The Behavior of the National Firm With Foreign Operations Under Fixed Exchange Rate "A Sales Agency Model"

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By:

Asem T. Arab*

I- INTRODUCTION:

There have been a number of important environmental changes and trends in the past forty years that have contributed to the general interest of business in foreign trade and investment, and that have fostered the growth of both. The growth in world demand for raw materials, the increasing demand among the less-developed countries for the goods and services produced by the developed ones, and the development of international and national institutions which facilitate these types of commercial transactions, all these, besides many other factors, led to the creation of firms which have foreign direct investments.

The existing literature on doing business abroad categorizes firms engaging in such operations as the following:

1. National firms with foreign operations.
2. Multinational corporations.
3. International corporations.

The major objective of these firms, as of other domestic firms, is to maximize their net global profit. In doing so, they face many financial, economic problems and constraints, which are related to the environmental adversities such as exchange rate

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risks, taxes and tariff laws imposed by different governments, transfer price problems, repatriation of profit restrictions, etcetera.

In this paper, we will study the behavior of national firms with foreign operations under fixed exchange rates.

We start in Section II by reviewing the existing literature on some of the environmental adversites facing this kind of firm, such as transfer price, taxes, tariffs, and devaluation.

In Section III we state the assumptions and form a model of the sales agency.

In Section IV, we derive the comparative statics properties of the model. These derivations include the change in home and foreign tax rates, changes in tariff rates imposed by the foreign government, and changes in the exchange rate due to devaluation in the home currency. We will analyze the impact of these changes on the level of sales, gross profit, net global profit, and on the tax and tariff revenues collected by the two countries.

In Section V, conclusions and comments on the results will be provided.

II- REVIEW OF THE LITERATURE:

2.1 Transfer Prices, Tariff and Tax Rates:

The multinational corporation can use transfer prices to achieve certain objectives such as:

1. A reduction in its world wide tax bill.
2. A reduction in tariffs paid on transferred product.
3. A transfer of profits and other funds between subsidiaries and the parent, etcetera.

Mason, Miller, and Weigel (1975), have stated in their book that the appropriate transfer price depends on the objective being sought and the particular circumstances that exist. Decentralization of production decisions requires that the transfer price be set at the marginal cost of the optimum output "or at the market-price if the market is competitive." A higher price may be needed, for example to extract funds from the importing subsidiary. A lower price on the other hand, may be needed to minimize the corporation's world wide tax bill. Therefore, the use of transfer prices to extract profit and capital may conflict with the desire to minimize tariff and tax payments, since higher transfer prices increase tariff payments on imports. Moreover, if the importing country has lower income tax rates than the exporting country, high transfer prices shift profits to high tax areas. Thus, taxes influence the

organizational structure of the multinational corporation. The desire to defer taxes leads corporations to establish subsidiaries in countries with low tax rates. The function of these "tax haven" subsidiaries is to collect profits and to reduce the corporation's total tax liability.

Copithorne (1971) emphasized that transfer prices are useful tools in moving profits from one company to another, but they are irrelevant in the process of maximizing global, before tax profit. In the case of the national firm with foreign operations, the firm always would prefer to price in such a way as to take its profits in the parent company. If the objective of the firm is to maximize global profits after tax, then, it must choose transfer prices and a profit target in each subsidiary such that the global tax bill is a minimum. It does that by allocating profits to the country with the lowest tax rates. If the rate are progressive, it will allocate profits so that the marginal tax rates are equal. If the tax functions are all linear with identical rates, it does not matter where the firm collects its profit.

Horst (1971) stressed the importance of transfer prices. If the firm wants to maximize its global profits after taxes, then it must choose between the smallest and the largest possible transfer price for its exports. If the relative differential in tax rates between the importing and exporting

countries is less than the tariff rate, the firm will always choose the lowest transfer price possible, because the firm would have an incentive to minimize transfer prices and save on tariff cost. Only in the unlikely case that the relative tax rate differential exceeds the tariff rate, the firm will choose the greatest transfer price. Horst derived two optimal strategies for the behavior of the multinational corporation under a different tariff and tax ratio. The first, where the firm has an increasing cost function and prices are chosen independently, under these conditions, a higher tariff rate will raise the subsidiary's import costs, and as a result prices in the importing country will rise. This will discourage imports by the subsidiary and encourage local production. For this assumption to be valid, the firm would never let the marginal revenues in the two markets differ by more than the cost of exporting from one country to the other. Since marginal revenue is related to market price through the elasticity of demand, thus, the higher the level of existing tariffs and the closer the elasticities of demand in the two markets are the more likely it is that independently chosen prices will be sustainable. Under the condition of having an increasing cost function and prices are not chosen independently, an increase in the tariff imposed by the importing country rises the cost of exporting, and the amount by which prices may differ the tariff will rise the price of the goods and as a result the demand will decline. An increase in the importing country tax rate induces a reduc-

tion in both country's sales, and a corresponding reduction in the demand for production. The second case considered by Horst is the decreasing cost function. If the firm has a decreasing cost function, independent prices, then there is a natural tendency for the firm to produce in the country having the larger market, in order to avoid the tariff duties on a large volume of imports. If the firm has a decreasing cost function, and prices are not chosen independently, then the firm must choose between two supply strategies: import versus local production or small market versus large market. If importing is the small market strategy, increasing the tariff will raise the cost of importing, but encourage the small market strategy. Thus the ability of a tariff increase to effect the substitution of local production for imports is highly uncertain, depending as it does on the balance of these two effects. If the tax rate increases, it has no effect on the cost of importing, but it will encourage the local production.

Adler and Stevens (1974), investigated the trade-off possibilities between trade and production for a multinational firm. One of the results they have obtained is that the effects of an increase in the income tax in the host country on sales by subsidiaries are negative. However, Itagaki (1977), in his dissertation, showed an opposite result. He concluded that an increase in the host tax promotes the domestic

production of the final good. Itagaki also gave a great concern to the role of transfer prices. He stated that all the effects of changes in the home and foreign tax rates depend on the magnitude of the transfer price relative to the marginal cost of the intermediate good.

2.2 Devaluation:

Once a firm's operations leap across national boundaries, the firm does encounter factors that are unique to international business, and the factor that most clearly distinguishes multinational firms from domestic firms is the need to do business in more than one currency. Exchange rate is endemic to international business and is related to all financial decisions encountered in multinational enterprises.

Dufey (1972), in his paper, concluded that the prospect of a devaluation or revaluation must be taken into account in the initial foreign investment decision. With firm continually deciding whether to expand or curtail investment, the possibility of international changes should be an intrinsic part of these decisions, since exchange rate changes affect the real rate of return.

Alexander and Murphy (1975), developed a two-country model to show the effects of exchange rate changes on inter-

national investment. They consider many alternative assumptions. Their result under the assumption that the investment is at home to produce goods to be marketed abroad was that a devaluation of home currency causes a reduction of direct investment flows out of the home country and causes an increase of the direct investment inflows into the home country.

Shapiro (1975), in his article about the value of the multinational firm, mentioned that the effect of exchange rate changes on profitability in a bi-national firm is identical to that of a one with one single subsidiary. The direction of changes in profitability is the same regardless of whethr or not production takes place in country two. He added, for infinitessimal change in exchange rate, the first order effect on the bi-national firm's profitability is exactly equal to the first order change in profit when production is restricted to country one.

Kohlhagen (1977), in his simple model, assumed that a firm desiring to sell abroad chooses between the alternatives, producing abroad or producing at home and exporting. His deriviation led to the hypothesis that a devaluation is more likely to reduce the excess profitability of foreign production over that of domestic production, the less production cost both at home and abroad respond to devaluation and the more foreign production costs are denominated in domestic currency.

Itagaki (1977), concluded that the devaluation of the home currency has effects similar to those of an increase in tariff. A devaluation of the home currency inhibits the trade of the intermediate good (when the firm produces the final product in both home and foreign country), but promotes foreign direct investment in the form of final processing (not in the form of production of the intermediate good).

III- ASSUMPTIONS AND THE MODEL:

The model assumes a national firm with foreign operations (NFFO) which produces a single homogenous product in its home country. Its total output (X) is divided into two portions:

1. Amount to be sold at home (X^1)
2. Amount to be exported and to be sold in a foreign country by a subsidiary "sales agency" owned by (NFFO) (X^2).

We denote the total cost function of producing the good by $f(X^1+X^2)$, since $X = X^1 + X^2$. We assume that the marginal cost is positive and increasing in X, which implies that $f' > 0$, and $f'' > 0$, for all non-negative values of X.

The transfer price (α) of (X^2) is assumed to be greater than the marginal cost ($\alpha > f'$), and is given in term of the home country currency unit. Thus, αX^2 is the value o exported goods to the subsidiary which is equal to $\alpha X^2 R$ i terms of the foreign country currency units where (R) is th exchange rate and is equal to the number of units of foreig currency per one unit of the home currency; it is assumed als that (R) is fixed.

We assume an advalorem import tariff (T) is imposed b

the foreign country on the imported good, and therefore, total tariff to be paid is ($T \alpha X^2 R$). We assume the loading, unloading and any other expenses in the host country for each unit of (X^2) is β in host country currency units, then other expense to be paid on (X^2) will total up to $\frac{\beta X^2}{R}$ in terms of the home country currency units.

We denote total revenue from the sale of the good in country i by $h^i(X^i)$. It is assumed that marginal revenue is positive and decreasing in (X^i), which implies that $(h^i)' > 0$ and $(h^i)'' < 0$, for all non-negative values of X^i.

Now, if we denote NFFO's gross profit before tax by (π), and (π^i) for gross profit before tax in country i, then,

$$\pi = \sum_{i=1}^{2} \pi^i$$

where $\pi^1 = h^1(X^1) + \alpha X^2 - f(X^1+X^2)$

and $\pi^2 = \frac{1}{R}[h^2(X^2) - R\alpha X^2 - \beta X^2 - T\alpha R X^2]$

To calculate net profit after tax, we follow Itagaki (6) in considering two different tax rates:

(1) Home country tax rate (t^1).

(2) Foreign country tax rate (t^2).

If we take the foreign tax credit act into account, then there

exist two possible cases in calculating the global net profit after tax for NFFO. The first case where the home tax rate (t^1) is higher than or equal to a foreign tax rate (t^2), and the second case where the foreign tax rate exceeds the home tax rate.

Case One $t^1 \geq t^2$

Under this case NFFO has to pay three different tax payments:

(i) The tax paid to the foreign government by the foreign subsidiary $t^2 \pi^2$.

(ii) The tax paid to the home government on the home profit of the parent $t^1 \pi^1$.

(iii) The tax paid to the home government on the foreign profit of the parent.

According to the tax credit act, this payment is equal to the difference between the applicable home tax on the gross profit of the foreign subsidiary $t^1 \pi^2$ and the tax paid to the foreign country $t^2 \pi^2$. Then we can express this payment as $(t^1 - t^2)\pi^2$. By adding these three different tax payments together, the total tax payment paid by NFFO is:

$$t^1\pi^1 + t^2\pi^2 + \pi^2(t^1 - t^2) = t^1\pi^1 + t^1\pi^2 = t^1(\pi^1 + \pi^2)$$

Based on this, the global net profit of NFFO after tax is expressed as:

$$\pi = \pi^1 + \pi^2 - t^1(\pi^1 + \pi^2) = (1 - t^1)(\pi^1 + \pi^2) \quad \ldots\ldots (3.1)$$

From the above result, it is quite clear that the foreign tax rate is not necessary for the calculation of the net global profit of NFFO.

Case Two $t^1 < t^2$

Under this case, the net global profit of NFFO after tax is:

$$\pi = (1-t^1)\ \pi^1 + (1-t^2)\ \pi^2 \quad \ldots\ldots\ldots\ldots\ldots (3.2)$$

Where NFFO does not pay any tax on foreign profit. In this paper, we will use (3.2) as a general case, and treat (3.1) as a special case of the general case.

Now, assuming that NFFO is making a positive profit at home and in the foreign country, then its net global profit after tax (using case 2) could be expressed as:

$$\begin{aligned}\pi &= (1 - t^1)\ \{ h^1(X^1) + \alpha X^2 - f\ (X^1 + X^2)\} \\ &\quad + \frac{1-t^2}{R}\ \{ h^2(X^2) - R\alpha X^2 - \beta X^2 - T\alpha R X^2 \} \\ &= (1 - t^1)\ \{ h^1(X^1) + \alpha X^2 - f(X^1 + X^2)\} \\ &\quad + \frac{1-t^2}{R}\ \{ h^2(X^2) - \beta X^2 - \alpha X^2 R\ (1 + T)\} \quad \ldots\ldots\ldots (3.3)\end{aligned}$$

In (3.3), the decision variables are the two levels of outputs sold at home (X^1) and by the subsidiary in the foreign country (X^2). Assuming an interior solution, in which the global net profit function possesses an entremum for some positive values of output, the first order conditions are:

$$\pi_1 = \frac{\partial \pi}{\partial X^1} = (1-t^1)(h^{1'}-f') = 0 \quad \ldots\ldots\ldots\ldots \quad (3.4)$$

$$\pi_2 = \frac{\partial \pi}{\partial X^2} = (1-t^1)\ (\alpha-f') + \left(\frac{1-t^2}{R}\right) \cdot (h^2)' - \beta - \alpha R(1+T) = 0 \quad \ldots\ldots\ldots\ldots \quad (3.5)$$

Equation (3.4) says that the net marginal revenue from the sales of X^1 in the home country $(1-t^1)\ h^{1'}$ is equal to the net marginal cost $(1-t^1)f'$. Equation (3.5) says that the net marginal revenue $\frac{1-t^2}{R}\ h^{2'}$ plus the net difference between transfer price and the marginal cost $(1-t^1)\ (\alpha-f')$ is equal to the net cost of imports $(1-t^2)\ \alpha$, plus net cost of tariff payment $(1-t^2)\ \alpha t$, plus the net cost of other expenses $\frac{1-t^2}{R}\ \beta$.

From equation (3.4) and (3.5), we can write the optimal values of the decision variables X^1 and X^2 as a function of home country tax rate, foreign country tax rate, tariff rate and exchange rate. Denoting the optimal values of the decision variables by $\bar{X}^i$, then:

$$\bar{X}^i = \phi^i\ (t^1, t^2, T.R.) \quad i = 1, 2 \quad \ldots\ldots\ldots\ldots \quad (3.6)$$

For the interior maximum to be a global maximum, the second order conditions must be satisfied; that is

$$\pi_{11} = \frac{\partial^2 \pi}{\partial (X^1)^2} = (1-t^1)\left[(h^{1"}) - (f")\right] < 0 \quad \ldots\ldots\ldots (3.7)$$

$$\pi_{22} = \frac{\partial^2 \pi}{\partial (X^2)^2} = - f" (1-t^1) + \frac{1-t^2}{R}(h^{2"}) < 0 \quad \ldots\ldots (3.8)$$

$$\pi_{12} = \frac{\partial^2 \pi}{\partial X^1 \partial X^2} = - f" (1-t^1) < 0 \quad \ldots\ldots\ldots\ldots (3.9)$$

$$\pi_{21} = \frac{\partial^2 \pi}{\partial X^2 \partial X^1} = - f" (1-t^1) < 0 \quad \ldots\ldots\ldots\ldots (3.10)$$

Thus,

$(1-t^1)\ (MR^{1'}-MC') < 0$, where MR = Marginal Revenue

MC = Marginal Cost

and

$$D = \begin{vmatrix} (1-t^1)\ (MR^{1'} - MC') & - MC'\ (1-t^1) \\ - MC'\ (1-t^1) & \frac{1-t^2}{R}\ MR^{2'} - (1-t^1)\ MC' \end{vmatrix} > 0$$

$$D = (1-t^1)\ (h^{1"}) - (f")\ \{\ \frac{1-t^2}{R}(h^{2})" - (f")(1-t^1)\ \}$$

$$- [\ (f)"(1-t^1)\ ]^2 > 0$$

Since D is greater than zero, the profit function will be strictly concave and the solution to the first order condition is a unique maximum.

IV- COMPARATIVE STATICS PROPERTIES:

In this part of the paper, we derive the comparative statics properties, and interpret their economic meanings. These derivations include:

1. The impact of a change in home tax rate on sales, gross profit, net global profit, and government revenues.
2. The impact of a change in foreign tax rate on sales, gross profit, net global profit, and government revenues.
3. The impact of a change in the tariff on sales, gross profit, net global profit, and government revenues.
4. The impact of devaluation on sales, gross profit, net global profit, and government revenues.

4.1. Change in the Home Tax Rate: Effect on Sales

Substituting equation (3.6) into the first order conditions (3.4) and (3.5) and differentiating them with respect to t^1 and using the relation $(1-t^1)\left[(h')-f'\right] = 0$, we get:

$$(1-t^1)\ (h^{1"}\ \phi^{1'}_{t^1} - f^{"}\ \phi^{1'}_{t^1} - f^{"}\ \phi^{2'}_{t^1}) = h^{1'} - f' \qquad \ldots (4.1)$$

$$-(1-t^1)\ f^{"}\ \phi^{1'}_{t^1} + \frac{1-t^2}{R}\ (h^{2"}\ \phi^{2'}_{t^1}) - f^{"}(1-t^1)\phi^{2'}_{t^1} = \alpha - f' \qquad \ldots (4.2)$$

Where,

$$\phi_{t^1}^{i'} = \frac{\partial \phi^i}{\partial t^1} \qquad i = 1,2$$

Putting (4.1) and (4.2) in a matrix form we get:

$$\begin{bmatrix} (1-t^1)\,(h^{1"} - f") & -(1-t^1)f" \\ -(1-t^1)f" & \frac{1-t^2}{R}\,h^{2"} - f"(1-t^1) \end{bmatrix} \begin{bmatrix} \phi_{t^1}^{1'} \\ \phi_{t^1}^{2'} \end{bmatrix} = \begin{bmatrix} 0 \\ \alpha - f' \end{bmatrix}$$

Solving the system we get:

$$\phi_{t^1}^{1'} = \frac{[-(1-t^1)f"][\alpha - f']}{D}$$

Since $(1-t^1)\,f" > 0$, $(\alpha - f') > 0$ by assumption, and since

$D > o$, then:

$$\phi_{t^1}^{1'} > 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.3)$$

and

$$\phi_{t^1}^{2'} = \frac{(1-t^1)(h^{1"} - f")\,(\alpha - f')}{D}$$

Since $(1-t^1)(h^{1"} - f") = \pi_{11} < 0$, $(\alpha - f') > 0$ and $D > 0$, the

$$\phi_{t^1}^{2'} < 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.4)$$

Equation (4.3) basically says, NFFO raises its home sales as a result of the increase in the home tax rate. This result contradicts the law of taxation for a firm producing and selling in one country. However, such results are obtained because the rise in t' depressed the incentive of doing business abroad. Equation (4.4) says NFFO cuts down its subsidiary sales as a result of the increase in the home tax rate.

Effects on Gross Profits

To have a clearer picture of the impact of an increase in home tax rate on the level of profit we differentiate the gross profits in the home and the host country with respect to t^1, we get:

$$\pi^1 = h^1(X^1) + \alpha X^2 - f(X^1 + X^2) \quad \ldots\ldots\ldots\ldots (4.5)$$

$$\therefore \frac{\partial \pi^1}{\partial t^1} = \phi^{1'}_{t^1}(h^{1'} - f') + \phi^{2'}_{t^1}(\alpha - f')$$

since, $\phi^{1'}_{t^1} > 0$, $(\alpha - f') > 0$, $\phi^{2'} < 0$, and $(h^{1'} - f') = 0$

$$\therefore \frac{\partial \pi^1}{\partial t^1} < 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.6)$$

Similarly,

$$\pi^2 = \frac{1}{R}[h^2(X^2) - R\alpha X^2 - \beta X^2 - T\alpha R X^2] \quad \ldots\ldots (4.7)$$

$$\therefore \frac{\partial \pi^2}{\partial t} = \left(\phi^{2'}_{\frac{t^1}{R}}\right)[h^{2'} - R\alpha - \beta - T\alpha R] = \phi^{2}_{\frac{t}{R}}\,1\,[(h^2)' - \beta - Ra(1+T)] \ldots\ldots (4.8)$$

By using the relation in equation (3.5) we have $\frac{1-t^2}{R}$

$[h^{2'} - \beta - \alpha(1 + TR)] < 0$ since

$(1-t^1)\ (\alpha-f') > 0.$

Also, we have $\left[\phi_{t^1}^{2'}\right] < o$, and $\left[h^{2'} - \beta - \alpha(1+TR)\right] < 0$, thus,

$$\frac{\partial \pi^2}{\partial t^1} > 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.9)$$

Therefore, an increase in home tax rate has a negative effect on gross profit earned in the home country and a positive effect on the gross profit earned in the foreign country. The positive impact on gross profit of the subsidiary is due to two main reasons:

1. (NFFO) transfer price is greater than the marginal cost, otherwise the whole results we have obtained would be reversed, and,
2. The decrease in exports created an excess demand for the good in the foreign country which causes an increase in the price of the good.

Effects on Net Global Profit

To see the impact of an increase in t^1 on net global profit, we differentiate (3.3) with respect to t^1

$$\frac{\partial \pi}{\partial t^1} = \pi^1 + (1-t^1)\ [\phi_{t^1}^{1'}\ (h^{1'} - f') + \phi_{t^1}^{2'}\ (R\alpha - f')]$$

$$+ \frac{1-t^2}{R}\ \phi_{t^1}^{2'}\ [h^{2'} - \beta - R\,\alpha\,(1 + T)]$$

$$\frac{\partial \pi}{\partial t^1} = - \pi^1 < 0$$

We have to notice that the above relationship comes from equation (3.1).

Thus, the effect on net global profit is negative.

Effects on Government Revenues

If we denote tax revenues collected by the home country by (H^1), then,

$$H^1 = \pi^1 t^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.10)$$

differentiating H^1 with respect to t^1, we get:

$$\frac{\partial H^1}{\partial t^1} = \pi^1 + \frac{\partial \pi^1}{\partial t^1} t^1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.11)$$

but, from (4.6), we have

$$\frac{\partial \pi^1}{\partial t^1} t^1 < 0, \quad \text{then} \quad \frac{\partial H^1}{\partial t^1} \lesseqgtr 0.$$

This result is obtained by Itagaki (6), too. It implies the possibility of having a positive or negative or no change at all in tax revenues in the home country. Where the possibility that a rise in the tax rate in the home country reduces tax revenue of the home government is peculiar to the multinational firm, in which it is known that the tax revenue of the government increases at the rate of the initial profit of the firm. If we denote tax revenues collected by the foreign government by (H^2), tariff revenues by e, then:

$$e + H^2 = \frac{\pi^2 t^2}{R} + RT\alpha X^2 \quad \ldots\ldots\ldots\ldots \quad (4.12)$$

Differentiating (H^2) and (e) with respect to t^1, we get:

$$\frac{\partial H^2}{\partial t^1} + \frac{\partial e}{\partial t^1} = \frac{t^2}{R} \cdot \frac{\partial \pi^2}{\partial t^1} + T\alpha_R \cdot \frac{\partial X^2}{\partial t^1} \quad \ldots\ldots\ldots\ldots (4.13)$$

From (4. 9), and (4.4) we have:

$$\frac{\partial \pi^2}{\partial t^1} > 0, \quad \frac{\partial X^2}{\partial t^1} > 0 \quad \text{respectively.}$$

then,

$$\frac{\partial H^2}{\partial t^1} + \frac{\partial e}{\partial t^1} \gtrless 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.14)$$

That is, because we do not know whether,

$$\frac{t^2}{R} \quad \frac{\partial \pi^2}{\partial t^1} \lessgtr T\alpha \frac{\partial X^2}{\partial t^1}$$

This result implies that an increase in home country tax rate will increase tax revenue collected by the foreign government ($\frac{t^2}{R} \cdot \frac{\partial \pi^2}{\partial t^1} > 0$), and decreases its tariff revenue ($T\alpha \frac{\partial X^2}{\partial t^1} < 0$). But, the total impact of an increase in home country tax rate on the total revenues from tax and tariff collected by the foreign government is indeterminate.

4.2 Change in Foreign Tax Rate

Effects on Sales

Substituting equation (3.6) into the first order conditions (3.4) and (3.5), and differentiating them with respect

to t, we get:

$$(1-t^1)(h^{1"}-f") \; \phi^{1'}_{t^2} - (1-t)\, f" \; \phi^{2'}_{t^2} = 0 \quad \ldots\ldots \quad (4.16)$$

$$-(1-t^1) f" \; \phi^{1'}_{t^2} - (1-t) f" \; \phi^{2'}_{t^2} + \frac{1-t^2}{R} h^{2"} \; \phi^{2'}_{t^2}$$

$$= \frac{1}{R}\{h^{2'} - \beta - \alpha(1 + TR)\}. \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.17)$$

where $\phi^{i}_{t^2}$ $\quad \frac{\partial \phi^i}{t^2}$

Putting (4.16) and (4.17) in a matrix form, we get:

$$\begin{bmatrix} (1-t^1)(h^{1"} - f") & -(1-t^1) f" \\ -(1-t^1) f" & \frac{1-t^2}{R} h^{2"} - f"(1-t^1) \end{bmatrix} \begin{bmatrix} \phi^{1'}_{t^2} \\ \phi^{2'}_{t^2} \end{bmatrix} = \begin{bmatrix} 0 \\ \frac{1}{R}\{h^{2'} - \beta - \alpha(1+TR)\} \end{bmatrix}$$

Solving the system, wet get:

$$\phi^{1}_{t^2} = \frac{-(-(1-t^1) f" \; \frac{1}{R}\{h^{2'} - \beta - \alpha(1+TR)\}}{D}, \text{ from (3.5) we have}$$

$h^{2'} - \beta - \alpha(1+TR) < 0$, then

$$\phi^{1'}_{t^2} < 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.18)$$

Similarly,

$$\phi^{2'}_{t^2} = \frac{(1-t^1)(h^{1"}-f")\left(\frac{1-t^2}{R} h^{2"} - f" \; (1-t^1)\right.}{D}$$

$$\phi^{2'}_{t^2} > 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.19)$$

The results we have obtained in (4.18) and (4.19) say that an increase in the foreign tax rate decreases sales in the home country and increases it in the foreign country. These are exact opposite result of those we have obtained in the case of an increase in the home tax rate.

Effects on Gross Profits

We take the gross profit function in both countries and differentiate them with respect to t^2.

$$\pi^1 = h^1(X^1) + \alpha X^2 - f(X^1 + X^2)$$

$$\frac{\partial \pi^1}{\partial t^2} = \phi_{t^2}^{1'} (h^{1'} - f') + \phi_{t^2}^{2'} (\alpha - f') \qquad (4.20)$$

Since $(h^{1'} - f') = 0$, $(\alpha - f') > 0$ and $\phi_{t^2}^{2'} > 0$

then,

$$\frac{\partial \pi^1}{\partial t^2} > 0 \qquad (4.21)$$

Similarly,

$$\pi^2 = \frac{1}{R} [h^2 (X^2) - \alpha X^2 - \beta X^2 - T\alpha R X^2]$$

$$\frac{\partial \pi^2}{\partial t^2} = \frac{\phi_{t^2}^{2'}}{R} [h^{2'} - \beta - \alpha(1 + TR)] \qquad (4.22)$$

since $[h^{2'} - \beta - \alpha(1+TR)] < 0$

$$\therefore \quad \frac{\partial \pi^2}{\partial t^2} < 0 \qquad (4.23)$$

Therefore, an increase in foreign tax rate has a positive effect on the gross profit in the home country and a negative effect on the gross profit in the foreign country.

Effects on Net Global Profit

To find the impact on net global profit, if there is an increase in foreign tax rate, we differentiate (3.3) with respect to t^2 , we get:

$$\frac{\partial \pi}{\partial t^2} = (1-t^1)\ \phi^{1'}_{t^2}\ (h^{1'} - f') + \phi^{2'}_{t^2}\ (\alpha - f')$$

$$- \frac{\pi^2}{R} + \frac{1-t^2}{R}\ \phi^{2'}_{t^2}\ [h^{2'} - \beta - R\alpha\ (1 + T)]$$

$$= - \pi^2 < 0$$

Thus, the impact is negative.

Effects on Government Revenue

Differentiating (4.10) the tax revenues of the home country with respect to t^2 , we get:.

$$\frac{\partial H^1}{\partial t^2} = t^1 \frac{\partial \pi^1}{\partial t^2}$$

$$= t^1\ [\ \phi^{1'}_{t^2}\ (h^{1'} - f') + \phi^{2'}_{t^2}\ (\alpha - f')]$$

$$= t^1\ \phi^{2'}_{t^2}\ (\alpha - f') > 0 \quad \ldots\ldots\ldots\ldots\ldots \quad (4.24)$$

Differentiating (4.12) the tax and tariff revenues collected by the foreign government with respect to t^2, we get:

$$\frac{\partial H^2}{\partial t^2} = \frac{\pi^2}{R} + \frac{t^2}{R} \frac{\partial \pi^2}{\partial t^2}$$

$$= \frac{\pi^2}{R} \frac{t^2}{R^2}\ \phi^{2'}_{t^2}\ [h^{2'} - \beta - \alpha(1 + TR)] \gtrless 0 \quad \ldots\ldots\ldots \quad (4.25)$$

and

$$\frac{\partial e}{\partial t^2} = T \alpha \phi_{t^2}^{2'} > 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.26)$$

$$\frac{\partial H^2}{\partial t^2} + \frac{\partial e}{\partial t^2} \gtrless 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.26)$$

Equation (4.24) says that the home country tax revenue will increase if there is an increase in the foreign tax rate. While the impact of an increase in the foreign tax rate on the overall tax and tariff revenues collected by that government is indeterminate.

4.3 Change in the Tariff Effects on Sales

Substituting equation (3.6) into the first order conditions (3.4) and (3.5) and differentiating them with respect to T, we get:

$$(1-t^1)\ (h^{1"} - f")\ \phi_T^{1'} - (1-t^1)\ f"\ \phi_T^{2'} = 0 \qquad \ldots\ldots \quad (4.28)$$

$$-(1-t^1)\ f"\ \phi_T^{1'} + \left[\ \frac{1-t^2}{R}\ h^{2"} - (1-t^1)\ f"\ \right] \phi_T^{2'} = (1-t^2)\alpha \qquad (4.29)$$

where

$$\phi_T^i = \frac{\partial \phi^1}{\partial T}$$

Putting (4.28) and (4.29) in a matrix form, we get:

$$\begin{bmatrix} (1-t^1) & (h^{1'} - f'') & -(1-t^1)f'' \\ -(1-t^2)f'' & \frac{1-t^2}{R} & h^{2''} - f''(1-t^1) \end{bmatrix} \begin{bmatrix} \phi_T^{1'} \\ \phi_T^{2'} \end{bmatrix} = \begin{bmatrix} 0 \\ (1-t^2)\alpha \end{bmatrix}$$

Solving the system, we get:

$$\phi_T^{1'} = \frac{-(-(1-t^1)f'')\ (1-t^2)\ \alpha}{D}$$

Where D is defined as

$$D = (1-t')(h^{1''} - f'')\left[\frac{1-t^2}{R}\ h^{2''} - f''\ (1-t')\right] - \left[(1-t')\qquad f''\right]^2$$

$\phi_T^{1'} > 0$ Then . . . . . (4.30)

Similarly:

$$\phi_T^2 = \frac{(1-t^1)\ (h^{1''} - f'')\ (1-t^2)\ \alpha}{D}$$

$\therefore\ (\phi_T^2)' < 0$ . . . . . (4.31)

Equations (4.30) and (4.31) say that an increase in the tariff rate imposed by the foreign country increases the level of sales in home country and decreases it in that foreign country. That is, the imposition of tariff raises the price of the good in the foreign country and lowers it in the home country.

Effect on the Gross Profit

We take the gross profit functions in both countries, and differentiate them with respect to T.

$$\pi^1 = h^1(X^1) + \alpha X^2 - f(X^1 + X^2)$$

$$\frac{\partial \pi 1}{\partial T} = \phi_T^{1'}[h^{1'} - f'] + \phi_T^{2'}[\alpha - f'] \quad \ldots\ldots\ldots \quad (4.32)$$

Since,

$$\phi_T^{2'} < 0,$$

$$\frac{\partial \pi^1}{\partial T} < 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.33)$$

$\frac{\partial \pi^1}{\partial T}$ is negative due to the decline in exports by the firm.

Similarly,

$$\pi^2 = \frac{1}{R}[h(X^2) - \alpha X^2 - \beta X^2 - T\,RX^2]$$

$$\frac{\partial \pi^2}{\partial T} = \frac{\phi_T^{2'}}{R}[h^{2'} - \alpha - \beta - T\alpha R] - \alpha R X^2 \quad \ldots\ldots\ldots \quad (4.34)$$

$$\therefore \quad \frac{\partial \pi^2}{\partial T} \lesseqgtr 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.35)$$

The results we have obtained in (4.33) emphasizes the movement in the price in the home country due to an increase in tariff imposed by the foreign country which resulted in a reduction in the amount of exports and finally a reduction in the gross profit. Equation (4.35) indicates the indeterminate impact on total gross profit in the foreign country. However, the total impact of an increase in tariff rate on total profit is equal

to $\frac{\partial \pi^1}{\partial T} + \frac{\partial \pi^2}{\partial T}$ which is after differentiation equals

to $- \alpha R X^2 < 0$.

Effect on Government Revenues

Differentiating (4.10) the tax revenue of the home country with respect to T, we get:

$$\frac{\partial H^1}{\partial T} = t^1 \frac{\partial \pi^1}{\partial T} \quad \ldots\ldots\ldots\ldots\ldots \quad (4.36)$$

since,

$$\frac{\partial \pi^1}{\partial T} < 0$$

$$\frac{\partial H^1}{\partial T} < 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.37)$$

Which means that revenues of the home country decrease, because π^1 has decreased.

Differentiating (4.12) tax and tariff revenues collected by the foreign government, with respect to T, we get:

$$\frac{\partial H^2}{\partial T} = \frac{t^2}{R} \frac{\partial \pi^2}{\partial T} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.38)$$

But,

$$\frac{\partial \pi^2}{\partial T} \lesseqgtr 0$$

$$\therefore \frac{\partial H^2}{\partial T} \lesseqgtr 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.39)$$

Similarly, for tariff revenues:

$$\frac{\partial e}{\partial T} = \alpha X^2 + T\alpha \frac{\partial X^2}{T} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.40)$$

$$\frac{\partial H^2}{\partial T} + \frac{\partial e}{\partial T} \lesseqgtr 0$$

Which implies the indeterminancy of the impact on the foreign government revenues.

Effect on Global Profit

Now, we take the net global profit function and differentiate it with respect to T, we get:

$$\frac{\partial \pi}{\partial T} = - \frac{1-t^2}{R} (\alpha X^2 R) < 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.41)$$

Therefore, the net global profit decreases as a result to an increase in tariff rate imposed by the foreign government.

4.4 Effects of Devaluation of the Home Currency

Effects on Sales

Substituting equation (3.6) into the first order conditions (3.4) and (3.5), and differentiating them with respect to R, we get:

$$(1-t^1)\ (h^{1"} - f")\ \phi_R^{1'} - (1-t^1)\ f"\ \phi_T^{2'} = 0 \quad \ldots\ldots (4.42)$$

$$-(1-t^1)\ f"\ \phi_R^{1'} + \left[\frac{1-t^2}{R} h^{2"} - (1-t^1)\ f"\right] \phi_R^{2'}$$

$$= \frac{1-t^2}{R^2} \left[h^{2'} - \beta - \alpha(1 - TR)\right] \quad \ldots\ldots\ldots\ldots\ldots \quad (4.43)$$

Where,

$$\phi_R^{i'} = \frac{\partial \phi^i}{\partial R}$$

Putting (4.42) and (4.43) in a matrix form, we get:

$$\begin{bmatrix} (1-t^1) & (h^{1"}-f") & -(1-t^1)f" \\ -(1-t^1)f" & \frac{1-t^2}{R} & h^{2"} \quad -(1-t^1)f" \end{bmatrix} \begin{bmatrix} \phi_R^{1'} \\ \phi_R^{2'} \end{bmatrix} = \begin{bmatrix} 0 \\ \frac{1-t^2}{R^2} [h^{2'}-\beta-\alpha(1-TR)] \end{bmatrix}$$

Solving the system, we get:

$$\phi_R^{1'} = \frac{-[-(1-t')f" \quad \frac{1-t^2}{R^2} \quad (h^{2'} - \beta - \alpha\ (1-TR)]}{D}$$

Where $D = (1-t^1)(h^{1"} - f")[\ \frac{(1-t^2)}{R}\ h^{2"} - (1-t^1)f"] - [(1-t^1) \qquad f"$

Thus

$$\phi_R^{1'} < 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (4.44)$$

Similarly,

$$\phi_R^{2'} = \frac{(1-t^1)\ (h^{1"}-f")\ (\frac{1-t^2}{R^2})\ (h^{2'} - \beta - \alpha\ (1-TR)}{R}$$

$$\therefore \quad \phi_R^{2'} > 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (4.45)$$

Thus, an increase in the exchange rate due to a decline in the value of the home currency increases the amount of sales in the foreign country and decreases it in the home country. That is, due to the devaluation the price of the good rises in the home country and declines in the foreign country. However, until the adjustment process takes place, there would be an increase in the quantity demanded from that good in the foreign country.

On the other hand, if a devaluation occurs in the foreign currency, then, all the above results will be reversed.

Effects on Gross Profits

We take the gross profit functions and differentiating them with respect to R, we get:

$$\pi^1 = h^1(X^1) + \alpha X^2 - f(X^1, X^2)$$

$$\frac{\partial \pi^1}{\partial R} = \phi_R^{1'} (h^{1'} - f') + \phi_R^{2'} (\alpha - f') \quad \ldots\ldots\ldots\ldots \quad (4.46)$$

$$\therefore \quad \frac{\partial \pi^1}{\partial R} > 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.47)$$

$$\pi^2 = \frac{1}{R} [h^2(X^2) - \alpha X^2 - \beta X^2 - T\alpha RX]$$

$$\frac{\partial \pi^2}{\partial R} = \frac{1}{R^2} [h^2 (\phi_R^2) - \alpha(\phi_R^2) - \beta(\phi_R^2) - T\alpha R (\phi_R^2)]$$

$$+ \frac{\phi_R^{2'}}{R} h^{2'} - \beta - \alpha(1 - TR) \quad \ldots\ldots\ldots\ldots \quad (4.48)$$

Since it is assumed that the firm is making positive profit every where, then the first term in the right hand side of (4.48) is positive. The second term is negative because:

$$\phi_R^{2'} > 0,\ h^2 - \beta - \alpha(1 - TR) < 0.$$

Thus,

$$\frac{\partial \pi^2}{\partial R} \gtrless 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.49)$$

This result means a devaluation in the home currency may have a positive, negative, or no effect, on the gross profit of the subsidiary in the foreign country.

Effects on Government Revenues

Differentiating (4.10) the tax revenue of the home country with respect to R, we get:

$$\frac{\partial H^1}{\partial R} = t^1 \frac{\partial \pi^1}{\partial R} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.50)$$

But,

$$\frac{\partial \pi^1}{\partial R} > 0$$

$$\therefore \quad \frac{\partial H^1}{\partial R} > 0 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.51)$$

Similarly, differentiating (4.12) the tax and tariff revenues collected by the foreign government with rtespect to R, we get:

$$\frac{\partial H}{\partial R} = -\frac{\partial^2 t^2}{\partial R^2} + \frac{t^2}{R} \cdot \frac{\partial \pi^2}{\partial R} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.52)$$

Using equation (4.49), we get:

$$\frac{\partial \hat{H}^2}{\partial R} \lesseqgtr 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.53)$$

and,

$$\frac{\partial e}{\partial R} = T\alpha \frac{\partial X^2}{\partial e} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.54)$$

By using (4.45), we get:

$$\frac{\partial e}{\partial R} > 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.55)$$

Then,

$$\frac{\partial H^2}{\partial R} + \frac{\partial e}{\partial R} \lesseqgtr 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.56)$$

Effects on Net Global Profit

Differentiating the net global profit with respect to R, we get:

$$\frac{\partial \pi}{\partial R} = \frac{-(1-t^2)}{R^2} \pi^2 - \frac{T\alpha X^2 (1-t^2)}{R} \quad \ldots\ldots\ldots\ldots \quad (4.57)$$

$$\therefore \quad \frac{\partial \pi}{\partial R} < 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.58)$$

Equation (4.51) says that an increase in the exchange rate will increase the home country tax revenue. While equation (4.56) shows the indeterminancy of the impact of a devaluation for the home currency on the total tax and tariff revenues collected by the foreign government. Equation (4.58) shows the negative impact of the devaluation on the net global profit of the firm.

V- CONCLUSION

Our analysis showed similar results to those obtained by the others, except for the following:

(1) an increase in home tax rate has a positive impact on sales in the home country (the producing country), and a negative one on the sales in the foreign country where the sales agency is located. This result is consistant with Itagaki (6) and contradicts Adler and Stevens (1). The rational behind that is the depressing effect on the (NFFO) desire of doing business abroad. The diminishing range between t^1 and t^2 will call for a higher transfr price, which brings about a higher tariff bill if NFFO continues to export the same level of goods, and, finally, a higher price will be charged, which, in turn, cuts the demand for the good in the foreign country.

(2) the impact of a devaluation in the home country currency on the net global profits is of indeterminate sign in all models under study. It turns out that in the case of (NFFO) (sales agency), such devaluation has a negative impact on net global profit. This negative impact might be interpreted as a result of a greater decline in gross profit in the home country.

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