

Competitiveness, Carbon Leakage, and Border Tax Adjustments: Might Imperfect Competition Matter?

**Ian Sheldon
(The Ohio State University)**

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DEPARTMENT OF
AGRICULTURAL, ENVIRONMENTAL,
AND DEVELOPMENT ECONOMICS

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Why Border Adjustments?

- With no international carbon price, domestic climate policy may affect *competitiveness* of domestic firms, i.e., lost profits and market share (WTO/UNEP, 2009)
- Non-universal application of climate policies also creates potential for *carbon leakage*
- Provisions in Waxman-Markey climate bill (2009) for border adjustments on energy-intensive imports
- Even if no agreed climate legislation comes out of current session of Congress, EU likely to implement its own border adjustments

Trade and Climate Policy

- Carbon leakage already covered in literature on “pollution havens” (Copeland and Taylor, 2004)
- Carbon taxes with import tariffs (export subsidies) on traded goods as resolution to free-riding in climate agreements (Hoel, 1996; Mæstad, 1997)
- Notion of tariffs being re-negotiated while maintaining competitiveness (Bagwell and Staiger, 2001)
- Concern that border tax adjustments (BTAs) for climate policy not allowed under WTO/GATT rules

Basic Logic of BTAs

- Old principle dating back to Ricardo:

“...In the degree then in which (domestic) taxes raise the price of corn, a duty should be imposed on its importation...By means of this duty...trade would be placed on the same footing as if it had never been taxed...” (Sraffa, 1953)

- ***Destination basis* of taxation – no effects on trade (Lockwood, de Meza and Myles, 1994)**
- **US raised issue of legality in 1960s after EEC adopted VAT with taxes on imports/tax rebates on exports**
- **GATT Working Party on BTAs established in 1968**

Trade Law and BTAs

- **Key WTO/GATT Articles:**
 - **Article II.2(a):** allows members to place on imports of any good, BTA equivalent to internal tax on *like* good
 - **Article III.2:** BTA cannot be *in excess* of that applied to like domestic good, i.e., have to be *neutral* in terms of effect on trade
- **Current legal debate about whether rules allow BTAs on final goods that embody energy inputs (WTO/UNEP, 2009)**

Trade Law and BTAs

- Article II.2(a) interpreted as restricting BTAs to inputs *physically incorporated* into the final product; Article III.2 interpreted as allowing BTAs to be applied to inputs *used* in the production process
- GATT *Superfund Case* (1987) cited as precedent for carbon tariffs - US taxes on imported substances that were end-products of chemicals taxed in the US, were deemed consistent with Article III.2
- Ultimately, clarity on issue will only come with a WTO Dispute Settlement Panel

Which Industries?

- **Steel, aluminum, chemicals, paper and cement (Houser *et al.*, 2009)**
- **May be appropriate to assume both upstream and downstream sectors are imperfectly competitive:**
 - **Electricity generation modeled as oligopolistic Bolle (1992); Borenstein and Bushnell (1999)**
 - **Evidence market power exerted in several energy-intensive industries (Yang, 2001)**
- **Apply McCorriston and Sheldon's (2005) model of successive oligopoly to BTAs and climate policy**

Vertical Market Structure

Stage

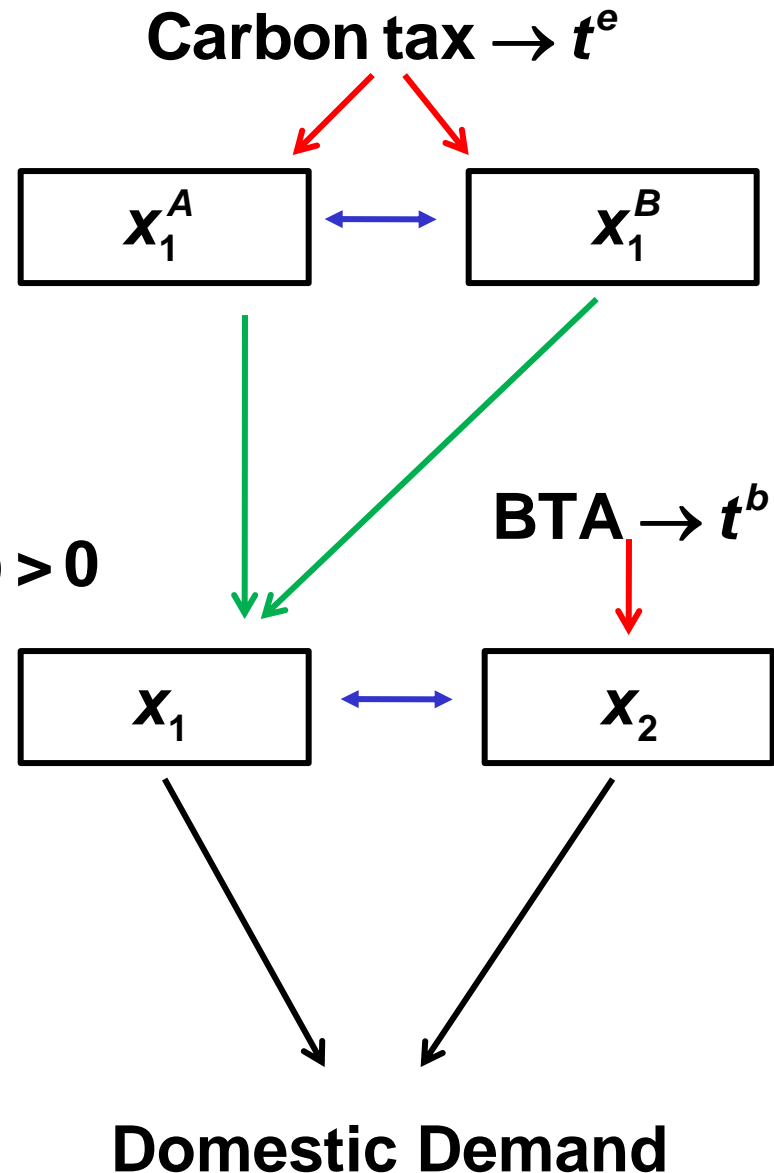
Domestic Upstream:

$$x_1 = \phi x_1^u$$

Technology: $x_1^u = x_1^A + x_1^B$

$$GHG = g(x_1^u), g'(x_1^u) > 0$$

Domestic Downstream:



Successive Oligopoly Model

- Three-stage game:

(1) Domestic government commits to t^e and t^b

(2)/(3) Nash equilibria upstream and downstream

- Downstream revenue functions:

$$R_1(x_1, x_2) \quad (1)$$

$$R_2(x_1, x_2) \quad (2)$$

- Downstream profit functions:

$$\pi_1 = R_1(x_1, x_2) - c_1 x_1 \quad (3)$$

$$\pi_2 = R_2(x_1, x_2) - c_2 x_2 \quad (4)$$

Downstream Equilibrium

- First-order conditions are:

$$R_{1,1} = c_1 \quad (5)$$

$$R_{2,2} = c_2 \quad (6)$$

- Nash equilibrium downstream:

$$\begin{bmatrix} R_{1,11} & R_{1,12} \\ R_{2,21} & R_{2,22} \end{bmatrix} \begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \begin{bmatrix} dc_1 \\ dc_2 \end{bmatrix} \quad (7)$$

- Slopes of reaction functions:

$$\frac{dx_1}{dx_2} = r_1 = - \frac{R_{1,12}}{R_{1,11}} \quad (8)$$

$$\frac{dx_2}{dx_1} = r_2 = - \frac{R_{2,21}}{R_{2,22}} \quad (9)$$

Substitutes (complements), $R_{i,ij} < 0(> 0)$, $r_i < 0(> 0)$

Downstream Equilibrium

- Solution found by re-arranging and inverting (7), and simplifying notation:

$$\begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \Delta^{-1} \begin{bmatrix} a_2 & -b_1 \\ -b_2 & a_1 \end{bmatrix} \begin{bmatrix} dc_1 \\ dc_2 \end{bmatrix} \quad (10)$$

where: $a_1 = R_{1,11}$ $a_2 = R_{2,22}$
 $b_1 = R_{1,12}$ $b_2 = R_{2,21}$,

and for stability, $a_i < 0$, and $\Delta^{-1} = a_1 a_2 (1 - r_1 r_2) > 0$

- From (8) and (9), substitute $r_i = -(b_i) / a_i$ into (10):

$$\begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \Delta^{-1} \begin{bmatrix} a_2 & a_1 r_1 \\ a_2 r_2 & a_1 \end{bmatrix} \begin{bmatrix} dc_1 \\ dc_2 \end{bmatrix} \quad (11)$$

Upstream Equilibrium

- Given technology, and two firms, upstream equilibrium can be derived in similar fashion:

$$\begin{bmatrix} dx_j^{uA} \\ dx_j^{uB} \end{bmatrix} = (\Delta_j^u)^{-1} \begin{bmatrix} a_j^B & a_j^A r_j^A \\ a_j^B r_j^B & a_j^A \end{bmatrix} \begin{bmatrix} dc_j^A \\ dc_j^B \end{bmatrix} \quad (12)$$

Imposition of domestic carbon tax t^e raises both c_1^A and c_1^B , raising price of electricity, $dp_1^U = dc_1$

Cost increase to domestic downstream firm affects imports, i.e., from (11), dx_2 / dc_1

BTA also affects imports, i.e., from (11), dx_2 / dc_2

Optimal BTAs

- **Neutrality of BTAs not defined explicitly by WTO - two possible rules:**
- ***Import-volume* neutrality**
 - change in foreign firm's costs c_2 through BTA that keeps import volume, x_2 , constant given carbon tax t^e
 - size of BTA depends on *incidence* of upstream carbon tax t^e on downstream firm's costs, c_1
 - profits fall (rise) for domestic (foreign) firm, and carbon leakage is prevented

$$\text{neutral BTA} = \frac{(dx_2 / dc_1) t^e}{-(dx_2 / dc_2)} \quad (13)$$

With competitive markets, absolute value of $dx_2 / dc_2 = dx_2 / dc_1$, and net effect is such that $dx_2 = 0$, i.e., neutral BTA = t^e

With imperfect competition, setting BTA = t^e leads to non-neutral outcome, $dx_2 \neq 0$

Using (11), effect of BTA is:

$$dx_2 = \Delta^{-1} a_1 dc_2 \quad (14)$$

Since $\Delta^{-1} > 0$ and $a_1 < 0$, BTA reduces level of imports

Impact of t^e upstream on downstream imports is:

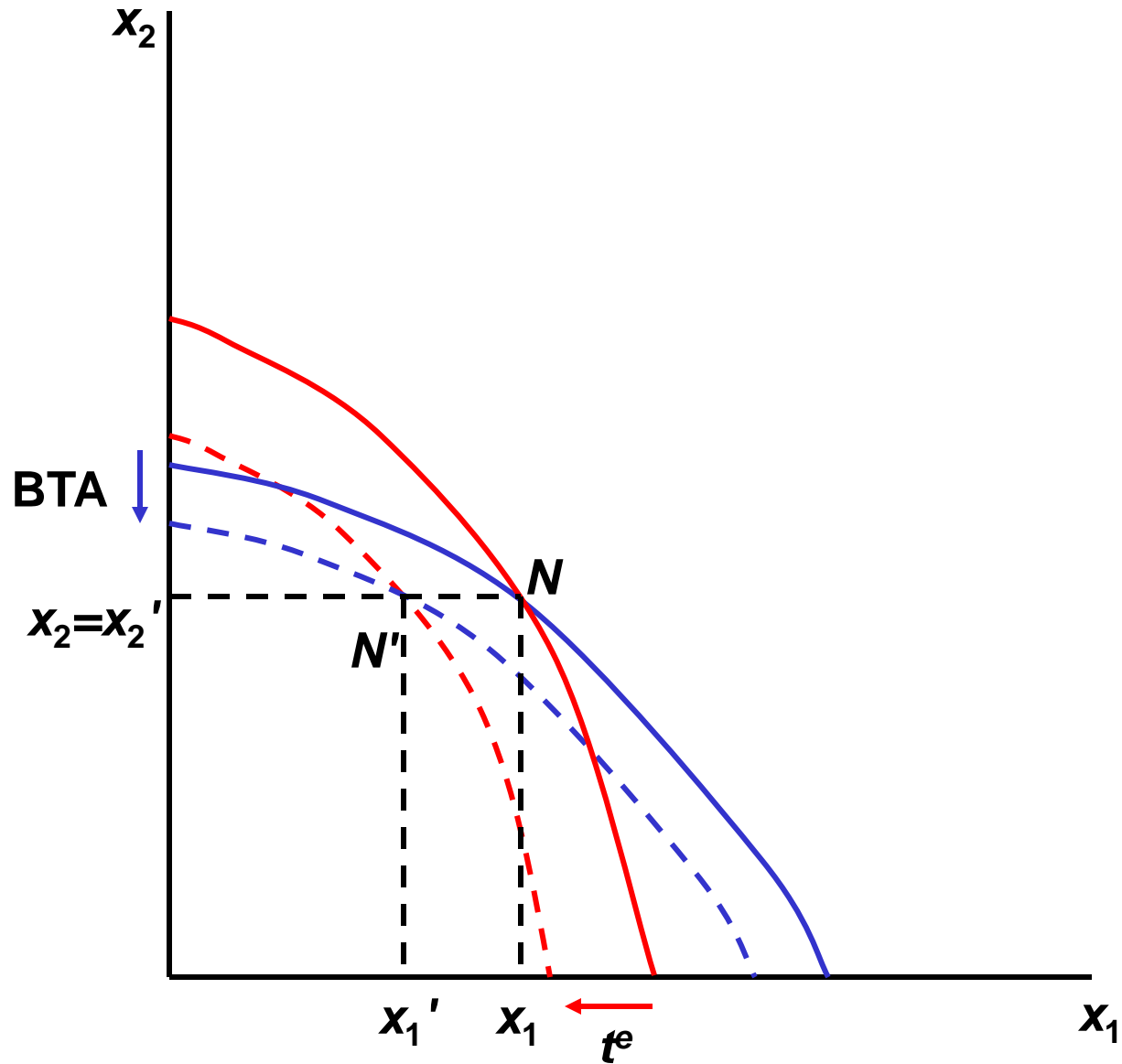
$$dx_2 = \Delta^{-1} a_2 r_2 dc_1 \quad (15)$$

As $\Delta^{-1} > 0$, $a_2 < 0$, and if $r_2 < 0$, then $dx_2 / dc_1 > 0$, i.e., import volume neutrality requires a border adjustment *tax*

Whether $dx_2 / dc_1 = dx_2 / dx_2$ depends on likelihood of $dc_1 = dc_2$ - which is a function of *incidence* of t^e , i.e., $dc_1 = \{dp_1^U / (dc_1^A + dc_1^B)\}$

Likely to be 'under-shifting' of t^e , neutral BTA = $-r_2 dc_1$, i.e., BTA < t^e

Figure 1: Import Volume Neutrality



Optimal BTAs

- ***Import-share neutrality***

- change in foreign firm's costs c_2 through BTA that keeps its import share $x_2/(x_1+x_2)$ constant given carbon tax t^e
- profits of both domestic and foreign firm increase, and global GHG emissions reduced
- while objective is to set border taxes so as not to be unwittingly protectionist, there are profit effects that affect way firms will lobby for policy

Appropriate BTA defined as one where net effect of t^e on x_1 and x_2 must equal the net effect of BTA on x_1 and x_2 is:

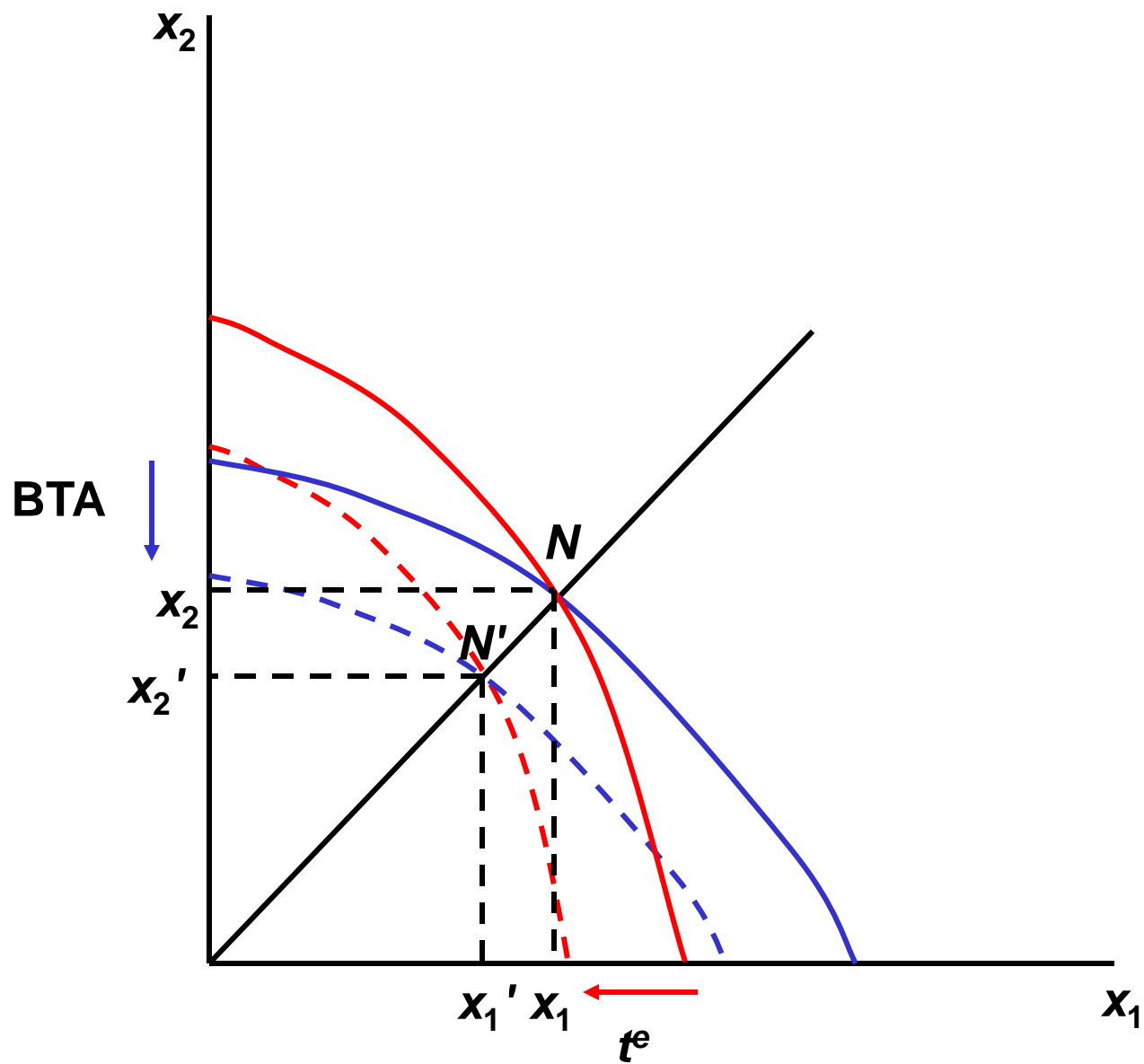
$$\text{neutral BTA} = \frac{t^e [(dx_2 / dc_1) + (dx_1 / dc_1)]}{[(dx_1 / dc_2) + (dx_2 / dc_2)]} \quad (16)$$

Substituting in from (11), and assuming, $a_1 \approx a_2$, neutral BTA can be written as:

$$\text{neutral BTA} = \frac{(r_2 + 1) t^e}{(r_1 + 1)} = \frac{(r_2 + 1) dc_1}{(r_1 + 1)} \quad (17)$$

With $r_i < 0$, and given, $|r_1| > |r_2|$, BTA for import-share neutrality > BTA for import-volume neutrality

Figure 2: Import Share Neutrality



Conclusions

- **Connection between trade and climate policy not a new issue – analysis since early 1990s of carbon leakage and competitiveness**
- **Legal issues also not new, although only a ruling on BTAs in presence of domestic climate policies will resolve legal uncertainty**
- **Climate policies present additional layer(s) of complexity when vertically-related markets can be characterized as successive oligopoly**