Export Competition and the Remission of Domestic Environmental Taxes

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Abstract

In this paper we consider the use of border adjustments to compensate exporters for domestic environmental taxes even when the environmental tax is imposed on an intermediate good. Although GATT/WTO rules allow for border adjustments, there has been little analysis of them. A model of successive oligopoly is used to consider the appropriate border adjustments since many industries where environmental excise taxes are applied can be characterised as imperfectly competitive. We show that the border adjustment currently allowed for in GATT/WTO rules is, under certain circumstances, likely to be too low to maintain the competitiveness of exporters. In some cases, an export tax would be justified.

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Introduction

With the on-going liberalisation of trade under the auspices of the World Trade Organisation (WTO), recent policy discussion has turned to the interaction between domestic policy instruments and their impact on trade. Examples of this include the potential links between competition and trade policies, the role of differing labour standards between countries, and trade and environmental policies. The principal concern relates to the possibility that domestic policy can substitute for more explicit trade policy instruments that can affect market access in importing countries or competition in export markets. This gives rise to two potential problems: 'race to the bottom' and 'regulatory chill'. The concern with a 'race to the bottom' relates to the possibility that countries will choose lower domestic standards with the aim of giving domestic firms a competitive advantage over foreign firms in either import or export markets. With 'regulatory chill', a country that would otherwise prefer to choose a higher domestic standard or impose an environmental tax will refrain from doing so on the basis that this would correspondingly harm the competitiveness of domestic firms. Recent papers that have addressed these or related issues include Anderson (1998), and Bagwell and Staiger (2001). In this paper, we confine the discussion to domestic environmental taxes and the issue of export competitiveness.

It should be noted however that current GATT/WTO rules allow, to some degree, for border adjustments for domestic environmental taxes. In the case of import competition, an environmental tax on a domestically produced good would potentially leave the domestic firm with a competitive disadvantage vis-à-vis imports of a like good that was not subject to an equivalent tax. Under such circumstances, the domestic government can impose a border tax

adjustment on the imported good, such that the pre-tax level of market access is left unchanged. A similar adjustment can be made with respect to exported goods: given that a domestic environmental tax would confer a competitive disadvantage on the domestic firm competing in export markets, GATT/WTO rules allow for a remission of the domestic tax on the exported good. As long as this border adjustment does not exceed the level of the domestic tax, it is not regarded as an export subsidy under the GATT Subsidies Code. It should also be noted that many domestic environmental taxes apply to intermediate goods. Nevertheless, in recognising that this can still have an impact on the competitiveness of domestic firms, the GATT/WTO rules still apply here with the border adjustments for exports and imports of final goods relating to the amount of the taxed input used in the intermediate good sector.

The focus of this paper is on border adjustments for the remission of domestic environmental taxes on exported goods. In considering this issue, we set the analysis in the context of an imperfectly competitive market. This is justified on the grounds that many of the industries where domestic environmental taxes and border adjustments apply are more likely to be characterised as imperfectly competitive (see below). Noting that the domestic taxes often apply to the intermediate good sector, and that industries at each vertical stage may be imperfectly competitive, the appropriate set-up for analysing the border adjustments for exported goods is one of successive oligopoly. This leads on to an additional concern. In the context of successively oligopolistic markets, trade policies directed at the downstream, final good stage can also affect market equilibrium upstream at the intermediate good stage.[1] We refer to the upstream impact of the downstream policy instrument as the 'back-shifting' effect. As we show in this paper, the appropriate level of remission for the domestic environmental tax on the input

used by the intermediate good sector will depend on both the incidence of the upstream environmental tax on exports and the back-shifting effect of the border adjustment on the intermediate good sector. As we show, failure to account for this back-shifting effect may lead to an inappropriate border adjustment. In such cases, a border adjustment that ignores this back-shifting effect may be inadequate for maintaining the competitiveness of domestic firms in final good export markets.

The paper is organised as follows. In section 1, we present a brief discussion of the use of domestic environmental taxes that are adjustable at the border under GATT/WTO rules. In section 2, we outline a model of successive oligopoly that will form the basis of the analysis. In section 3, we report the main results and discuss the implications they have for appropriate setting of border adjustments on exported final goods. In section 4, we summarise the main results of the paper.

1. GATT/WTO Rules on Border Adjustments for Environmental Taxes

GATT/WTO rules on border adjustments for domestic taxes are based on two premises. The first draws the distinction between the origin and destination principle, with the destination principle being the one that applies in GATT/ WTO rules. Second, the logic of GATT/WTO rules is that only indirect, not direct, taxes are subject to border tax adjustments. As noted by a recent WTO Committee on Trade and the Environment, the distinction between direct taxes and indirect taxes is made on the basis that indirect taxes are passed onwards and hence raise the price of the taxed product, whereas direct taxes are not (WTO, 1997).[2] A further feature of WTO rules on border adjustable environmental taxes is that they apply to taxes on the product not the process of

production. For example, a tax on an environmentally-damaging activity would not be adjustable at the border while a tax on the price of the good would be.[3]

The basic purpose of GATT/ WTO rules on border adjustable environmental taxes is to "equalise competitive conditions in international trade" (Demaret and Stephenson, 1994, p.7). As far as exports are concerned, an environmental tax that would otherwise reduce the competitiveness of domestic firms in export markets could be remitted to restore exports to their pre-domestic tax levels. Following the Uruguay Round Agreement on Subsidies and Countervailing Measures, it was noted that "the remission of such taxes not in excess of those accrued, shall not be deemed to be a subsidy" (WTO, *op. cit.*). The border adjustable tax also applies to inputs used in the production process of the exportable good when the tax applies to the raw material or semi-manufactured stage of production yet it is the manufactured good that is exported: where these inputs are used in a prior stage in the production process, they can also be remitted when exported as long as the remission is not in excess of the tax on the prior stage input.

Environmental taxes that are potentially border adjustable under GATT/WTO rules are widely used. In the United States, for example, a range of environmental excise taxes are or have been applied. Examples include the so-called LUST tax imposed on motor fuels to pay for the environmental damage associated with leakage of underground tanks. A Superfund tax on petroleum was used to fund the Oil Spill Liability Trust and taxes are imposed on toxic chemicals to deal with toxic waste. With the expiration of the Superfund and Oil Spill Liability Trust in the late 1990s, the most important taxes (by revenue raised) now relate to taxes on

ozone-depleting chemicals or CFCs which can be dealt with via GATT/WTO border adjustment rules when they affect exportable final goods.

The range of environmental excise taxes applied in Europe mirror those in the United States with several European countries applying taxes to deal with toxic waste and the disposal of environmentally damaging goods. Carbon taxes are also applied in many European countries including Austria, Denmark, Finland and the Netherlands. As Majocchi (2001) notes, with the increased use of environmental excise taxes in Europe, the issue of border adjustments to maintain the competitiveness of domestic firms is becoming an increasingly important issue in the design of environmental tax schemes.

In the framework set out below, we take the basic objective of border adjustable taxes as being one of maintaining the level of exports prior to the imposition of the domestic environmental tax. It is also assumed that the environmental tax is applied on an upstream stage of production which reflects both GATT/WTO rules on border adjustable taxes and the fact that many of these domestic taxes apply to intermediate goods production yet it is the manufactured good that is exported. One final observation is that the intermediate and final goods sectors where these domestic environmental taxes typically apply are highly concentrated. For example, in the United States, the motor vehicle, office machinery and chemical-related industries which are all affected by the domestic environmental taxes, have high five-firm levels of industry concentration. These industries are also typically the most concentrated in Europe. Taking these observations together, the main results that follow show that current GATT/WTO rules that set the remission on the final exportable good equal to the level of the domestic environmental tax

will likely be insufficient given the aim of maintaining the initial level of competitiveness in final good export markets.

2. Theoretical Framework

2.1 *Assumptions*

The model introduced here is one of successive oligopoly, i.e., both the upstream (intermediate) and downstream (final) stages are imperfectly competitive. At the downstream stage, the domestic firm competes with a foreign exporter of the final good. In the domestic upstream stage, two firms produce the intermediate good which is assumed to be homogenous. Although the foreign upstream stage can have the same structure, this sector is ignored in the present case. The domestic intermediate good sector uses an environmentally-harmful input; consequently, the environmental excise tax raises the intermediate firms' costs, which subsequently raises the downstream firm's costs due to the price of the intermediate good. The technology linking each stage is one of fixed proportions. Formally, $x_1 = \phi x^U$, where x_1 and x^U represent output in the domestic downstream and upstream stages respectively, and where ϕ is the constant coefficient of production.[4] To ease the exposition, ϕ is set equal to one in the framework outlined below. Arm's length pricing between the downstream and upstream stages is also assumed, i.e., the downstream stage takes input prices as given.

In terms of the game-theoretic structure of the model, the timing of the firm's strategy choice goes from upstream to downstream. Specifically, given costs and the derived demand curve facing the upstream sector, an upstream firm will maximize profits contingent on a conjecture of

how the other upstream firm will respond. This generates Nash equilibrium at the upstream stage. The intermediate input prices are taken as given by the domestic downstream firm which maximizes profits contingent on their expectation of how their foreign competitor will respond, thus giving Nash equilibrium at the downstream stage. Although it is common to assume a particular firm strategy, the general model introduced below allows us to identify the role of Cournot and Bertrand strategies in determining the outcome. In terms of solving the model, equilibrium at the downstream stage is derived first and then the upstream stage.[5]

2.2 *Equilibrium in the Downstream Market*

The model is written in general form following Dixit (1986). Let x_1 equal output of the domestic downstream firm and x_2 the output of its foreign competitor. Both firms compete in the world market with the level of output of the domestic firm being equal to the level of exports i.e., no domestic consumption of the good is assumed. The revenue functions can be written as:

$$R_1(x_1, x_2) \tag{1}$$

$$R_2(x_1, x_2). \tag{2}$$

We assume downward sloping demands and substitute goods.

Given (1) and (2), the relevant profit functions are given as:

$$\pi_1 = R_1(x_1, x_2) - (c_1 - m)x_1 \tag{3}$$

$$\pi_2 = R_2(x_1, x_2) - c_2 x_2, \tag{4}$$

where c_1 and c_2 are the domestic and foreign firms' respective costs. Firms' costs relate to the purchase of the intermediate input. m is the level of remission on the exportable good given that an environmental tax has been imposed upstream.[6]

The first-order conditions for profit maximisation are given as:

$$R_{1,1} + v_1 R_{1,2} = c_1 - m \tag{5}$$

$$R_{2,2} + v_2 R_{2,1} = c_2 \ , \tag{6}$$

where v_1 and v_2 are the conjectural variations parameters for each firm. While the much-warranted criticisms of conjectural variations are acknowledged, our use of them here is restricted to comparing Cournot and Bertrand outcomes in a consistent framework; as shown below, the Bertrand-equivalent strategies in quantity-space imply a conjecture in quantities less than the value for the Cournot conjecture.[7]

In the case of Cournot conjectures, each firm believes that its rival will not change output in response to a change in its own output, i.e.,

$$v_i = \ dx_j / dx_i = \ 0 \quad i = 1,2, \ \ j \neq i. \tag{7}$$

For the purposes of the presentation here, all that is required to compare the Cournot with the Bertrand outcome is that, in quantity-space, the value for v_i will be less than zero when the goods are imperfect substitutes. Specifically, for the Bertrand case, each firm believes that when it increases its output, the other firm will reduce its output by just enough to keep its own price constant. The direct demand functions for the two firms are defined as:

$$D_1 (p_1 , p_2) \tag{8}$$

$$D_2 (p_1 , p_2), \tag{9}$$

where p_1 and p_2 are their respective prices. The conjectural variations terms can be derived by totally differentiating the demand functions (8) and (9):

$$\begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \begin{bmatrix} D_{1,1}\, D_{1,2} \\ D_{2,1}\, D_{2,2} \end{bmatrix} \begin{bmatrix} dp_1 \\ dp_2 \end{bmatrix}. \tag{10}$$

As Bertrand conjectures imply that each firm believes its rival will hold price constant in response to a change in its own price, the conjectural variations parameter is defined as:

$$v_i = \left[\frac{dx_j}{dp_i} \Big/ \frac{dx_i}{dp_i} \right]_{dp_j = 0} = \frac{D_{j,i}}{D_{i,i}} \quad i = 1,2,\ j \neq i, \tag{11}$$

where $v_i < 0$ for imperfect substitutes, and $v_i = -1$ for perfect substitutes.

Equilibrium in the downstream stage can be derived by totally differentiating the first-order conditions (5) and (6):

$$\begin{bmatrix} R_{1,11} + v_1 R_{1,21} & R_{1,12} + v_1 R_{1,22} \\ R_{2,21} + v_2 R_{2,11} & R_{2,22} + v_2 R_{2,12} \end{bmatrix} \begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \begin{bmatrix} d(c_1 - m) \\ dc_2 \end{bmatrix}. \tag{12}$$

The slopes of the reaction functions are found by implicitly differentiating the firms' first-order conditions:

$$\frac{dx_1}{dx_2} = r_1 = -(R_{1,12} + v_1 R_{1,22}) / (R_{1,11} + v_1 R_{1,21}) \tag{13}$$

$$\frac{dx_2}{dx_1} = r_2 = -(R_{2,21} + v_2 R_{2,11}) / (R_{2,22} + v_2 R_{2,12}). \tag{14}$$

For a Cournot game with substitute goods, the reaction functions will be downward sloping in quantity space, i.e., $r_i < 0$. For a Bertrand game with substitute goods, upward sloping reaction functions in price space are implied by $r_i > 0$, i.e., each firm responds to an output increase (price cut) of its rival by raising its output (cutting price).[8]

Given (12), the solution to the system is found by re-arranging in terms of dx_i and inverting where Δ is the determinant of the left-hand side of (12):

$$\begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \Delta^{-1} \begin{bmatrix} R_{2,22} + v_2 R_{2,12} & -(R_{1,12} + v_1 R_{1,22}) \\ -(R_{2,21} + v_2 R_{2,11}) & R_{1,11} + v_1 R_{1,21} \end{bmatrix} \begin{bmatrix} d(c_1 - m) \\ dc_2 \end{bmatrix}. \tag{15}$$

This can be simplified to:

$$\begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \Delta^{-1} \begin{bmatrix} a_2 & b_1 \\ b_2 & a_1 \end{bmatrix} \begin{bmatrix} d(c_1 - m) \\ dc_2 \end{bmatrix}, \tag{16}$$

where,

$$a_1 = (R_{1,11} + v_1 R_{1,21}) \quad a_2 = (R_{2,22} + v_2 R_{2,12})$$

$$b_1 = (R_{1,12} + v_1 R_{1,22}) \quad b_2 = (R_{2,21} + v_2 R_{2,11}).$$

As Dixit (*op. cit.*) has shown, for stability of the duopoly equilibrium, the diagonal of the matrix has to be negative, i.e., $a_i < 0$, and the determinant positive, i.e., $\Delta = (a_1 a_2 - b_1 b_2) > 0$. Given these conditions, further comments can be made about the reaction functions. $r_i = -(b_i)/a_i$ from (13) and (14). Hence, if $a_i < 0$, then for Cournot conjectures $b_i < 0$, in order to satisfy $r_i < 0$, and $b_i > 0$ in order to satisfy $r_i > 0$ for Bertrand conjectures. The expression for r_i can be substituted into (16) in order to make the comparative statics easier to follow:

$$\begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \Delta^{-1} \begin{bmatrix} a_2 & a_1 r_1 \\ a_2 r_2 & a_1 \end{bmatrix} \begin{bmatrix} d(c_1 - m) \\ dc_2 \end{bmatrix}. \tag{17}$$

2.3 *Equilibrium in the Upstream Market*

Given the fixed proportions technology and $\phi = 1$, total output in the domestic upstream sector is given by $x^U (= x_1)$. It is assumed that there are two upstream firms (*A* and *B*) whose combined

output equals x^U, i.e., $x_A + x_B = x^U$. The intermediate good is assumed to be homogeneous so that the downstream firm is indifferent about the relative proportions of x_A and x_B used in its production process. Assuming that the downstream firm faces no costs other than the price paid for the intermediate input, the inverse derived demand function facing firms in the upstream sector can be found by substituting p_1^U for c_1 in (5) where superscript U denotes the upstream sector. Firms' profits in the upstream sector are, therefore, given by:

$$\pi_A^U = R_A^U(x_A, x_B) - c_A^U x_A \tag{18}$$

$$\pi_B^U = R_B^U(x_A, x_B) - c_B^U x_B, \tag{19}$$

where c_A^U and c_B^U are the upstream firms' costs respectively. The domestic environmental tax affects the upstream firms' costs.

Given this, the equivalent of (17) can be re-written for the domestic upstream market:

$$\begin{bmatrix} dx_A^U \\ dx_B^U \end{bmatrix} = (\Delta^U)^{-1} \begin{bmatrix} a_B^U & a_A^U r_A^U \\ a_B^U r_B^U & a_A^U \end{bmatrix} \begin{bmatrix} dc_A^U \\ dc_B^U \end{bmatrix}. \tag{20}$$

3. Border Adjustments for Environmental Taxes

As noted above, the main aim of the border adjustment for the environmental tax is to maintain the competitiveness of the domestic firm in exporting the final good. If the domestic environmental tax was not remitted, then the competitiveness of the domestic firm would be affected and exports would fall to the benefit of the foreign firm. However, GATT/WTO rules allow the domestic tax to be remitted on exports to restore the level of exports to their pre-tax level. We show here that simply setting the level of the remittance equal to the domestic tax is

likely to be wrong due to the 'back-shifting' effect associated with the effect of the remittance of the tax in the final stage on upstream prices.

More formally, we set the border adjustment such that the volume of exports following the imposition of the tax is unchanged. Specifically, the border adjustment (*BA*) rule is:

$$(dx_1 / dp_1^u)t^e - BA(dx_1 / -dm) = 0,$$

which is re-arranged as:

$$BA = \frac{(dx_1 / dp_1^u)t^e}{(dx_1 / -dm)}. \tag{21}$$

The numerator is the effect of the upstream environmental tax t^e on the level of downstream final good exports. The denominator is the effect of the level of the remittance on the level of exports. However, the downstream border adjustment will also affect the upstream price as it will shift the inverse derived demand function for the upstream intermediate good.[9] Therefore, the denominator can be expanded to:

$$dx_1 / -dm = (dx_1 / -dm) - (dx_1 / dp_1^u)(\partial p_1^u / -\partial m),$$

i.e., the remittance of the tax has the direct effect of increasing exports but the 'back-shifting' effect shifts the inverse derived demand curve that results in an increase in upstream prices that, *ceteris paribus*, would have the off-setting effect of reducing exports. Using (17) and (21), the appropriate border tax adjustment is given as:

$$BA = \frac{\Delta^{-1} a_2 [p_{1,1}^u \{.\}] t^e}{\Delta^{-1} a_2 - \Delta^{-1} a_2 [p_{1,1}^u \{.\}]},$$

which can be re-written as:

$$BA = \frac{p^{u}_{1,1}\{.\}t^{e}}{1 - p^{u}_{1,1}\{.\}}, \tag{22}$$

where $\{.\} = \left\{(\Delta^{U})^{-1}\left[dc^{U}_{A}\ a^{U}_{B}(1+r^{U}_{B}) + dc^{U}_{B}\,a^{U}_{A}(1+r^{U}_{A})\right]\right\}$. Therefore, $p^{u}_{1,1}\{.\}$ represents the effect of the domestic tax or export remittance on downstream firms' costs and as such represents the incidence of the policies on upstream prices. Since $p^{u}_{1,1}$ and $\{.\}$ are both negative the tax and/or the export remittance will be expected to increase downstream firms' costs. As is well-known from the tax incidence literature, the impact of a tax on the price of a good can be greater or less than the level of the tax when industries are imperfectly competitive.[10] Several results arise from (22). The incidence of the policies is the key to identifying the level of the appropriate border adjustment.

Result 1: If $p^{u}_{1,1}\{.\} < 1$, then the appropriate border adjustment for the environmental tax should be positive.

$p^{u}_{1,1}\{.\} < 1$, implies that the incidence of the tax/remittance policies is not fully reflected in changes in the price of the intermediate good. As is well-known from the tax incidence literature, this typically arises when markets are imperfectly competitive and the demand function is not sufficiently convex.

Result 2: If a positive remittance on exports is justified, it should be greater than the corresponding environmental tax.

If the level of the remittance were set equal to the environmental tax, it would not fully compensate for the decrease in exports. This arises because in setting the remittance on exports

(which acts as a negative tax), the policy-maker has not fully accounted for the upstream or 'back-shifting' effect.[11] The consequence of this is that export competitiveness will still be harmed even if a border adjustment policy is used but ignores this effect.

Result 3: If the incidence of the environmental tax is greater than 1, then the appropriate border adjustment policy would be an export tax.

This is readily observed from (22). With $p^{u}_{1,1}\{.\} > 1$, the *BA* will be negative.[12] Intuitively, if the incidence of the tax/remittance policy is greater than one, a tax on exports would serve to reduce costs via the 'back-shifting' effect thus restoring exports to the pre-domestic environmental tax level.

Result 4: If a positive remittance on exports is justified, the level of the remittance will be higher with Bertrand compared to Cournot behaviour. If an export tax is justified, the level of the tax will be higher with Bertrand compared with Cournot behaviour.

Result 4 arises from the effect of alternative forms of behaviour on the incidence of the policies. Drawing on results from the tax incidence literature, it is well-known that, the more competitive a market, the higher the level of incidence.[13] Consequently, the value of $p^{u}_{1,1}\{.\}$ will be higher if firms play Bertrand than if they play Cournot. It follows, therefore, that if a positive remittance is justified, it should be greater with Bertrand behaviour; if an export tax is justified, it should also be greater with Bertrand behaviour.

4. Summary and Implications

In this paper we have focussed on GATT/WTO rules for border tax adjustments for domestic environmental taxes where the concern is with maintaining the competitiveness of domestic exporters in world markets. Current GATT/WTO rules allow domestic environmental taxes to be remitted when firms export the good up to the level of the domestic environmental tax. These rules apply even if the domestic tax is imposed on raw material or semi-manufactured goods but where it is the manufactured good that is exported. Drawing on the observation that most of the environmental excise taxes in use apply to intermediate good sectors and that final and intermediate goods sectors tend to be characterised as being imperfectly competitive, we have utilised a successive oligopoly model to focus on the appropriateness of current GATT/WTO rules. The principal results of this paper show that setting the remittance on exports equal to the level of the domestic tax is an inadequate rule for maintaining the competitiveness of exporters in world markets. Where a positive remittance is justified, it should be set higher than the environmental tax. In some cases, an export tax may be justified. These insights arise from the fact that although GATT/WTO rules recognise the relevance of a domestic environmental tax on intermediate good sectors in affecting export competitiveness, they fail to take account of the 'back-shifting' effect when a policy instrument is targeted at the downstream stage. If export competitiveness matters and governments wish to avoid the problem of 'regulatory chill', then overly-simplistic rules for compensating for domestic policy standards will not necessarily deal adequately with the problem of competitiveness.

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Notes

[1] The literature on trade policy with successive oligopoly is limited. Recent examples include Ishikawa and Lee (1997) and Spencer and Ishikawa (1999).

[2] We do not concern ourselves with the validity of this distinction in this paper.

[3] As Demaret and Stephenson (1994) note, the GATT Panel in the Tuna/Dolphin case viewed the regulations concerning the process of manufacture as beyond the rules of GATT. However, a tax on the product would not have been treated in the same way if the domestically produced tuna had also been taxed.

[4] It is also assumed that there is no joint production. As Poterba and Rotemberg (1995) point out, in such cases, it is not possible to prescribe the appropriate border taxes.

[5] Essentially we are assuming here that the initial equilibrium in either game will be benchmarked on the pre-tax level of market access.

[6] It should be noted that the level of the remission enters the profit function as though it were a subsidy on exports. From a conceptual point of view, this is what the remission on exports amounts to. However, the GATT/WTO definition of a subsidy in this case relates to the remission in excess of the domestic environmental tax.

[7] While it is unnecessary for the key results of this paper, the conjectural parameters can be interpreted as indicating various degrees of competition (see Dixit, 1986).

[8] Following the terminology of Bulow *et al.* (1985), when $r_i < 0$ the goods are 'strategic substitutes'; when $r_i > 0$, the goods are 'strategic complements'.

[9] This is easily confirmed by noting that in re-arranging (5) the remittance influences the inverse derived demand function and will increase $c_1 (= p^u_{1,1})$.

[10] A useful recent summary of tax incidence in imperfectly competitive markets can be found in Fullerton and Metcalf (2002).

[11] More specifically, the incidence of the tax would exceed 0.5 for this to be true. This is likely to be the case under most reasonable circumstances.

[12] The incidence of the tax can be greater than the level of the tax when markets are imperfectly competitive if the demand function is sufficiently convex.

[13] Formally, the change from Cournot to Bertrand behaviour is reflected in an increase in $p^u_{1,1}$ and $\{.\}$ via the increase in the conjecture. It is clear from (22) that $dBA / d(p^u_{1,1}\{.\}) > 1$.