

A GENERAL FRAMEWORK FOR ANALYZING ENDOGENOUS TRADE DIVERGENCES

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Abstract

This paper gives a general framework for analyzing a trade divergence that runs across both the New International trade theory and the traditional analysis of export policy. The source of the trade divergence, the motive for intervention and the analytical framework is shown to be the same in all models. The sign of the trade divergence and hence the policy recommendation is determined by the market structure chosen to endogenise the divergence. The magnitude of the subsidy in all models is determined by the maximum potential profitability of the home industry. It is argued that interpretations based on "profit shifting" or on a "terms of trade improvement" as a motive for trade intervention are misleading.

Keywords: Endogenous trade divergences; intervention; subsidy; 'profit shifting'; terms of trade improvement'; profitability; trade theory; export policy.

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INTRODUCTION

Over the last decade we have seen an outpouring of research in what is described as the new theory of International Economics on trade policy. It is the view of many that the recent New International trade theory on export policy - such as the profit shifting motive for trade policy - represents a major breakthrough which calls into question the lessons of traditional trade theory. Yet, some authors have begun to realise that the new theory shares some analytical features with the orthodox optimal tax argument for trade policy (Deardoff and Stern (1987), Harris(1989) and Corden(1990)). At the same time they would argue that the arguments for government intervention become different in kind when trade policy is integrated with Industrial Organisation. Corden (1990) felt that within the profit shifting model of Brander and Spencer "...the issue on which the orthodox terms of trade argument focuses disappears." In what follows, we show that the profit shifting model of Brander and Spencer (1985) and the terms of trade argument for a tax on trade that originates with Bickerdike (1906), have the same analytical framework and the motive for government intervention in both models is the same. We argue that interpretations based on "profit shifting" or on a "terms of trade improvement" as a motive for trade intervention are misleading.

Within the New International trade theory there is a rival model to that of Brander and Spencer, introduced by Eaton and Grossman (1986), which shows that the policy conclusion is not robust to the type of strategic competition assumed. Helpman and

Krugman (1989) saw both these oligopoly models as rivals to the traditional model, but showed that there was a common principle for intervention within the oligopoly framework.

The aim of this paper is to demonstrate a general framework for analyzing a trade divergence that runs across both the new models and the traditional analysis. The above literature has produced several suggestive ideas about the role of export policy in different market structures and about the links between the analysis under different market structures. However no common analytical framework or motive for trade intervention has been established with any generality. This paper sets out to fill this gap by showing that there is a common analytical framework and common motive for trade intervention in the presence of an endogenous trade divergence.

ENDOGENOUS TRADE DIVERGENCES

The aim of this paper is to show an analytical equivalence between the new international trade theory and the orthodox theory on export policy. We demonstrate this in a series of games which include one corresponding to the traditional or "orthodox" view, following Bickerdike, as well as the now familiar Cournot and Bertrand two stage games. The set of players in the orthodox game will consist of domestic firms in a competitive industry and the domestic government. The set of players in the oligopoly games will consist of a domestic firm, a foreign firm, and a domestic government. In all games the firms are assumed to operate in a third market we call consumerland. There is no domestic consumption of any industry output. This allows us to focus on the trade divergences that are present in the oligopoly models and in

the competitive model of international trade. All other governments remain non-active players throughout this paper¹.

(1) The Bickerdike two stage game

(i) Firms

A large number of identical home firms produce a homogeneous product. The strategy common to all firms for the one-shot-non-cooperative game is the "Perfectly Competitive" equilibrium in output levels. A representative home firm is a price taker which produces x_i and earns a payoff π_i . The industry inverse demand curve is assumed to be the following:

$$(1:1) \quad P = P(\sum_{i=1}^n x_i) = P(X) \quad : P' < 0$$

We write the payoff to the representative home firm as:

$$(1:2) \quad \pi_i(x_i, X) = P(X) \cdot x_i - c_i \cdot x_i + s_i \cdot x_i$$

Where c_i = the firms constant marginal cost and s_i = per unit of output subsidy. We write the payoff to the industry as:

$$(1:3) \quad \Pi(X) = P(X) \cdot X - C \cdot X + S \cdot X$$

¹ We do not look at the effects of the entry of new firms, general equilibrium effects, strategic interaction between governments and abstract from having domestic consumption of the traded good. The aim is to take the most basic models and show an analytical equivalence between the normative side of the new and orthodox international trade theory on export policy.

Where: $\Pi = \sum_{i=1}^n \pi_i$, $C = \sum_{i=1}^n c_i$, $S = \sum_{i=1}^n s_i$ and home firms fixed costs of production are assumed to be zero.²

(ii) The Domestic government

The domestic government will wish to choose the optimal subsidy level to maximise the following domestic surplus function,

$$(1:4) \quad G = \Pi - S.X$$

The government is assumed to put an equal weighting on the home firm's profits and on government expenditure in evaluating welfare.

(iii) The Two Stage Game

We will look at the behaviour of the domestic industry and the domestic government in a two stage game. In the first stage the domestic government unilaterally determines the size of the subsidy to maximise its payoff. In the second stage the domestic firms takes their domestic cost of production, domestic subsidy and industry price as given and unilaterally set their respective output levels. The domestic government is assumed to understand the dependence of the second stage on the first when choosing its optimal subsidy level. This will lead to a Nash equilibrium in the first stage. Hence we consider the second stage first.

² We assume C measures the true social marginal cost of exports i.e. we assume the absence of any domestic divergences.

Second stage:

In the second stage the domestic firms choose x_i to maximise π_i given c_i , s_i and P . This implicitly leads the home industry to use the following strategy: It chooses X to maximise Π given C and S and holds P constant.

The Home Industry

$$(1:5) \text{ First order condition: } \Pi_x = P - C + S = 0$$

$$\Rightarrow P - AC = 0$$

The mark-up of price over average cost (AC) is zero.

$$(1:5)' \text{ Second order condition: } \Pi_{xx} = P' < 0$$

The solution function for the endogenous variable X can be solved from the first order conditions (1:5). We can express it as the following³:

$$(1:6) \quad X^o = \phi (C , S)$$

Taking a total differential of (1:5), we find the comparative static effects of changes in S and C :

$$(1:7) \quad X_s > 0 \text{ and } X_c < 0$$

³ Each firm in the industry produces $x_i^o = X^o/n$.

The subsidy increases the output of the competitive industry and output is greater the more cost competitive the home industry.

First stage:

In this stage the domestic government is going to maximise domestic surplus with respect to S in anticipation that X is going to be a function of the subsidy level it chooses.

$$(1:8) \quad \text{Max}_S G = \Pi - S.X$$

$$(1:9) \text{ First order condition: } G_s = \Pi_s - X - S.X_s = 0$$

Taking a total differential of (1:3) holding C constant, we obtain

$$(1:10) \quad \Pi_s = \Pi_x.X_s + \partial\Pi/\partial S$$

$$\Pi_s = X.dP/dX.X_s + X > 0$$

(1:10) is re-expressed using (1:5). From (1:9) we can solve for the optimal subsidy,

$$(1:11) \quad S^0 = X.dP/dX < 0$$

(1:11) is signed using (1:1)⁴. A tax is optimal when a competitive industry is exporting abroad. The motive for the optimal tax was claimed to be an aggressive action against consumerland, aimed at improving the home nation's terms of trade. It is wrong to emphasize the terms of trade improvement as the motive for trade intervention. The presence of a competitive industry in the export market ensures the social marginal benefit of another unit of domestic output is greater than the private marginal benefit. This divergence is due to the home industry not taking into account the effect of another unit of output on the industry price. The loss of revenue on inframarginal sales is not expected and perceived marginal revenue is actually greater than the true marginal revenue. As Corden (1974) notes, we have a trade divergence as the private and social marginal revenue facing the exporting industry diverge. The trade divergence is endogenously explained by the presence of the perfectly competitive export industry. The tax is set to equate the social marginal benefit and private marginal benefit of another unit of domestic industry output.⁵

$$(1:12) \quad \text{SMR} = P + X.P'$$

$$\text{PMR} = P$$

We can rewrite (1:11) as the following using (1:12):

$$(1:11)' \quad S^{\circ} = X.P' = \text{SMR} - \text{PMR} < 0$$

⁴ This tells us that the per unit tax on each firm is $s^{\circ}_i = S^{\circ}/n < 0$. Orthodox theory usually expresses it as the optimum export tax "rate" $t = 1/\epsilon$. Where ϵ is the elasticity of export demand.

⁵ If the industry was made up of one monopoly firm the above divergence would not exist.

We can see this in figure 1. The level of output that sets $PMR = PMC_0$ is the competitive industry level of output X^c . The level of output that sets $SMR = PMC_0$ is at X^m . This is the optimal output the industry should produce if the home industry takes into account the changes in the industry price and the loss of revenue on inframarginal sales when producing another unit of industry output. It is the level of output a home firm would set if it was a monopoly with full information about the foreign demand curve it faced⁶. At the competitive industry level of output there is a trade divergence between the SMR and PMR given by the distance A-B. The tax is set to internalise this divergence and we will claim this is identical to the motive for intervention in new international trade models in the presence of a trade divergence⁷.

Proposition 1(a): The domestic government has a unilateral incentive to offer a tax to the competitive industry in order to internalise the trade divergence created by the price taking behaviour of the firms in the industry, which moves the equilibrium to what would be, in the absence of a tax, the monopoly position in price-output space. This equates the social and private marginal benefit of another unit of output.⁸

⁶ A monopoly would maximise (1:3) but subject to (1:1) and would not hold P constant. From the first order condition we get $P-AC/P = 1/\epsilon$. This tells us that the more inelastic the demand curve in consumerland, the bigger the potential monopoly rent is.

⁷ To claim that the motive for government intervention is to improve the terms of trade is a well documented fallacy.

⁸ The optimal tax is a first best intervention policy assuming no retaliation (which in the orthodox model implies the demand curve in consumerland does not shift strategically to deter an export tax), no political economy and informational considerations. This will also apply to the oligopoly models in the next sections.

Next we look at what determines the magnitude of the above divergence. The more cost competitive the home industry and the more inelastic the demand curve, the bigger the trade divergence. To see this reexpress (1:11) as,

$$(1:13) \quad S^{\circ} = \phi (C) = AR / \varepsilon = SMR - PMR < 0$$

$$\Rightarrow S^{\circ}_c < 0$$

From (1:13) one can see that the trade divergence in the Bikerdike model, is greater the more inelastic the demand curve and the more cost competitive the home industry. The tax sets out to equate the social and private marginal benefit of producing another unit of output. The divergence in this type of model is endogenous and changes with any government intervention. The government takes into account that as one moves up along the foreign demand curve it becomes more elastic. As the tax increases the gap between SMR and PMR partially decreases as one moves up along the demand curve. The final tax is smaller than the initial divergence i.e. the gap between SMR and PMR decreases to the distance C-D. The tax ensures that the industry is producing the socially optimal level of output and that the home country gets maximum rent from the foreign country in the form of tax revenue. The magnitude of the ex-post divergence or tax can be expressed as the following,

$$(1:14) \quad S^{\circ} = - (P - AC)^m = SMR - PMR < 0$$

The tax set creates and takes home the monopoly rent that exists in consumerland. The ex-ante and ex-post divergence both depend on the elasticity of

demand and cost competitiveness. The bigger the initial divergence the bigger the potential monopoly rent the tax can create from internalising the divergence.

Proposition 1(b): The optimal tax, if positive, is greater the more profitable (cost competitive) the home industry would be as a monopoly firm, as the trade divergence due to the price taking behaviour of the firms in the industry is bigger.

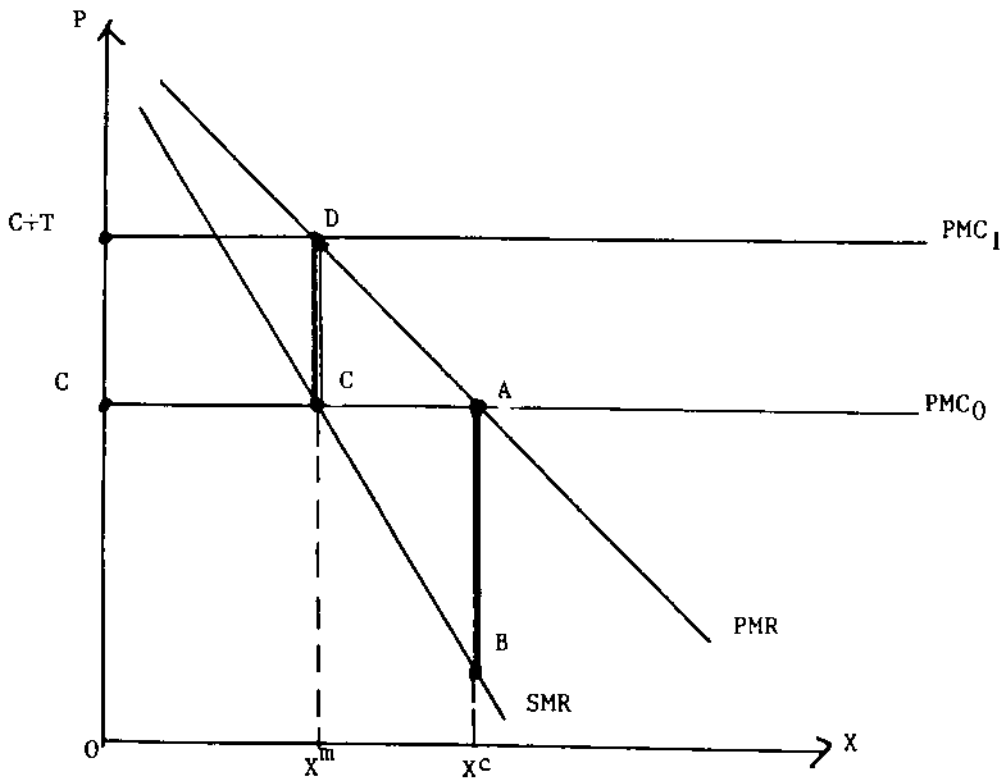
The tax that equates the SMB and PMB of another unit of output causes an improvement in the terms of trade. This is a consequence of the motive to internalise the endogenous trade divergence. The motive for intervention is due to a trade divergence created by the failure of the competitive exporting industry to take account of the loss on inframarginal sales when producing another unit of output. Intervention is said to be exploitative in the sense that it creates monopoly rents and takes them home in the form of tax revenue at the expense of foreign consumers⁹. One could also say that foreign consumers no longer benefit from the presence of the trade

⁹ In the above model the short run supply curve of the competitive industry is assumed to be perfectly elastic, as we assumed the marginal cost of production to be constant at the firm level. This implies that the trade divergence is as big as it can get and the home government generates the biggest welfare gain from internalising it for a given demand curve. The tax creates and takes home all the monopoly rents at the expense of the foreign consumers. When the short run supply curve is upward sloping the competitive industry is likely to capture some rents in consumerland. Again the tax will take all the monopoly rents home but the burden is shared by the home industry and the consumers. The rent taken off the home industry does not give the home country any net gain, but there will be a loss in industry rent that is not captured by anybody due to forgone exports. (In the misleading language of orthodox theory the optimal tax improves the terms of trade at the cost of the loss on forgone sales). The welfare gain is not as big as in the above case. The more inelastic the supply curve the smaller the initial trade divergence will be and the smaller the welfare gain from internalising it. The optimal tax will always capture all the monopoly rents in the form of tax revenue.

divergence. We will see that the analysis of a trade divergence in the recent oligopoly models of international trade is identical to this.

Proposition 1(c): The optimal tax to internalise the endogenous trade divergence, which is explained by the presence of the perfectly competitive exporting industry, will make the trade divergence less acute before it is internalised. The tax will lead to an improvement in the terms of trade and consumers will no longer benefit from the presence of the trade divergence.

FIGURE 1



(2) The Cournot two stage game

(i) Firms

The two firms produce a homogeneous product.¹⁰ The strategy common to both firms for the one-shot-non-cooperative game is the Nash "Cournot" equilibrium in output levels. The domestic firm produces x and earns a payoff π . The foreign firm produces y and earns a payoff π^* . The inverse demand curve is assumed to be linear¹¹ and we write it as the following:

$$(2:1) \quad P = P(x + y) = a - b(x + y); \quad b > 0 \quad P' < 0$$

We write the payoff to the domestic firm as:

$$(2:2) \quad \pi(x, y) = P(x + y).x - c.x + s.x$$

Where c = the domestic marginal cost and s = per unit of output subsidy. We write the payoff to the foreign firm as:

$$(2:3) \quad \pi^*(x, y) = P(x + y).y - c^*.y$$

¹⁰ The results would still hold if the two firms produced differentiated products which would be a variation of Neary's (1988) model. A homogeneous good makes the exposition of the results simpler.

¹¹ The results would be robust if we used a general inverse demand curve, once we ruled out the case of demand being very convex.

Where c^* = the foreign marginal cost. Domestic and foreign fixed costs of production are assumed to be zero.¹²

(ii) The Domestic government

The domestic government will wish to choose the optimal subsidy level to maximise the following domestic surplus function,

$$(2:4) \quad G = \pi - s.x$$

The government is assumed to put an equal weighting on the home firms profits and on government expenditure in evaluating welfare.¹³

(iii) The Two Stage Game

We will look at the behaviour of the firms and the domestic government in a two stage game. In the first stage the domestic government unilaterally determines the size of the subsidy to maximise its payoff. In the second stage the domestic firm takes the domestic cost of production and the domestic subsidy as given and the foreign firm takes the foreign cost of production as given. They unilaterally and simultaneously set

¹² The potential importance of fixed costs are ignored in this paper. The effects of fixed costs in generating links between markets or entry considerations are considered in Krugman (1984), Dixit and Kyle (1985), Horstmann and Markusen (1986) and Markusen and Venables (1988). We assume that both industries are constant cost industries. Dixit (1984) and Dixit and Grossman (1986) look at a case where there are resource constraints in factor markets i.e. an increasing cost home industry. The firms marginal cost is assumed to represent the social marginal cost of producing output.

¹³ Neary (1991) showed that a subsidy becomes non-optimal under quantity competition for very low values of the shadow price of government funds. If $G = \pi - \delta sx$ where $\delta > 1$, given the subsidy is optimal for $\delta = 1$ it becomes nonoptimal for low values of $\delta > 1$.

their respective output levels under the common strategy used. The domestic government is assumed to understand the dependence of the second stage on the first when choosing its optimal subsidy level. This will lead to a subgame perfect equilibrium in a two stage game. Hence we consider the second stage first.

Second stage:

In the second stage the domestic firm chooses x to maximise π given c and s and holds y constant. The foreign firm's strategy is to choose y to maximise π^* given c^* and to hold x constant. They play simultaneously.

Domestic Firms

(2:5) First order condition: $\pi_x = P + x \cdot dP/dx - c + s = 0$

$$\Rightarrow P - AC/P = \phi / \varepsilon = \text{Lerner Index}$$

$$\Rightarrow x = R(y)$$

The mark-up of price over marginal cost or average cost (AC) depends positively on ϕ (market share) and negatively on ε (elasticity of product demand). This is also expressed as the domestic firm's optimal response function.

(2:5)' Second order condition: $\pi_{xx} = 2 \cdot P' < 0$

Foreign Firms

(2:6) First order condition: $\pi_y^* = P + y \cdot dP/dx - c^* = 0$

$$\Rightarrow P - AC^*/P = \phi^* / \varepsilon$$

$$\Rightarrow y = R^*(x)$$

This is the Lerner Index and optimal response function for the foreign firm.

$$(2:6)' \text{ Second order condition: } \pi''_{yy} = 2.P' < 0$$

The following implies the uniqueness and stability of the equilibrium,

$$(2:7) \quad D \equiv \pi_{xx} \cdot \pi''_{yy} - \pi_{xy} \cdot \pi''_{yx} > 0$$

$$\text{Where :} \quad \pi_{xy} = P' < 0 \quad \pi''_{yx} = P' < 0$$

This is a Nash Equilibrium as the strategy chosen by the domestic firm maximises its payoff given the strategy of the foreign firm and vice versa. $\pi_{xy} = \pi''_{yx} < 0$ implies that output levels in this game in the phraseology of Bulow et al (1985) are strategic substitutes. The solution functions for the endogenous variables can be solved from the first order conditions (2:5) and (2:6). We can express them as the following:

$$(2:8) \quad x^0 = \phi_1(c, c^*, s)$$

$$y^0 = \phi_2(c, c^*, s)$$

Taking a total differential of (2:5) and (2:6) while holding c^* constant, applying Cramer's Rule, we find the comparative statics effects of changes in s ,

$$(2:9) \quad x_s = - \pi''_{yy} / D > 0$$

$$y_s = \pi''_{yx} / D < 0$$

We make a short observation, the subsidy creates additional output in the home firm while causing a partial displacement of output in the foreign firm.

First stage:

In this stage the domestic government maximises domestic surplus with respect to s in anticipation that x and y are going to be a function of the subsidy level it chosen.

$$(2:10) \quad \text{Max}_s G = \pi - sx$$

$$(2:11) \text{ First order condition: } G_s = \pi_s - x - s.x_s = 0$$

Taking a total differential of (2:2) holding c constant,

$$(2:12) \quad \begin{aligned} \Rightarrow \pi_s &= \pi_x \cdot x_s + \pi_y \cdot y_s + \partial \pi / \partial s \\ \Rightarrow \pi_s &= x \cdot P' \cdot y_s + x > 0 \\ \Rightarrow \pi_s &= - \{ P - AC \} \cdot y_s + x > 0 \end{aligned}$$

(2:12) is signed and re-expressed using (2:5), (2:2), (2:9) and (2:1). The home firms profits rise due to the subsidy. This is a result of two reinforcing effects: (1) The direct effect of the subsidy is a second order effect according to the envelope theorem. (2) The indirect or strategic effect in the Cournot game reinforces the direct effect to the first order and is bigger the more profitable the home firm. The subsidy cost is a sum of two things: firstly each inframarginal output gets a subsidy and secondly, the

additional output the subsidy creates must also be subsidised. From (2:11) we can solve for the optimal subsidy as,

$$(2:13) \quad s^0 = P'.y_s/x_s \cdot x^0 = -\{P - AC\}.y_s/x_s > 0$$

(2:13) signed using (2:12), (2:8) and (2:1). This confirms the Brander and Spencer (1985) proposition and shows that a subsidy is optimal under international quantity competition. Brander and Spencer claimed that the sole motive for the government to subsidise was to use the imperfectly competitive environment to raise home profits at the expense of the foreign competitor i.e. the profit shifting motive for trade policy. This was seen as a very new motive for trade policy and as a clearcut departure from the lessons of traditional trade theory. What we will argue here is that it is wrong to emphasize the profit shifting motive for trade policy. The presence of international Cournot competition ensures the social marginal benefit of another unit of domestic output is greater than the private marginal benefit. The trade divergence is due to the home firm not taking into account the effect a one unit increase in output has on foreign output and hence on the industry price, which offsets the revenue lost on inframarginal sales. The loss of revenue on inframarginal sales will be less than expected and perceived marginal revenue is actually less than the true marginal revenue. The trade divergence is modelled using a different market structure but the source of the divergence is the same, vis à vis the failure to calculate accurately the loss on inframarginal sales of producing another unit of output. The subsidy is given

to equate the social marginal benefit and private marginal benefit of another unit of domestic output.¹⁴

$$(2:14) \quad \begin{aligned} \text{SMR} &= P + x.P' + x.P'.dy/dx \\ \text{PMR} &= P + x.P' \end{aligned}$$

Taking a total differential of (2:6) while holding c' constant,

$$\Rightarrow dy/dx = - \pi'_{yx} / \pi'_{yy} = y_s/x_s < 0$$

We can rewrite (2:13) as the following using (2:14),

$$(2:13)' \quad s^0 = - (P - AC) \cdot y_s/x_s = \text{SMR} - \text{PMR} > 0$$

We can see this in figure 2. The level of output that sets $\text{PMR}_0 = \text{PMC}_0$ is a x^c . The level of output that sets $\text{SMR} = \text{PMC}_0$ is at x^s . This is the optimal output the firm should produce if the home firm had taken into account the offsetting effect of changes in foreign output on the industry price and on inframarginal sales. It is the equilibrium output at the Stackelberg position in output space with the domestic firm as leader¹⁵.

¹⁴ If the firm was competing with other domestic firms they would generate external diseconomies for each other. Another unit of output would reduce revenue for the other firms as the industry price would fall and the $\text{SMR} < \text{PMR}$. A tax is needed to internalise this negative externality. The subsidy would only be optimal if the domestic industry is sufficiently concentrated and competes against foreign firms. As the number of home firms gets larger the model moves closer to the competitive one and we end up with the standard export tax formula in the Bikerdike model.

¹⁵ As stackelberg leader the home firm would choose x to $\text{Max } \pi(x, y=R^*(x))$ and as a result no trade divergence would be present as we would be at the optimal level of output.

At Cournot equilibrium, there is a trade divergence between the SMR and PMR_0 by the distance a-b. The motive for a subsidy is to internalise this trade divergence, which is the same motive for intervention in the orthodox trade model in the previous section in the presence of a trade divergence.¹⁶

Proposition 2(a): The domestic government has a unilateral incentive to offer a subsidy to the home firm in order to internalise the trade divergence created by international Cournot competition and to move the equilibrium to what would be, in the absence of a subsidy, the Stackelberg leader-follower position in output space with the domestic firm as leader. This equates the social and private marginal benefit of another unit of output.

We next look what determines the magnitude of the trade divergence. Neary (1991) within the same framework as Brander and Spencer (1985) showed that the optimal subsidy, if positive, is greater the more cost competitive the home firm.¹⁷ He felt it was paradoxical to argue that governments should provide more help to the relatively profitable firm rather than the unprofitable one. Neary felt that the sole motive to subsidise in this simple model was to raise home profits at the expense of foreign competitors. The more competitive the home firm, the greater the payoff to shifting

¹⁶ The subsidy is not designed as an aggressive action against the foreign firm but rather to internalise the trade divergence. The profit shifting motive, like the terms of trade argument for trade intervention, is a well documented fallacy.

¹⁷ de Meza (1986) when looking at the one period retaliation game of Brander and Spencer (1985) showed that when the home and foreign governments end up in a prisoners dilemma, they both give a subsidy, but a relatively bigger subsidy is given to the more cost competitive firm. The Neary result was also in Mai and Hwang (1988).

rents towards it.¹⁸ We also show that the more cost competitive (profitable) the home firm, the bigger the subsidy but we offer a different explanation. We can go back to (2:13) and rewrite it using (2:9),(2:1) and (2:8) as,

$$(2:13)' \quad s^0 = \phi(c, c^*) = -\{P - AC\} \cdot y_s / x_s = \text{SMR} - \text{PMR} > 0$$

$$\Rightarrow s_c^0 < 0 \quad \text{and} \quad s_{c^*}^0 > 0.$$

This implies that the optimal subsidy and trade divergence is a decreasing function of domestic costs and to a lesser extent an increasing function of the foreign costs. The expression (2:13)' shows how, in this simple model, a cost asymmetry affects the magnitude of the trade divergence. From (2:13)' one can see that the trade divergence due to international Cournot competition is greater the more profitable or cost competitive the home firm.¹⁹ The Cournot induced trade divergence is endogenous. The presence of international competition à la Cournot ensures at the optimal level of output x^c there is a divergence between SMR and PMR_0 by the distance a-b. This is the motive for government intervention. The ex-ante divergence is given by (2:13) as

¹⁸ Neary (1991) saw it as the home country having a comparative advantage in rent shifting.

¹⁹ The Lerner index shows the more inelastic the elasticity of product demand and the bigger the firms market share, the more profitable the firm. The more inelastic the elasticity, the more the industry price will rise due to a fall in foreign output, in response to an increase in home output (rise in market share). Hence, when the home firm plays the Cournot strategy against a foreign firm, the perceived marginal revenue is further below the actual marginal revenue when the home firm is more profitable. This also implies that the potential rent from internalising the divergence is also going to be bigger.

$-(P-AC)^c \cdot y_s/x_s$. The level of output which sets the $SMR=PMC_0$ is at x^s (Stackelberg output level). The subsidy sets out to equate the social and private marginal benefit of producing another unit of output. The divergence in this type of model is endogenous and changes with any government intervention. The government takes into account the strategic effect and the direct effect of the subsidy on the home firms profits. As the subsidy increases it partially increases the gap between SMR and PMR as the home firm becomes more profitable. The final subsidy is bigger than the initial divergence, as it makes the divergence worse before it is internalised i.e. the gap between SMR and PMR increases to the distance c-d. The ex-post divergence and hence the subsidy that is required to move us to x_s is given by (1:13) as $s^0 = -(P-AC)^s \cdot y_s/x_s$. The subsidy ensures that the home industry is producing the socially optimal level of output and that the home country gets maximum rent from its exports.

Proposition 2(b): The optimal subsidy, if positive, is greater the more profitable (cost competitive) the home firm would be as Stackelberg Leader, as the trade divergence due to international Cournot competition is bigger.

The subsidy causes home profit to rise and foreign profit to fall. We also see a disimprovement in the terms of trade and notice that consumerland is better off.²⁰

²⁰ Neary (1988) shows that export subsidies in any market structure lead to a direct welfare loss, due to the deterioration of the terms of trade and the cost of the subsidy payments. There can be indirect by-product gains due to (i) increasing returns to scale, which reduce costs (ii) gains from repercussions in markets for related goods (see Feenstra (1988) and Itoh and Kiyono (1987)), (iii) increase in the home industries profits. In the above model the gains from rent creation for the home country due to the subsidy, dominate the normal direct welfare loss. Take (2:10) and express it $G = (P - c) \cdot x$ and take a derivative with respect to s ($G_s = (p - c) \cdot x_s + x \cdot P_s > 0$). The by-product gain in the Cournot game in terms of rent creation dominates the normal

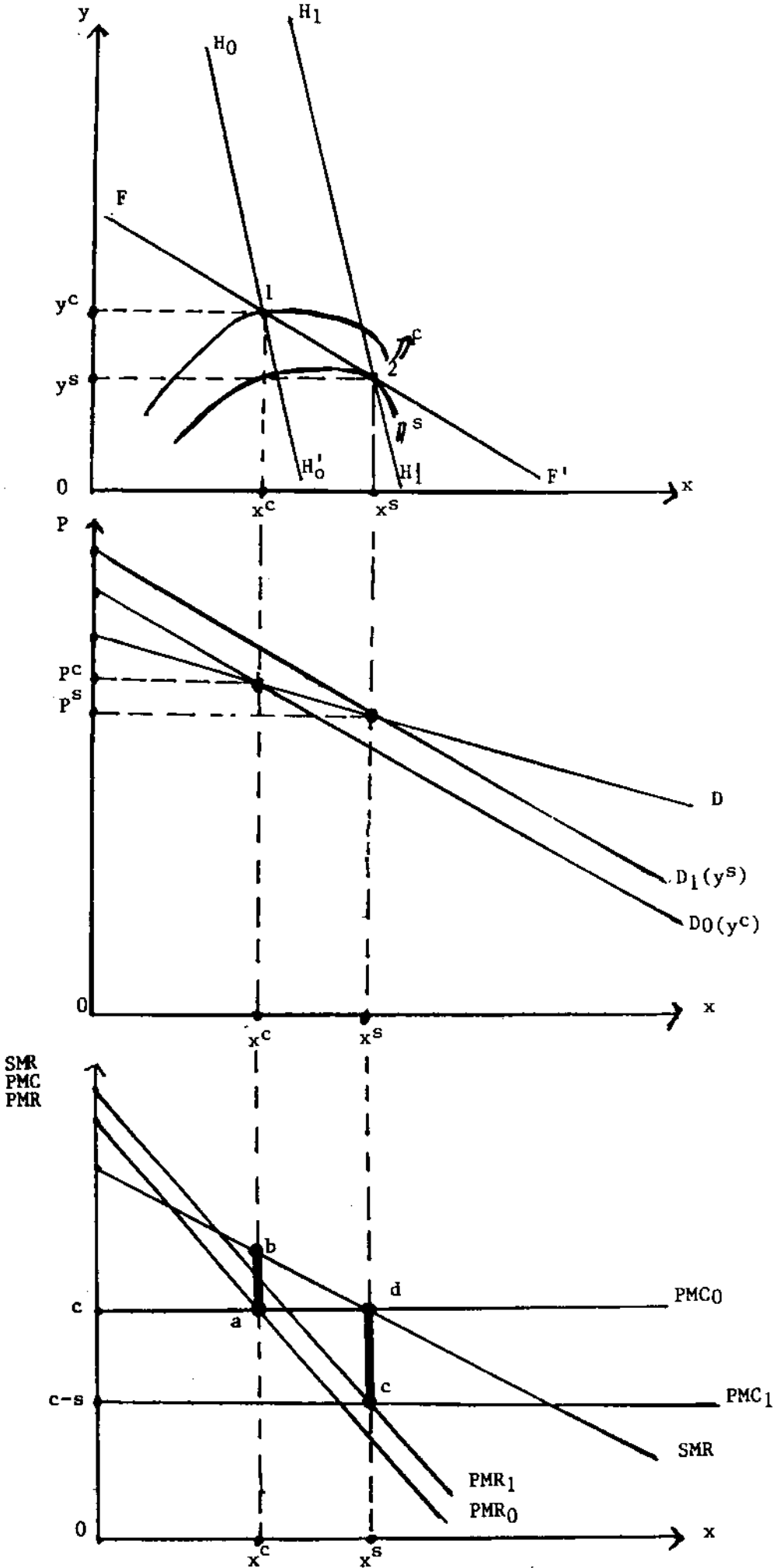
One could say that intervention is exploitive against the foreign firm, but one can also say that the foreign firm no longer benefits from the presence of the trade divergence and consumers no longer suffer. All this is just a consequence of the motive to internalise the oligopoly induced trade divergence. There is no profit shifting motive for trade policy. The rise in home profit and fall in the foreign profit due to intervention results from the trade divergence being endogenous and the fact that firms compete on output levels that are strategic substitutes.²¹ We will see that the motive for government intervention is the same under Bertrand competition, but the policy recommendation and the consequences for the foreign firm will be different as we are dealing with strategic complements.

Proposition 2(c): The optimal subsidy to internalise the endogenous trade divergence, explained by the presence international Cournot competition, makes the trade divergence more acute before it is internalised. The subsidy will lead to a disimprovement in the terms of trade. The foreign firm will no longer benefit and the consumers will no longer lose due to the presence of the home trade divergence.

direct welfare loss.

²¹ The subsidy here creates Stackelberg leader rent for the home Country, which is bigger than a share in monopoly rents. The Stackelberg rent created by the subsidy is bigger the more profitable the home industry originally was. Rents are taken home by the home industry rather than in the form of tax revenue.

FIGURE 2



(3) The Bertrand Two Stage Game

(i) Firms

The two firms produce differentiated products which are substitutes. The strategy common to both firms for the one-shot-non-cooperative game is the Nash "Bertrand" equilibrium in price levels. The domestic firm produces x at a price P and earns a payoff π , while the foreign firm produces y at a price P^* and earns a payoff π^* . The demand conditions facing firms are symmetric. The demand functions may therefore be written as,

$$(3:1) \quad x = x(P, P^*): x_p < 0 \quad x_{p^*} > 0, \quad x_p + x_{p^*} < 0$$

$$(3:2) \quad y = y(P, P^*): y_p > 0 \quad y_{p^*} < 0, \quad y_p + y_{p^*} < 0$$

We write the payoff to the domestic firm as:

$$(3:3) \quad \pi(P, P^*) = P \cdot x(P, P^*) - c \cdot x(P, P^*) + s \cdot x(P, P^*)$$

We write the payoff to the foreign firm as:

$$(3:4) \quad \pi^*(P, P^*) = P^* \cdot y(P, P^*) - c^* \cdot y(P, P^*)$$

s , c and c^* are defined in the same way as in the Cournot two stage game²². Again, I assume that firms have zero fixed costs.

(ii) The Domestic Government

The domestic government will wish to choose the optimal subsidy level to maximise (2.4). Again we assume that the home government puts an equal weighting on the home firms profits and on government expenditure in evaluating welfare.²³

(iii) The two stage game

The game is the same as under this heading in the Cournot two stage game except that the strategic variable in this game is price and not quantity. Again we aim for a subgame perfect equilibrium in a two stage game. Hence we consider the second stage first.²⁴

Second stage:

In the second stage the domestic firm chooses P to maximise π given c and s and holds P^* constant. The foreign firms strategy is to choose P^* to maximise π^* given c^* and holds P constant. They play simultaneously.

²² Carmichael (1987) made an empirical observation that a subsidy is targeted at a price secured on an export contract rather than on the volume of sales. Neary (1990) showed that the effect of a subsidy targeted at price or output is the same in the Eaton and Grossman (1986) framework.

²³ To put a greater weighting on government revenue in this model, for the reasons given under this heading in the two stage Cournot game, would not change, but would reinforce the optimal policy which we will see is to tax.

²⁴ Carmichael (1987), with another empirical observation, noted that the level of the subsidy is typically determined, not before, but after an export contract has been secured. Gruenspecht (1988) showed that a subsidy may be optimal under price competition when the subsidy is given ex-post. Neary (1990) showed that there are bigger welfare gains in the above ex-ante game compared to the ex-post game. The fact that profits of firms are higher after intervention in the ex-post game points to a political economy explanation for this empirical observation.

Domestic Firms

$$(3:5) \text{ First order condition: } \pi_p = P \cdot x_p + x + s \cdot x_p - c \cdot x_p = 0$$

$$\Rightarrow P \cdot AC / P = 1 / \epsilon_p$$

$$\Rightarrow P = R(P^*)$$

The mark-up of price over marginal cost (average cost) depends negatively on the price elasticity of demand for the home firm's product holding P^* constant. It is also expressed as the domestic firms optimal response function.

$$(3:5)' \text{ Second order condition: } \pi_{pp} < 0$$

Foreign Firms

$$(3:6) \text{ First order condition: } \pi_{p^*} = P^* \cdot y_{p^*} + y - c^* \cdot y_{p^*} = 0$$

$$\Rightarrow P^* \cdot AC^* / P^* = 1 / \epsilon_{p^*}$$

$$\Rightarrow P^* = R^*(P)$$

$$(3:6)' \text{ Second order condition: } \pi_{p^*p^*} < 0$$

The following implies uniqueness and stability of the equilibrium,

$$(3:7) \quad D \equiv \pi_{pp} \cdot \pi_{p^*p^*} - \pi_{pp^*} \cdot \pi_{p^*p} > 0$$

$$\text{Where: } \pi_{pp} > 0 \quad \pi_{p^*p^*} > 0$$

This will yield to a Nash Equilibrium as the strategy chosen by the domestic firm maximises its payoff given the strategy of the foreign firm and vice versa. π_{pp} and π_{p^*p} being positive implies that price levels in the phraseology of Bulow et al (1985) in this game are strategic complements. The solution functions for the endogenous variables can be solved from the first order conditions (3:5) and (3:6),

$$(3:8) \quad P^0 = f(c, c^*, s)$$

$$P^{*0} = f^*(c, c^*, s)$$

Taking a total differential of (3:5) and (3:6) while holding c^* constant, then by applying Cramer's Rule we find the comparative static effects of changes s .

$$(3:9) \quad P_s = -x_p \cdot \pi_{p^*p} / D < 0$$

$$P^*_s = x_{p^*} \cdot \pi_{p^*p} / D < 0$$

We make a short observation from (3:9). The subsidy decreases the domestic price by more than the foreign price.

First stage:

In this stage the domestic government maximises (3:6) with respect to s in anticipation that P and P^* are going to be a function of the subsidy level it chosen. The optimisation and first order condition are the same as (2:10) and (2:11).

(a) To see the effect of the change in the subsidy level on domestic output we take a total differential of (3:1) and sign it using (3:1), (3:2), and (3:9):

$$(3:10) \quad x_s = x_p \cdot P_s + x_{p^*} \cdot P^*_s > 0$$

The subsidy has two opposing effects on domestic output: (i) the subsidy causes the home price to fall causing an expansion in domestic output; (ii) to a lesser extent the subsidy causes the foreign price to fall (since goods are substitutes) causing domestic output to fall. Overall domestic output increases as the subsidy rises.

(b) Taking a total differential of (3:3) holding c constant.

$$(3:11) \Rightarrow \pi_s = \pi_p \cdot P_s + \pi_{p^*} \cdot P_s^* + \partial\pi/\partial s$$

$$\Rightarrow \pi_s = (P - AC) x_{p^*} \cdot P_s^* + x < 0$$

Re-expressed using (3:1),(3:2),(3:3),(3:5) and (3:9). Home profits fall due to the subsidy, again there are two opposing effects: (i) The direct effect of the subsidy causes the home price to fall and only increases home profits to the second order, according to the envelope theorem; (ii) The subsidy causes a fall in P^* which leads to a fall in the home firms profits. This is an indirect effect (strategic effect) and it decreases the home firms profits to the first order. The strategic effect is bigger the more profitable the home firm. In this model we see that the indirect effect dominates the direct effect and home profits fall with an increase in the subsidy level. From (2:11) we solve for s^0 using (3:10) and (3:11) as,

$$(3:12) \quad s^0 = (P - AC) \cdot x_{p^*} \cdot P_s^* / x_p \cdot P_s < 0$$

$$s^0 = - (P - AC) \cdot \epsilon_{xP^*} / \epsilon_{xP} \cdot \epsilon_{yP} / \epsilon_{yP^*} < 0$$

Hence the Eaton and Grossman (1986) proposition is confirmed, showing that the optimal policy is to tax under international price competition. It has been claimed that the profit shifting motive for trade policy was not robust to the type of strategic competition assumed (Eaton and Grossman(1986)). Many authors appear to believe that the arguments for government intervention become different in kind when trade theory is integrated with industrial organisation. They also believe the fragility of many of the results in this area is one of the less attractive features of this literature. However, as we shall see the basic principle for intervention in the Bertrand case is the same as in the orthodox and Cournot cases. International Bertrand competition endogenously explains a divergence between social marginal revenue and private marginal revenue of the home export industry. The Bertrand strategy ensures that there is a trade divergence, as the home firm fails to take into account the effect a one unit increase in output has on the foreign price. The foreign price falls causing the home price to fall even further due to the increase in output. The revenue lost on inframarginal sales will be greater than the home firm expects and this is the source of the trade divergence, which has the same origin as in the previous two market structures.²⁵

$$(3:13) \quad \text{SMR} = P + x/x_p + (P - AC) \cdot x_p / x_p \cdot dP'/dP$$

$$(3:14) \quad \text{PMR} = P + x/x_p$$

²⁵ If the home firm was competing with other domestic firms the same externality would be present as in the Cournot case. This just reinforces the need for an export tax.

Taking a total differential of (3:6) while holding c^* constant,

$$(3:15) \quad \Rightarrow dP'/dP = P'_s / P_s = - \pi'_{p^*p} / \pi'_{p^*p^*} > 0$$

$$\Rightarrow s^0 = \text{SMR} - \text{PMR} = (P - AC) \cdot x_p / x_p \cdot P'_s / P_s < 0$$

We can see from figure 3 that the level of output that sets $\text{PMR}_0 = \text{PMC}_0$ is the Nash Bertrand equilibrium level of output x^B . The level of output that ensures that the $\text{SMR} = \text{PMC}_0$ is x^S . This is the output that the home firm would produce if it had taken into account the effect of changes in the foreign and hence home price on inframarginal sales (taking into account the optimal response function of the foreign firm). It is the equilibrium output at the Stackelberg leader-follower position in price space with the domestic firm as leader.²⁶ At the Bertrand equilibrium there is a divergence between SMR and PMR given by the distance A-B. The motive to internalise the above trade divergence is the same motive for intervention in both the Cournot and orthodox trade divergence models.

Proposition 3(a): The domestic government has a unilateral incentive to tax the home firm in order to internalise the trade divergence created by international Bertrand competition and to move the equilibrium to what would be, in the absence of a tax, the Stackelberg leader-follower position in price space with the domestic firm as leader. This equates the social marginal benefit and private marginal benefit of another unit of output.

²⁶ As a Stackelberg leader the home firm would set a price to $\text{Max } \pi(P, P^* = R^*(P))$. This would lead to the socially efficient output and no trade divergence would be present.

As in the orthodox theory the oligopoly induced divergence is endogenous. We first look at what determines the magnitude of the above divergence. From (3:12) and (3:15) we can see that it is greater the more profitable the home firm and the lower the degree of product differentiation (more elastic the cross price elasticities) as the divergence the tax has to internalise is bigger. We next look at how a labour cost asymmetry affects profitability and the magnitude of the optimal tax.

$$(3:16) \quad t = \phi (c , c^*) = (P - AC) \cdot \epsilon_{xP} / \epsilon_{xP} \cdot \epsilon_{yP} / \epsilon_{yP} = (P - AC) \delta > 0$$

$$\Rightarrow t_c > 0 \quad t_{c^*} > 0$$

The optimal tax is easily shown to be an increasing function of the domestic costs and, to a greater extent, an increasing function of foreign costs. Again it is worth noting that the Bertrand induced divergence is endogenous and when internalised by the tax, the gap between the perceived marginal revenue by the home firm and the actual marginal revenue, gets partially bigger as the firm becomes more profitable. In figure 3, in the absence of the tax, the optimal level of output under Bertrand competition is x^B . This creates a divergence between the social and private marginal benefit of another unit of output, given by the distance A-B. The ex-ante divergence is given by $(P-AC)^B \delta$. The level of output that equates $SMR=PMC_0$ is at x^S . The tax increases to equate the social and private benefit of another unit of output. As the tax goes up, it increases home profits. This partially increases the gap between private and social revenue. The tax will have to make the divergence worse before it is internalised to the distance C-D at the Stackelberg leader level of employment x^S . The ex-post

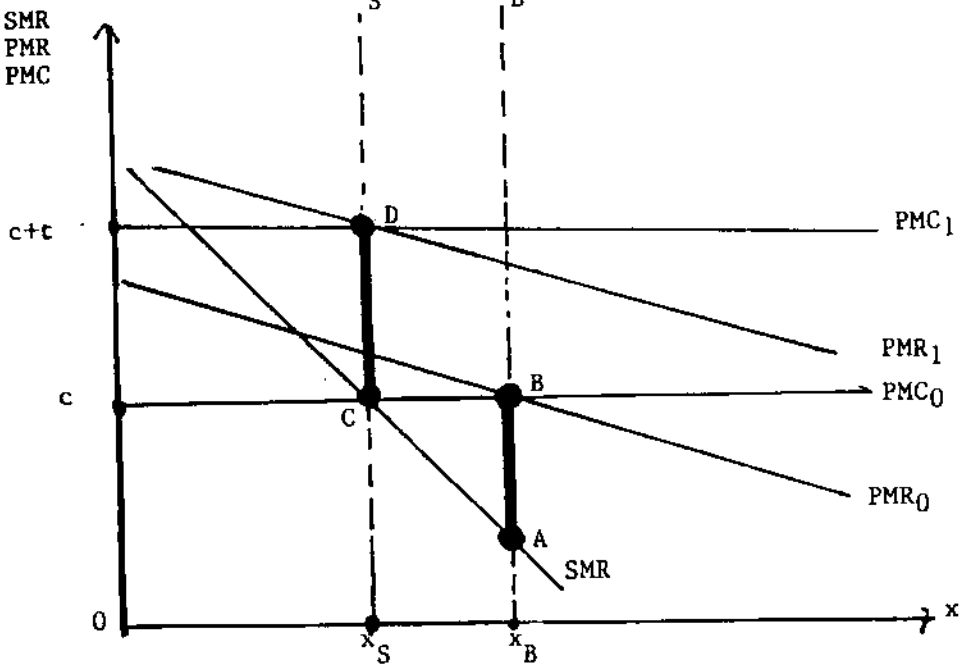
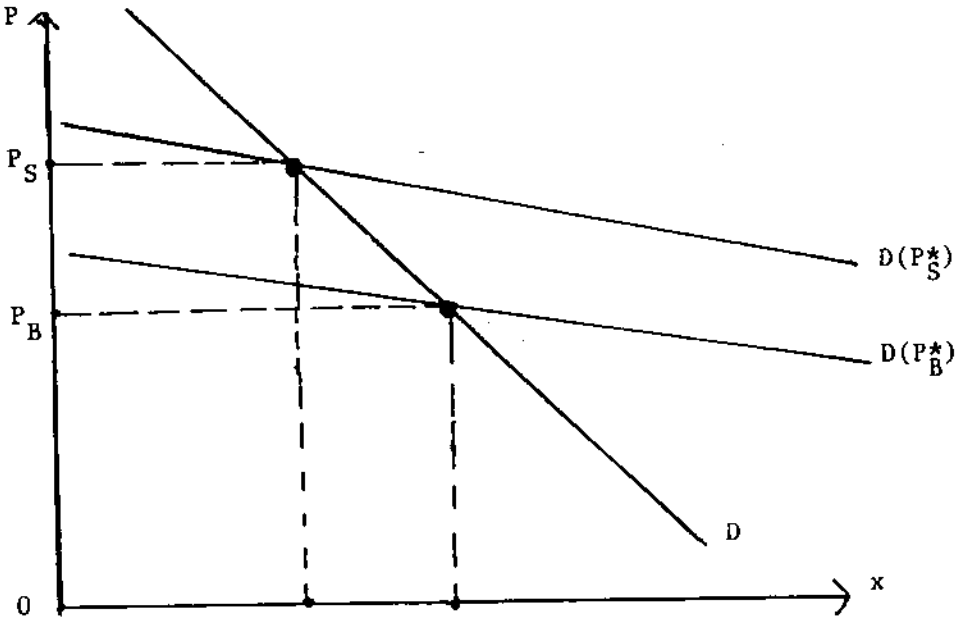
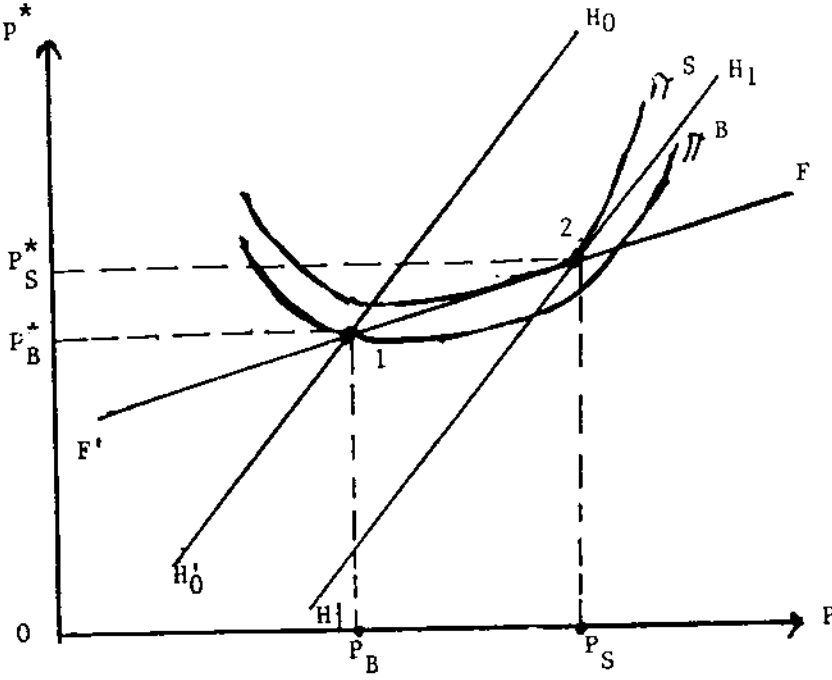
divergence and hence the tax that is required to move us to x^s is $t^o = (P-AC)^S \delta$. The more profitable the home firm initially the bigger the Stackelberg rent the tax creates.

Proposition(3b): The optimal labour tax, if positive, is greater the more profitable the home firm would be as a Stackelberg price leader, as the trade divergence created by Bertrand Competition is bigger.

The tax that equates the SMB and the PMB of another of output causes both home and foreign profit to rise. This is a consequence of the Bertrand induced divergence being endogenous and the fact that firms products are strategic complements. The tax ensures that the home country gets maximum rents from the foreign country. The rent created in consumerland due to the tax, is captured by the home country in terms of higher home profits and tax revenue and by the foreign country in terms of higher foreign profit. Again, as in the traditional case, the rent that is created is at the expense of the consumers in consumerland.

Proposition 3 (c): The optimal tax to internalise the trade divergence explained by the presence of international Bertrand competition will have to make the trade divergence more acute before it is internalised. The tax will lead to an improvement in the terms of trade and consumers will no longer gain nor will the foreign firm lose due to the presence of the trade divergence.

FIGURE 3



Conclusion

This paper set out to show that the New International trade theory on export policy is analytically equivalent to the orthodox theory. The basic source of the trade divergence in the oligopoly models and in the competitive model of international trade was the same. In all models there is an imperfection of private information that leads to the failure of the home industry to calculate the true loss on inframarginal sales of another unit of output.²⁷ In the oligopoly models the loss on inframarginal sales was overestimated in the Cournot model, underestimated in the Bertrand model, while no account was taken of it in the orthodox Bickerdike model. This lead to a divergence between the PMR and SMR of the exporting industry.

The presence of the trade divergence leads to a socially inefficient output level as the home industry is not capturing all the potential rent it should be in consumerland. In the competitive model, consumers benefit from the trade divergence; in the Cournot model, consumers lose and the foreign firm gains from the trade divergence; and in the Bertrand Model, the foreign firm loses and the consumers gain from the trade divergence. The motive for intervention is the same in all models: The government wishes to internalise the trade divergence so that the SMB and the PMB of producing another unit of output will be the same. In all models we have an asymmetric game in which the government has the first mover advantage.²⁸ The government has full information on the market structure that creates the trade divergence and the reactions

²⁷ We note that in the case of a monopoly firm or in the case of a duopoly model with consistent conjectures, (Bresnahan (1981)) the loss on inframarginal sales is calculated or guessed correctly and there is no trade divergence.

²⁸ To classify the New International trade theory on export policy as strategic export policy and the orthodox as non-strategic export policy is misleading. The Bickerdike game above is as strategic or non-strategic as the oligopoly models.

of all other players in the game.²⁹ The sign of the trade divergence and hence the policy conclusion is determined by the market structure chosen to endogenise the trade divergence. The magnitude of the subsidy (positive or negative) in all models depends on the potentially profitable of the home industry. In the oligopoly models the home industry would get maximum rent by setting the output of a Stackelberg leader and in the competitive model the home industry would get maximum rent by setting the output of a monopoly firm. In all models the bigger the initial divergence the bigger the potential rent from internalising it. The failure to calculate exactly the loss on inframarginal sales is more costly and hence more beneficial if internalised. Hence in all models, a bigger subsidy is needed to internalise the trade divergence the more potentially profitable the home industry. When internalising any trade divergence, the government realises that divergence will change with any government intervention, as it is built into the model endogenously. In the oligopoly models, the trade divergence is made bigger before it is internalised and in the competitive model the divergence gets smaller. To say that there is a different first best argument for trade policy in the orthodox model (a terms of trade improvement) relative to the New International trade theory on policy (the profiting shifting motive) is simply misleading. In each model the

²⁹ (a) In all models there is an imperfection of private information that the government can correct if it knows better than the home industry. This assumption may be acceptable when a competitive industry exports abroad but may not be an appropriate assumption in oligopolistic industries.

(b) In all models we assumed no retaliation in response to trade intervention i.e. no by-product loss due to the intervention to internalise the trade divergence. Even a competitive model and an oligopoly model which take account of by-product losses due to retaliation, have a common analytical framework. In the one-shot retaliation games of Brander and Spencer (1985) and Johnson (1954) the same prisoners dilemma situation occurs. Both are starting points for analyzing repeated games which would make a case for free trade rather than trade intervention. The by-product loss over an infinite period, due to retaliation, would offset any one period gain of internalising the trade divergence.

particular market structure assumed explains the presence of a trade divergence within the model. The source of the divergence, the motive for trade intervention and the analytical framework is the same in all models. The sign of the divergence and its magnitude is determined by the market structure chosen to endogenise the divergence and the maximum potential profitability of the home industry.

The optimal policy in the face of a trade divergence in the competitive and price competition model is a trade tax. A trade subsidy can be optimal in the Cournot model, but it is only valid for a small number of firms in the home industry and for low values of the shadow price of government funds. The above policy recommendations are only optimal in the absence of retaliation, domestic divergences and political economy considerations. The present approach offers a more general way of analyzing endogenous trade divergences.

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