"Climate Policy, Carbon Leakage, and Competitiveness: How Might Border Tax Adjustments Help?"

Ian Sheldon (Ohio State University)

Steve McCorriston (University of Exeter)

IATRC Meetings, St. Petersburg, FL, December 10-13, 2011

THE OHIO STATE UNIVERSITY
DEPARTMENT OF
AGRICULTURAL, ENVIRONMENTAL,
AND DEVELOPMENT ECONOMICS
aede.osu.edu

Trade and Climate Policy

With no international carbon price, domestic climate policy may affect *competitiveness* of domestic firms

Non-universal application of climate policies also creates potential for *carbon leakage*

Carbon taxes with import tariffs (export subsidies) on traded goods solution to free-riding (Hoel, 1996)

Switch from *origin* to *destination* based taxation system may be *neutral* – principle reflected in WTO/GATT rules on border tax adjustments (BTAs) (Lockwood and Whalley, 2010)

Competitiveness?

Competitiveness and carbon leakage often linked in policy debate, but former is harder to define

Typically thought of in terms of market share and/or firms' profits – a function of market structure, technology and behavior of firms (WTO/UNEP, 2009)

Analyze climate policy and BTAs in context of *strategic trade theory* and application to environmental policy (Barrett, 1994; Conrad, 1993)

Governments may have incentive to shift rents to firms via trade and environmental policies, accounting for tradeoffs between consumers, firms and climate

Which Industries?

Steel, aluminum, chemicals, paper and cement (Houser *et al*., 2009; Monjon and Quirion, 2010)

Carbon leakage already modeled in an oligopolistic setting for steel sector (Ritz, 2009) and cement sector (Ponssard and Walker, 2008)

Previous modeling by McCorriston and Sheldon (2005) treated environmental policy as exogenous in analyzing BTAs in oligopolistic setting

Adapt model of Conrad (1996) to examine extent to which BTAs can be targeted at competitiveness and carbon leakage issues in presence of carbon tax

Basic Model

Home firm facing foreign competitor in domestic market playing Nash game in output, profit functions being:

$$\pi^1(x^1, x^2; t, b) = r^1(x^1, x^2; t, b) - c^1[x^1, z^1(t)]$$

$$\pi^2(x^2, x^1; t, b) = r^2(x^2, x^1; t, b) - c^2[x^2, z^2] - b(x^2)$$

Home government moves first, pre-committing to emissions tax *t* and border tax adjustment *b*

Price of environmental services z^1 function of tax on unabated emissions and unit abatement costs, i.e., environment treated as an input

$$z^1(t) = ka^1e^1 + t(1 - a^1)e^1 \quad \text{where, } k(a^1)' > 0, \text{and, } k(a^1)'' > 0$$

Basic Model

Home firm minimizes unit costs of using environmental services such that in equilibrium marginal abatement costs equal emissions tax

Home and foreign goods treated as substitutes, given, Nash equilibrium characterized by first-order conditions:

$$\pi_1^1 = p + x^1 p' - c_1^1 = 0$$

$$\pi_2^2 = p + x^2 p' - c_2^2 = 0$$

where $\pi_{1,1}^1 < 0, \pi_{2,2}^2 < 0$, and $\pi_{1,2}^1 < 0, \pi_{2,1}^2 < 0$, implying,

$\Delta^{-1} = \pi_{1,1}^1 \pi_{2,2}^2 - \pi_{1,2}^1 \pi_{2,1}^2 > 0$, i.e., own-effects on marginal profit outweigh cross-effects

Basic Model

First-order conditions totally differentiated with respect x^i, t and b:

$$\begin{bmatrix} dx^1 \\ dx^2 \end{bmatrix} = \Delta^{-1} \begin{bmatrix} \pi^2_{2,2} & -\pi^1_{1,2} \\ -\pi^2_{2,1} & \pi^1_{1,1} \end{bmatrix} \begin{bmatrix} dt \\ db \end{bmatrix}$$

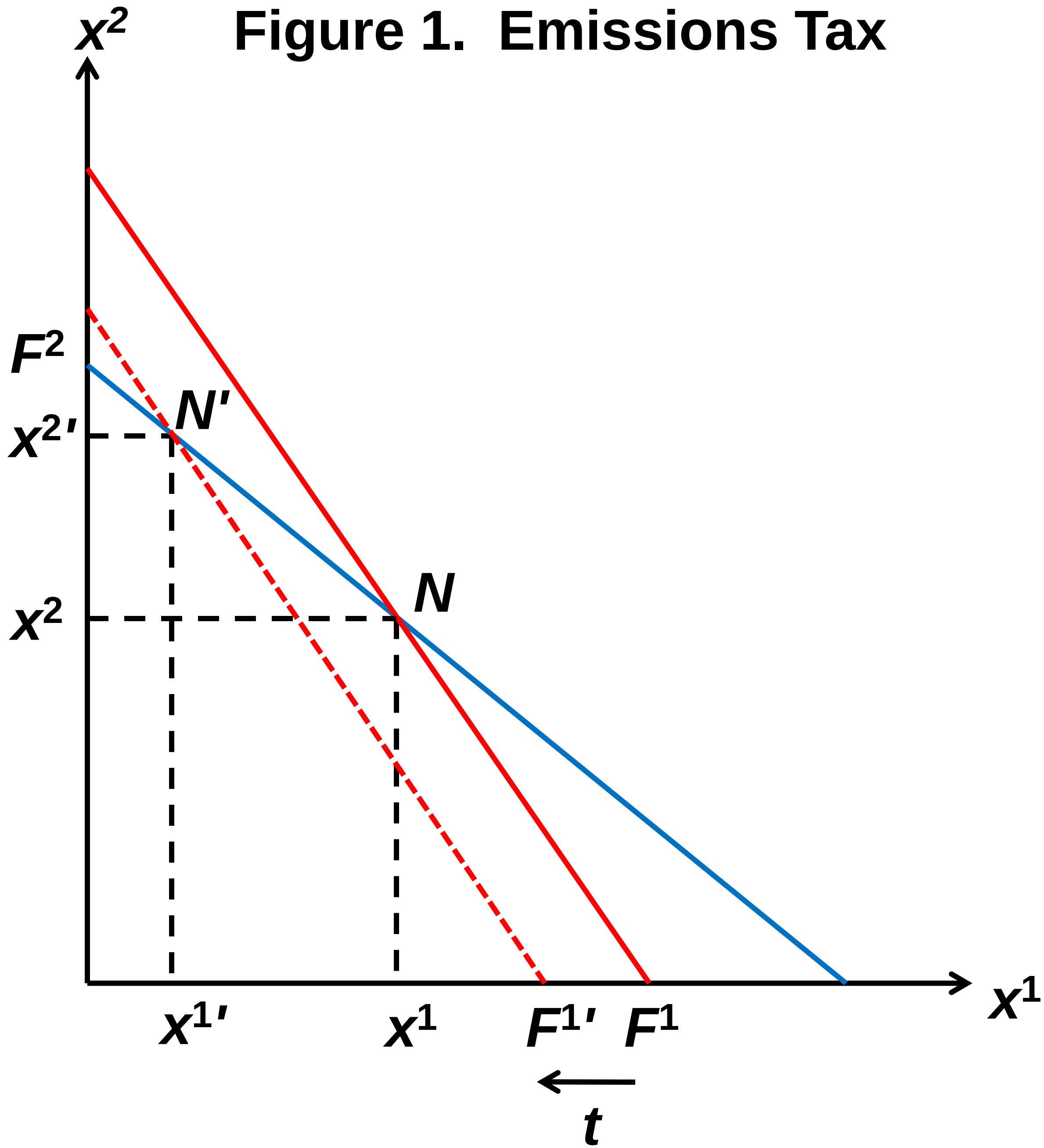
Comparative statics can be derived:

$$dx^1 / dt = \Delta^{-1} \pi^2_{2,2} < 0, dx^2 / dt = \Delta^{-1} - \pi^1_{1,2} > 0$$

$$d(x^1 + x^2) / dt = \Delta^{-1} (\pi^2_{2,2} + \pi^1_{1,2})$$

i.e., home (foreign) output declines (increases) with emissions tax, and total home output declines with emissions tax

Figure 1. Emissions Tax



Optimal Emissions Tax

Objective function of home government:

$$max_t w(t) = \int_0^X p(\xi)d\xi - p(X)X + \pi^1(x^1, x^2; t) + t(1-a^1)e^1v^1 - d(U^1)$$

where, $d(U^1) = (1-a^1)e^1v^1 + e^2v^2, d'(U^1) > 0 \text{ and } d''(U^2) > 0$
and v^i **is quantity of environmental services used**

Optimal emissions tax:

$$\hat{t} = md^1 \left\{ 1 + \frac{1}{md^1(1-a^1)e^1v_1^1(dx^1/dt)} \left[\frac{p}{\eta}\left(\frac{x^1}{X}\frac{dx^1}{dt} + \frac{x^2}{X} \times \frac{d(x^1+x^2)}{dt} \right) + md^1e^2v_2^2\frac{dx^2}{dt} \right] \right\}$$

Optimal Emissions Tax

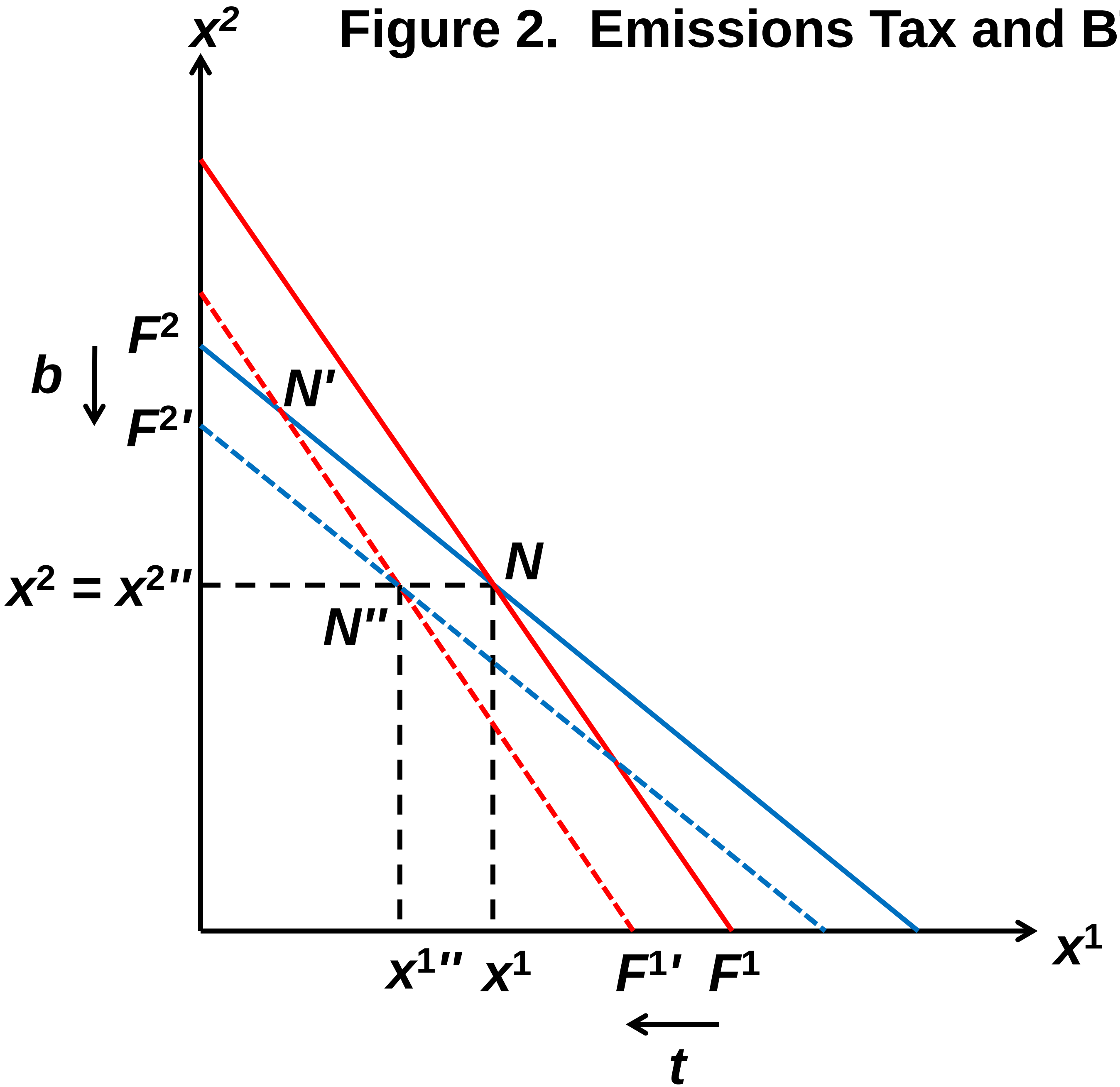
$t < md^1$ for three key reasons:

- deadweight loss effect
- competitiveness (rent-shifting) effect
- carbon leakage effect

Assume a *neutral* BTA can be used, where b keeps volume of imports constant given t (McCorriston and Sheldon, 2005):

$$\max_t w(t)\big|_b = \int_0^X p(\xi)d\xi - p(X)X + \pi^1(x^1, x^2; t, b) + t(1-a^1)e^1v^1 + bx^2 - d(U^1)$$

Figure 2. Emissions Tax and BTA



Conclusions

Optimal emissions tax higher in presence of BTA

Carbon leakage can be prevented with BTA, but competitiveness issue not fully resolved

Deadweight loss an issue in presence of emissions tax and BTA – key problem: only two policy instruments, but three market failures

Need to extend model to vertical market structure with an intermediate input (electricity) also subject to emissions tax