot credibly precommit its commercial policy, it can credibly precommit to production policy (since *ex post* changes in production taxes will not affect domestic production levels). Consequently, we can infer that a domestic production tax on importables is beneficial.

The production tax, *ex post* tariff equilibrium is determined as follows. Equations (11), (12) and (15′), with $\overline{p}^a \equiv \overline{p}$, determine ($\overline{p}$, p, and y) as functions of p_F^a (and α). Differentiating V(y, p) with respect to p_F^a, using (11), (12), (15′) and (21) yields :

$$(22)\ \frac{dV}{dp_F^a} = V_y\left[\frac{\partial y}{\partial \overline{p}} - C_F\frac{\partial p}{\partial \overline{p}}\right]\frac{\partial \overline{p}}{\partial p_F^a} + V_y\left[\frac{\partial y}{\partial \overline{p}^a} - C_F\frac{\partial p}{\partial \overline{p}^a}\right]\frac{\partial \overline{p}^a}{\partial p_F^a} + V_y\left[\frac{\partial y}{\partial p_F^a} - C_F\frac{\partial p}{\partial p_F^a}\right]$$

$$= V_y\{(p-p_F^a)\, S_p^F + t\overline{S}_F' \cdot (\partial\overline{p}^a/\partial p_F^a)\} = 0$$

Since increases in domestic production of importables (in p_F^a) will lower world price $([\partial\overline{p}/\partial p_F^a] < 0)$, it immediately follows that it is optimal to tax domestic production of importables ($p_F^a < p$) provided foreign supply is price responsive. Totally differentiating

3. As discussed in Lapan (1988), the second order conditions for the *ex post* tariff do not guarantee a unique time consistent solution. For simplicity, define : $\triangle=[2(\overline{X}'-\overline{S}_F')-t(\overline{X}''-\overline{S}_F'')]$. Then the SOC, given $(\overline{p}^a, p_F^a)$ is :

$$E= \{(-B)\ [\triangle-t\ \overline{F}_y\ \overline{S}_F'] + (\overline{X}'-\overline{S}_F')^2\} > 0$$

where $[\triangle-t\ \overline{F}_y\ \overline{S}_F']$ reflects the curvature of the *ex post* offer curve. Sufficient conditions are that $[\triangle-t\ \overline{F}_F\ \overline{S}_F'] > 0$, i.e, that the foreign *ex post* offer curve $(\overline{X}(\overline{I}))$ be concave in $\overline{I}$ (foreign imports) and $B<0$. Uniqueness of the time consistent equilibrium requires :

$$G=[(S_p^F - B)\ (\triangle+\overline{S}_F') + (\overline{X}'-\overline{S}_F')\ (\overline{X}' - t\ F_y\ \overline{S}_F')] > 0$$

Sufficient conditions for uniqueness are that the slope of the *ex post* offer curve $(d\overline{I}/d\overline{X})$ increase as we move up the *ex ante* offer curve $((\triangle + \overline{S}_F') > 0)$, and that $S_p^F > 0 > B$. Clearly, if $\overline{F}_y \geqslant 0$, then concavity of every *ex post* offer curve suffices to insure uniqueness. For details, see Lapan (1988).

(15′), using (16) and (17), yields $(\partial\overline{p}^{a}/\partial p_F^a)$; substituting in (22) gives the optimal production tax : [4]

$$(23)\ 0 < [p-p_F^a] = [t(\overline{X}' - S_F')\overline{S}_F'/W] < t, \text{ where :}$$
$$(24)\ W = [(\overline{X}' - \overline{S}_F')\,\overline{X}' - B\cdot\{2\overline{X}_F' - \overline{S}_F' - t(\overline{X}'' - \overline{S}_F'')\}] > (\overline{X}' - \overline{S}_F')\,\overline{S}_F' > 0$$

The ex-post tariff, production tax equilibrium is found by solving (11), (12), (15′) and (23) simultaneously. Denote the optimal domestic consumer price by $p^t(\alpha)$, the domestic producer price by $p_F^t(\alpha)$, and the world price by $\overline{p}^t(p_F^t, \alpha)$, where the latter notation indicates that changes in α affect $\overline{p}$ directly(given p_F^t), and indirectly through its impact on p_F^t. As noted above, $p^t > p_F^t > \overline{p}^t$, so that the net price domestic producers of F receive is above the world price, but below the domestic consumer price.

Ⅲ. Time Consistency and Immiserising Growth

We are now in a position to demonstrate the possibility of immiserising growth in the no-precommitment, no production tax equilibrium. Assuming perfect foresight ($\overline{p}^a = \overline{p}$), and using (21), the impact of a technological innovation on domestic welfare is given by :

$$(25)\ \frac{dV}{d\alpha} = V_y\left[\frac{dy}{d\alpha} - C_F\frac{dp}{d\alpha}\right] = V_y\left[\{t\overline{X}' - \overline{X}\}\frac{d\overline{p}}{d\alpha} + \{(p-p_F^a)\,S_p^F\}\frac{dp_F^a}{d\alpha} + g_\alpha\right]$$

where g_α, as defined in (20), is the increase in the value of domestic output (evaluated at domestic *consumer* prices), given prices, due to the technological (or resource) innovation. From (25) it is immediately apparent that with the *ex ante* optimal tariff ($p=p_F^a$, $t\overline{X}' = \overline{X}$), $g_\alpha > 0$ is a necessary and sufficient condition for the *economic growth* to lead to an increase in domestic welfare.

However, consider the time consistent optimal tariff, no production tax equilibrium ($\overline{p}^N(\alpha)$). Using (15′), and the perfect foresight assumption ($p=p_F^a$), (25) becomes :

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4. From footnote 3,
$W=E + \overline{S}_F'[(\overline{X}' - \overline{S}_F') - B\,(1+t\,\overline{F}_y\,\overline{S}_F')\} > \overline{S}_F'\,(\overline{X}' - \overline{S}_F')$
assuming $E>0$ (as implied by the SOC), $\overline{F}_y \geqslant 0$, $\overline{S}_F' > 0 > B$. Hence $0 < (p-p_F^a) < (p-\overline{p})$.
For subsequent purposes, note :
$p_F^a = \gamma\overline{p} + (1-\gamma)p$, where : $\gamma=[\overline{S}_F'(\overline{X}' - \overline{S}')/W]$, $\gamma\in(0, 1)$.
Thus, the optimal domestic producer price is a weighted average of the world and domestic consumer price.

$$(26)\ \frac{dV}{d\alpha} = V_y\,[t\,\bar{S}'_F\,\frac{d\bar{p}^N}{d\alpha} + g_\alpha]$$

Thus, $g_\alpha > 0$ is neither a necessary, nor a sufficient, condition to imply that outward shifts in the domestic PPF lead to an improvement in domestic welfare. Furthermore, note that *increases* in $\bar{p}$, the world relative price of domestic imports, lead to *increases* in domestic welfare. This seemingly paradoxical result arises because the inability to precommit reduces the volume of world trade and implies that the domestic economy would benefit from *moving up* the foreign offer curve (to higher $\bar{p}$). It also implies that, given g_α, *domestic growth is most likely to be beneficial when it is export-biased,* thereby leading to increases in $\bar{p}$ (a deterioration in the domestic terms of trade). Conversely, it also implies that if the *growth is import-biased,* so that $\bar{p}$ falls, *both countries can experience a decline in welfare.* This latter situation cannot, of course, arise under free trade unless there are domestic distortions.

Proposition 1 : Assume the large country cannot precommit to its *ex ante* optimal tariff and that there are no production taxes. Then ultra-import biased growth ($\frac{\partial s^M}{\partial\alpha} < 0$) can lead to a deterioration in welfare for the large country *and* to a deterioration in welfare for foreign nations which export the large country's import good.

Proof :

Totally differentiating (15′), assuming perfect foresight, yields :

$$(27)\ -dp^N[\bar{X}' - \bar{S}'_F] + d\bar{p}^N[2\bar{X}' - \bar{S}' - t^N(\bar{X}'' - \bar{S}''_F)] = 0$$

Substituting (27) into (17), using (15′) and perfect foresight, yields :

$$(28)\ \frac{d\bar{p}^N}{d\alpha} = -[(\bar{X}' - \bar{S}'_F)\,S^F_\alpha - F_y\,g_\alpha)/G]\ ;\ G>0$$

where G, defined in footnote 3, is positive assuming uniqueness of the time consistent solution. Simplifying (28) implies :

$$(29)\ \frac{d\bar{p}^N}{d\alpha} \gtrless 0 \text{ as } [(p^N F_y)\,S^M_\alpha \gtrless (1-p^N F_y)\,S^F_\alpha$$

Note that $(p^N F_y)$ is the domestic marginal propensity to consume importables, $(1-p^N F_y)$ the domestic marginal propensity to consume exportables.

Substituting (28) into (26) and simplifying yields :

$$(30)\ \frac{dV}{d\alpha} = (V_y/G)[Gg_\alpha - t^N \bar{S}'_F(\bar{X} - \bar{S}'_F)\,(S^F_\alpha - F_y g_\alpha)]$$

$$= (V_y/G)[Dg_\alpha - t^N \bar{S}'_F(\bar{X}' - \bar{S}'_F)\,S^F_\alpha],\ \text{where :}\ ^5$$

$$(31)\ D=[\bar{X}'\,(\bar{X}' - \bar{S}'_F) + (S^F_p - B)\,(2\bar{X}' - \bar{S}'_F - t^N[\bar{X}'' - \bar{S}''_F])] > 0$$

From (30) it is apparent that $g_\alpha > 0 \geqslant S^F_\alpha$ suffices to imply that economic growth increases welfare in the large country (and in foreign exporting nations). However, it is equally apparent that for $S^F_\alpha > 0$ and g_α *near* zero (implying $S^M_\alpha < 0$) all countries could be worse off due to the growth. Specifically, rewrite (30) as : [6]

$$(32)\ \frac{dV}{d\alpha} = [V_y D/G]\,[S^M_\alpha + \theta S^F_\alpha],\ \ \bar{p} < \theta < p,\ \text{where :}$$

$$(33)\ \theta = \mu\bar{p} + (1-\mu)p\ ;\ \mu = [\bar{S}'_F(\bar{X}' - \bar{S}'_F)/D]\ ;\ 0 < \mu < 1$$

Thus, $g_\alpha = [S^M_\alpha + p\,S^F_\alpha] > 0$ is neither necessary, nor sufficient, for *growth* to benefit the large country. Hence, if $pS^F_\alpha > -S^M_\alpha > \theta\,S^F_\alpha$ (implying $S^F_\alpha > 0 > S^M_\alpha$) then $g_\alpha > 0$, and the *growth* immiserizes the large country and foreign exporting nations. Q.E.D.

This result can be understood as follows. If the large country could credibly precommit to (any) world price $\bar{p}$, then the domestic price, p, would reflect the social value of increased output of F, and hence $g_\alpha > 0$ would be a necessary and sufficient condition to imply domestic welfare increases. However, since it cannot credibly precommit, the true social value of increased output of F, given no production taxes, is θ, which is below the domestic price (but above the world price). If the domestic growth causes foreign producers to anticipate a lower world price for their exports, then part of the potential gains to the large country from this growth are lost due to the reduced volume of world trade (even though the country's terms of trade improve). Finally, if this growth is sufficiently import-biased, then it can be immiserising. This, of course, merely reflects the fact that, without precommitment, commercial policy is not the first best (institutionally constrained) solution, and that a domestic production tax is also

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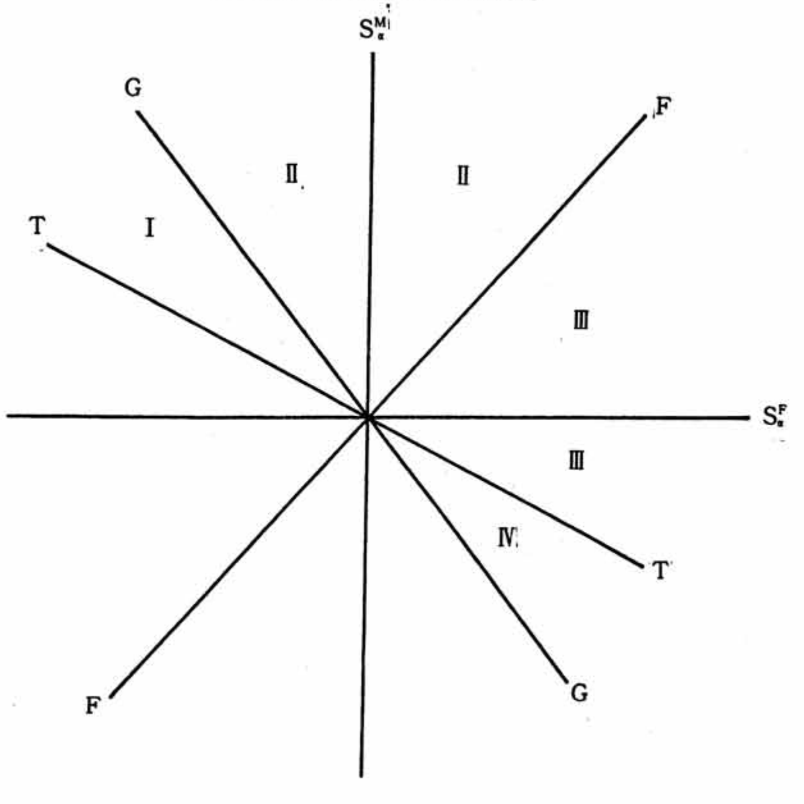
5. $D=G+t^N F_y \bar{S}'_F\ (\bar{X}' - \bar{S}'_F)$. Uniqueness implies $G>0$; thus, $F^y \geqslant 0$ implies $D > 0$.

6. $\mu > 0$ follows immediately from $D > 0$; however, $\mu < 1$ does not follow directly from the SOC and uniqueness. A sufficient condition for $\mu < 1$ is : $\triangle \equiv [2(\bar{X}' - \bar{S}'_F) - t(\bar{X}'' - \bar{S}''_F)] > 0$. This latter condition is a necessary condition for the SOC to hold for all B (see footnote 3). We assume this to be the case.

part of the (constrained) *first best* solution.

Figure 1 graphically depicts these results. The horizontal axis (S^F_α) measures the change in domestic output of importables and the vertical axis the change in domestic output of exportables, at given prices, due to the growth. The line labelled FF reflects the locus such that (*ex post*) world prices are unchanged ; it is drawn under the assumption both goods are normal in consumption. Points above (to the left of)the locus lead to higher $\overline{p}$, and hence higher foreign welfare ; those below the locus to lower foreign welfare. The line labelled GG represents the combination of changes in outputs such that the value of domestic output, evaluated at consumer prices, is constant ($g_\alpha=0$). Points above the locus imply *economic growth* ($g_\alpha > 0$), those below the locus correspond to a (local) inward shift of the domestic PPF ($g_\alpha < 0$), assuming no domestic production taxes. Finally, the locus TT corresponds to domestic output changes that leave the value of domestic output, evaluated at the shadow price θ, unchanged ($[S^M_\alpha + \theta S^F_\alpha]=0$).

Figure 1
Economic Growth and Welfare



Region I corresponds to a (local) *inward* shift of the domestic PPF that is ultra-export-biased. Even though the value of domestic output (evaluated at p) *declines,* $\bar{p}$ rises, and all countries gain. Region II depicts a more conventional case of export-biased growth where the value of domestic output, domestic welfare and foreign welfare ($\bar{p}$) all rise. In region III the growth is import, or ultra-import, biased, so that $\bar{p}$ (and foreign welfare) decline, but the value of domestic output, and of domestic welfare, increase. Finally, in region IV the domestic growth leads to ***a decline in welfare for the large country and for foreign exporters.***

The preceding should make it clear that immiserising growth cannot occur if the large country also employs its optimal *ex ante* production tax. Intuitively, since the government can use this tax to choose any point on the domestic PPF, as long as the original production point is feasible, the growth cannot be immiserising. By continuity, if the growth leads to a (local) outward shift in the PPF, there must be some feasible production point that, coupled with the *ex post* tariff, leads to higher domestic welfare.

More formally, the production tax, *ex post* tariff equilibrium (p_F^t (α), $\bar{p}^t$ (p_F^t, α)) is determined from (11), (12), (15') and (22). From (25) :

$$(34)\ \frac{dV}{d\alpha} = V_y\,[(t\,\bar{X}' - \bar{X})\,\frac{\partial \bar{p}^t}{\partial \alpha} + (t\,\bar{X}' - \bar{X})\,\frac{\partial \bar{p}^t}{\partial p_F} + (p - p_F^a)\,S_p^F]\,\frac{dp_F^t}{d\alpha} + g_a]$$

Using (15′) and (22) :

$$(35)\ \frac{dV}{d\alpha} = V_y\,[t\,\bar{S}_F'\,\frac{\partial \bar{p}}{\partial \alpha} + g_a]$$
$$= V_y\,[g_a - \{(p - p_F^t)\,S_p^F \cdot (\partial \bar{p}/\partial \alpha)\,/\,(\partial \bar{p}/\partial p_F)\}]$$

Using (17) and (27) :

$$(36)\ \frac{\partial \bar{p}}{\partial \alpha} = -[(\bar{X}' - \bar{S}_F')\,(S_a^F - F_y\,g_a)\,/K]\,;$$

$$(37)\ \frac{\partial \bar{p}}{\partial p_F} = -[S_p^F\ \ (1 - \eta F_y)\,(\bar{X}' - \bar{S}_F')\,/K],\ \text{where}\ \eta = (p - p_F)\ \text{and :}$$

$$(38)\ K \equiv [(-B)\,\{2\bar{X}' - \bar{S}_F' - t(\bar{X}'' - \bar{S}_F'')\} + (\bar{X}' - \bar{S}_F')\,(\bar{X}' - tF_y\,\bar{S}_F')]$$

Substituting in (35) yields :

$$(39)\ \frac{dV}{d\alpha} = [V_y/\{1-(p-p_F^t)F_y\}]\,[S_\alpha^M + p_F^t S_\alpha^F]$$

Since $[S_\alpha^M + p_F^t\ S_\alpha^F]$ reflects the change in the value of domestic output, evaluated at the domestic producer price, it follows immediately that economic growth must lead to increased domestic welfare, provided the large country uses *ex ante* production taxes, as well as the *ex post optimal* tariff.[7] The preceding, of course, is merely an application of the envelope theorem.

In conclusion, the inability of a large country to credibly precommit to its optimal tariff leads to an equilibrium in which the world price of that country's import good is lower, and the domestic price higher, than would occur under precommitment. In addition, if only *ex post* commercial policy is used, then the domestic price of impotables will exceed the social value of additional domestic output of importables, and hence ultra-import biased growth can be immiserising. However, if the country also appropriately taxes domestic production of importables, then immiserising growth cannot occur.

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7. There is an analogy between this case and the previous case in which θ reflected the shadow price of domestic output. The difference is that, with the tax producers respond to p_F^t, whereas without the tax they respond to p, not θ.