Raw Materials, Processing Incentives and Foreign Ownership

John Gilbert
Postdoctoral Fellow
Department of Agricultural Economics
Washington State University
PO Box 646210
Pullman, WA 99614-6210
Ph: (509) 335-3817
Fax: (509) 335-1173
e-mail: jpgilbert@wsu.edu

Abstract

The effect of foreign ownership on trade policy outcomes has long been a topic of interest, but only recently have the consequences of multiple levels of production been considered. We examine processing incentives in a simplified general equilibrium framework with foreign ownership of a primary factor. Second-best considerations mean non-intervention is sub-optimal, but multiple levels of production can lead to an investment terms-of-trade effect of indeterminate sign, depending critically on the production structure. We illustrate how this may change standard conclusions regarding the effect of trade restrictions where there is foreign ownership, and optimal intervention to achieve specific policy objectives.

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1. Introduction

In many economies where a significant proportion of exports are primary products, there have been vocal calls for processing incentives. Many of these same economies have been the recipients of foreign investment. An example is New Zealand. The majority of New Zealand's forest resources are owned by foreign interests, as a result of government sales in the late 1980s. In response to a negative perception of increased log sales, there have been numerous calls to follow the example of Indonesia and others and impose export restrictions, to expand domestic processing. Hence, an analysis of the implications of processing incentives and foreign ownership is of considerable practical interest.

The presence of foreign owned factors of production in an economy has long been a topic of interest in international trade theory, but the literature focuses almost exclusively on final goods models. Beladi and Marjit (1992) make an interesting extension to consider export processing zones, but do not consider a production structure with multiple levels. More recently, Marjit and Beladi (1996) consider tariff-jumping foreign investment into an intermediate sector. Marjit et al. (1997) consider the same issue in the context of a Harris-Todaro model. Both of these significant contributions reach the conclusion that, in contrast to the conventional argument of Brecher and Diaz-Alejandro (1977), tariff-jumping investment may not be immiserizing if it flows into an intermediate sector.

While Marjit and Beladi (1996) provide a counter to the received wisdom on tariff-jumping, *pre-existing* foreign ownership can provide an incentive to distort trade, or a disincentive to liberalize (Bhagwati and Tironi, 1980; Bhagwati and Brecher, 1980; Brecher and Bhagwati, 1981). The Stolper-Samuelson effect of intervention can lower returns to foreign owned factors, raising national welfare. The issue described above concerns how this argument stands up when the investment is in an intermediate sector. Thus, this paper is intended to complement Marjit and Beladi (1996), by considering the dual foreign ownership problem. Like Marjit and Beladi, we conclude in a strikingly different way from the conventional literature – under plausible circumstances pre-existing foreign investment provides no incentive to distort trade, and no disincentive to liberalization.

Section 2 develops the basic welfare decomposition for an export tax, Section 3 presents the effects on income distribution and output under one potential specification where the standard result is maintained, and Section 4 explores a plausible alternative that reverses the standard result. Section 5 briefly considers other processing incentives, while Section 6 contains concluding remarks.

2. Processing Incentives and Welfare

We consider a three good model. Let the production of an aggregate importable (manufactures) be industry 0, raw material production be industry 1, and processing be industry 2. The economy uses three primary factors of production, labor (*L*), capital (*K*) and natural resources (*N*), assumed to be available in fixed supply and fully employed. Natural resources are owned by foreign interests, who receive the income stream generated by those assets. Ownership of factors and world prices are exogenous to the system to highlight the basic issues involved.

We assume that the production functions of all three goods have standard properties (they are positive, continuous, concave for inputs greater than zero, and linearly homogeneous). Perfect competition prevails. All goods are freely tradable, and the economy exports raw materials and processed goods in exchange for manufactures. Consumers have identical preferences, and their individual utility functions can be aggregated into a direct social utility function $u(z_o, z_2)$, where z_i is the consumption of good *i*. Raw materials are a 'pure' intermediate, they do not enter the utility function. The social utility function is non-negative, continuous, quasi-concave, and increasing in consumption of all goods.

The budget constraint facing the economy in the presence of foreign ownership and an export tax on the raw material can be expressed in terms of the *GNP* and expenditure functions as:

$$G(p_i, \overline{K}, \overline{L}, \overline{N}) + ty_1 - n\overline{N} = E(p_j, u) \qquad i = 0...3, \quad j = 0,2 \tag{1}$$

where $n\bar{N}$ is the payment for the use of foreign factors of production, y_1 is net output (exports) of raw materials, and t is the tax on those exports. Revenue associated with the tax is redistributed in a lump-sum fashion that does not favor any particular class of factor owner.

We assume the *GNP* and expenditure functions are continuous. Differentiating (1) totally holding factor endowments and all prices except p_1 constant, and simplifying by making use of the definition of imports and the fact that $dp_1 = dp_1^* - dt$:

$$dW = tdy_1 - \bar{N}dn \tag{2}$$

where $dW \equiv E_u du$. The incremental change in welfare is the movement of exports across the trade distortion minus the change in payments to the foreign owned natural resources. To explore the signs that the two components of (2) may take in a model with multiple levels of production, we need to consider the production structure that underlies the *GNP* function.

3. General Equilibrium Framework

Assume raw materials are produced using labor (*L*) and the specific factor natural resources (*N*), while manufactures are produced using labor and the specific factor capital (*K*). These two industries form what in the parlance of Jones and Spencer (1989) is the primary tier of the economy. The secondary tier consists of processing, using labor and raw materials. The profit maximizing are:

$$c^0(w, r) = p_0 \tag{3}$$

$$c^1(w, n) = p_1 \tag{4}$$

$$c^2(w, p_1) = p_2 \tag{5}$$

Factor prices are uniquely determined by equations (3)-(5) in this model. Differentiating totally for a small change in p_1, holding p_2 and p_0 constant, and expressing in percentage change form yields:

$$\begin{bmatrix} q_{0L} & q_{0K} & 0 \\ q_{1L} & 0 & q_{1N} \\ q_{2L} & 0 & 0 \end{bmatrix} \begin{bmatrix} \hat{w} \\ \hat{r} \\ \hat{n} \end{bmatrix} = \begin{bmatrix} 0 \\ \hat{p}_1 \\ -q_{2q_1}\hat{p}_1 \end{bmatrix}$$

where the q_{ij} are cost shares and a hat denotes relative changes (i.e., $\hat{w} \equiv dw/w$). Solving for the relative changes in factor prices yields:

$$\hat{w} = (-q_{2q_1}/q_{2L})\hat{p}_1 \tag{6}$$

$$\hat{r} = (q_{0L}q_{2q_1}/q_{2L}q_{0K})\hat{p}_1 \tag{7}$$

$$\hat{n} = [(q_{2L} + q_{1L}q_{2q_1})/q_{1N}q_{2L}]\hat{p}_1 \tag{8}$$

Equations (6)-(8) reveal that an export tax on raw materials causes the real return to owners of natural resources and owners of capital to fall, and the real return to labor to rise. Hence, the second term in equation (2) is negative. An export tax has a beneficial effect on home welfare by reducing the payments to foreign owners of natural resources – as in the final goods only models.

Of course, given the assumed objective of increasing processing, we are restricting ourselves to second-best policies here – the optimal policy would be to tax natural resources directly.[1] Governments may, however, prefer their nationalization to take this more subtle form.

[1] Huizinga and Nielson (1997) have recently considered optimal taxation policy with foreign firms. See also Chao and Yu (1996).

It follows that, in this simple model, intervention will raise domestic welfare, as in the standard analysis. The first term of (2) is negative under our assumptions, and it is elementary to derive the effect of intervention on output. Factor market equilibrium requires:

$$a_{0K} g_0 = \overline{K} \tag{9}$$

$$a_{0L} g_0 + a_{1L} g_1 + a_{2L} g_2 = \overline{L} \tag{10}$$

$$a_{1N} g_1 = \overline{N} \tag{11}$$

Logarithmically differentiating (9)-(11) totally holding factor endowments constant we have:

$$\begin{bmatrix} 1 & 0 & 0 \\ l_{0L} & l_{1L} & l_{2L} \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} \hat{g}_0 \\ \hat{g}_1 \\ \hat{g}_2 \end{bmatrix} = \begin{bmatrix} -\hat{a}_{0K} \\ -(l_{0L}\hat{a}_{0L} + l_{1L}\hat{a}_{1L} + l_{2L}\hat{a}_{2L}) \\ -\hat{a}_{1N} \end{bmatrix}$$

where the l_{ij} are the proportions of factor *j* used by industry *i*. Substituting in expressions for the relative changes in the optimal input-output coefficients yields after some manipulation:[2]

$$\hat{g}_0 = q_{0L} s_0 (\hat{r} - \hat{w}) \tag{12}$$

$$\hat{g}_1 = q_{1L} s_1 (\hat{n} - \hat{w}) \tag{13}$$

$$\hat{g}_2 = (-l_{0L} s_0 (\hat{r} - \hat{w}) - l_{1L} s_1 (\hat{n} - \hat{w}) - l_{2L} q_{2q_1} s_2 (\hat{p}_1 - \hat{w})) / l_{2L} \tag{14}$$

[2] The elasticity of substitution between labor and capital in industry 0 is $s_0 \equiv (\hat{a}_{0K} - \hat{a}_{0L})/(\hat{w} - \hat{r})$. The distributive share-weighted average of changes in the optimal input-output coefficients along the unit isoquant vanish near the cost-minimization point: $q_{0L}\hat{a}_{0L} + q_{0K}\hat{a}_{0K} = 0$. Similar pairs of equations can be constructed for the other two industries. Solving for the proportional changes in the input-output coefficients, substituting back into the differential forms of (9)-(11) and rearranging yields the solutions for gross outputs.

where the s_i are the elasticities of substitution between inputs in industry *i*. These expressions reveal that gross output of manufactures (g_0) and raw materials (g_1) must fall, and gross output of processing (g_2) must rise. The first two terms in the numerator of (14) reveal the effect of labor released from other activities, the third the effect of substitution between labor and the now cheaper raw material.

Usage of the raw material in the processing industry has risen ($\hat{a}_{2q_1} = -q_{2L} s_2 (\hat{p}_1 - \hat{w})$ is positive) and gross output has fallen, so net output of the raw material falls. Raw materials are not consumed directly, so exports fall with the imposition of the tax, and the first term in (2) is negative, as expected.

4. An Alternative

While in the above model the standard result holds, once intermediates are introduced contrasting results are possible. Let us change the situation by allowing for capital to be used in all three industries and to be perfectly mobile. Using labels as above:

$$c^0(w, r) = p_0 \tag{15}$$

$$c^1(w, r, n) = p_1 \tag{16}$$

$$c^2(w, r, p_1) = p_2 \tag{17}$$

The corresponding effects on factor prices of an export tax applied to the raw materials are:

$$\hat{w} = \left[-q_{2q_1} q_{0K} / |q|\right] \hat{p}_1 \tag{18}$$

$$\hat{r} = \left[q_{0L} q_{2q_1} / |q|\right] \hat{p}_1 \tag{19}$$

$$\hat{n} = \left[\{q_{0K}(q_{1L} q_{2q_1} + q_{2L}) - q_{0L}(q_{1K} q_{2q_1} + q_{2K})\} / q_{1N} |q|\right] \hat{p}_1 \tag{20}$$

where $|q| \equiv (q_{2L}q_{0K} - q_{0L}q_{2K})$. $|q| > 0$ iff $q_{2L}/q_{2K} > q_{0L}/q_{0K}$. We can now derive the following two propositions:

PROPOSITION 1: *The export tax causes returns to owners of capital and labor to move in opposite directions.*[3]

PROOF: See (18) and (19) and discussion above. QED.

PROPOSITION 2: *The real return to owners of natural resources will fall (rise) with the imposition of an export tax if the processing activity is more intensive in the same (opposite) factor than manufacturing in direct terms as in total terms*.

PROOF: Note that the terms in the innermost brackets of (20) are the total cost shares of labor and capital (the sums of the direct and indirect, i.e: that used in the raw material, cost shares) in processing. The numerator of (20) will be positive iff $(q_{1L}q_{2q_1} + q_{2L})/(q_{1K}q_{2q_1} + q_{2K}) > q_{0L}/q_{0K}$, and therefore the entire expression will be negative iff this condition holds and $|q| > 0$. QED.

The intuition behind the result is clear. The export tax provides an implicit subsidy to processing, benefiting whichever factor is used intensively in processing (say, capital) and harming the other mobile factor (labor). The rise in the return to capital and the fall in the price of the raw material squeeze the return to natural resources, but the price of labor falls. If raw material production is sufficiently labor intensive, the return to natural resources rises.

[3] This results is stronger than that of Burgess (1976) despite the similarity of the model construction because of the assumption that intermediates do not enter into the production function of the importable.

The result implies that the second term of (2) can be negative, in contrast to the standard result. Somewhat perversely, an export tax could result not only in a welfare loss from trade reduction, but also from an increase in transfers to foreign interests. Of course, the fact that the return to natural resources can rise raises issues of stability. In particular, we need to be sure that output of good 1 will fall with a reduction in its price. Using the same techniques as above, it can be shown that $\hat{g}_1$ is now:

$$\hat{g}_1 = \frac{-\hat{p}_1}{|q|}\left\{q_{2q_1}(q_{0L}h^1_{NK} - q_{0K}h^1_{NL}) + \frac{h^1_{NN}|q^*|}{q_{1N}}\right\} \tag{21}$$

where $h^1_{ij} = q_{1i}s^1_{ij}$ is the elasticity of demand for input i with respect to the price of input j in industry 1, s^1_{ij} is the partial elasticity of substitution, and $|q^*|$ is the sum of the direct and indirect cost shares in processing as in (20) above. Evidently for the model to be stable we require that $|q|$ and the term inside the brackets of (21) take the opposite sign. Clearly, this is possible even if $|q|$ and $|q^*|$ take opposite signs. In general, we require that the factor used intensively in processing be more substitutable with N than the factor used intensively in industry 0 for a stable equilibrium to be feasible (the chances are improved if N and the other factor are complementary).

5. Other Processing Incentives and Specificity

While export restrictions are not the only means of increasing processing, alternative policies have similar effects. However, foreign ownership can alter standard 'specificity' conclusions. We briefly demonstrate. Consider a policy that lowers the price of the raw material for processing, while holding the price that domestic raw material producers receive constant. Using techniques as above to solve for the changes in factor returns we obtain the following:

PROPOSITION 3: *An input subsidy will result in an income transfer effect that is inferior from the home country perspective to that of an export tax, under either specification.*

PROOF: Under the first specification, the impact on wages and the return to capital will be identical to (6) and (7), only the change in the return to natural resources will differ, becoming:

$$\hat{n} = \left(q_{1L}q_{2q_1}/q_{1N}q_{2L}\right)\hat{p}_1^s \tag{22}$$

where p_1^s is the subsidy inclusive price paid by processors. The proportional change is larger in (8) by $\hat{p}_1/q_{1N}$.

In the alternative specification considered in Section 4:

$$\hat{n} = \left[q_{2q_1}(q_{1L}q_{0K} - q_{0L}q_{1K})/q_{1N}|q|\right]\hat{p}_1^s \tag{23}$$

$\hat{n} > 0$ iff $q_{1L}/q_{1K} > q_{0L}/q_{0K}$ and $|q| < 0$, or vice versa. Rewriting (20):

$$\hat{n} = \left[\{|q| + q_{2q_1}(q_{1L}q_{0K} - q_{0L}q_{1K})\}/q_{1N}|q|\right]\hat{p}_1 \tag{24}$$

Equation (24) is directly comparable to (23). In words, if the processing activity is more labor intensive than general manufacturing, then $|q|$ is positive. If raw materials production is more capital intensive than general manufacturing, then the owners of natural resources would unambiguously gain from an input subsidy. An export tax of equivalent magnitude would raise the return to owners of natural resources by less, and may lower it, since $|q|$ appears as an additive term in (24). QED.

The intuition behind the result is as follows. With a subsidy the price received by raw material producers remains unchanged, while the wage and capital rental rates change in the same proportion as with an export tax. Hence the residual return to natural resources is squeezed by less.

What are the implications? First, it is not clear that either an export tax or an input subsidy will raise welfare, since the sign of dn is indeterminate in both cases. Second, foreign ownership in these circumstances turns the standard specificity arguments around. Although in general a subsidy will be welfare superior to an export tax when the objective is to increase processing, the presence of foreign ownership can reverse that result – yet another example of how second best considerations play havoc with standard trade policy conclusions.

6. Concluding Comments

In terms of simple models with multiple levels of production, we have shown that the presence of foreign ownership may not provide a rationale for trade intervention (or a disincentive to liberalization), in contrast to the results in the existing literature which concentrates on final goods models. In addition, we have shown that export restrictions may be superior to more direct support mechanisms under the same circumstances. These results complement those of Marjit and Beladi (1996) and Marjit et al. (1997). While the use of processing incentives has grown in popularity in recent decades, the results suggest that considerable attention needs to be paid to production structures even where factors are foreign owned, a favorable investment terms-of-trade effect cannot be assumed.

References

Beladi, H. and Marjit, S. (1992) 'Foreign Capital and Protectionism' *Canadian Journal of Economics* 15(1):233-238.

Bhagwati, J.N. and Brecher, R.A. (1980) 'National Welfare in an Open Economy in the Presence of Foreign Owned Factors of Production' *Journal of International Economics* 10(1):103-15.

Bhagwati, J.N. and Tironi, E. (1980) 'Tariff Change, Foreign Capital and Immiserization: A Theoretical Analysis' *Journal of Development Economics* 7(1)71-83.

Brecher, R.A. and Bhagwati, J.N. (1981) 'Foreign Ownership and the Theory of Trade and Welfare' *Journal of Political Economy* 89(3):497-511.

Brecher, R.A. and Diaz-Alejandro, C.F. (1977) 'Tariffs, Foreign Capital and Immiserizing Growth' *Journal of International Economics* 7(4):317-22.

Brecher, R.A. and Findlay, R. (1983) 'Tariffs, Foreign Capital and National Welfare with Sector-Specific Factors' *Journal of International Economics* 14(3):277-88.

Burgess, D.F. (1976) 'The Income Distributional Effects of Processing Incentives: A General Equilibrium Analysis' *Canadian Journal of Economics* 9(4):595-612.

Chao, C.C. and Yu, E. (1996) 'Optimal Policies of Taxation on Foreign Investment and Export Performance Requirements' *Public Finance* 51(2): 201-16.

Harris, J.R. and Todaro, M.P. (1970) 'Migration, Unemployment and Development: A Two-Sector Analysis' *American Economic Review* 60:126-42.

Huizinga, H. and Nielsen, S.B. (1997) 'Capital Income and Profit Taxation with Foreign Ownership of Firms' Journal of International Economics 42(1-2):149-65.

Jones, R.W. and Spencer, B.J. (1989) "Raw Materials, Processing Activities, and Protectionism" *Canadian Journal of Economics* 22(3):467-86.

Marjit, S. and Beladi, H. (1996) 'Protection and the Gainful Effects of Foreign Capital' *Economics Letters* 53(3):311-6.

Marjit, S., Broll, U. and Mitra, S. (1997) 'Targeting Sectors for Foreign Capital Inflow in a Small Developing Economy' *Review of International Economics* 5(1):101-6.