Competitiveness, Leakage and Efficiency Justifications for Differentiated Climate Policy Measures

Thomas F. Rutherford (ETH Zürich)

Christoph Böhringer (University of Oldenburg)

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Outline

1. Motivation

2. Canadian Context

3. A Numerical Model

4. Illustrative Results

Background

Issues

- Environmental taxes typically discriminate in favor of energy-intensive industries, including complete tax exemptions (OECD 2001).

- Tax differentiation contradicts conventional economic reasoning: cost-efficiency implies a uniform tax rate that equalizes marginal abatement costs.

Potential Reasons for Tax Differentiation

- Tax interaction
- Distributional incidence
- **Terms of trade**
- **Environmental effectiveness (leakage)**

Literature

- Terms-of-trade manipulation via environmental taxes: A country which is a net exporter of "dirty" goods will levy higher environmental taxes on these commodities as a substitute for an optimal export tax (Krutilla [1991], Anderson [1992], Rauscher [1994]).

- *Leakage* can be reduced by discriminating environmental taxes in favor of emission- and export-intensive industries (Hoel [1996], Böhringer and Rutherford [1998, 1999]. Border tax adjustments may serve as an equivalent instrument to offset leakage (Babiker and Rutherford [2005]).

Competitiveness and Structural Change

Competitiveness of a sector may be defined in terms of market share, productivity or profitability.

Emission taxes increase cost of production for emission-intensive industry. Environmental regulation may spur (desired) structural change towards less emission-intensive production and consumption.

Efficiency versus "Equity"

Pronounced structural change are often associated with costly strategies to compensate losers, e.g. tax exemptions of sectors (Böhringer and Rutherford [1997]) or updating allocation schemes (Böhringer and Lange [2005]).

Objective

Quantify the *policy relevance* of theoretical arguments for non-uniform taxation on the degree and pattern of tax differentiation.

Approach

Within the framework of an applied general equilibrium model calibrated to empirical data, we compute the optimal structure of environmental taxes. We use the model to explore how alternative assumptions regarding leakage and market power in international trade affect the optimal tax structure.

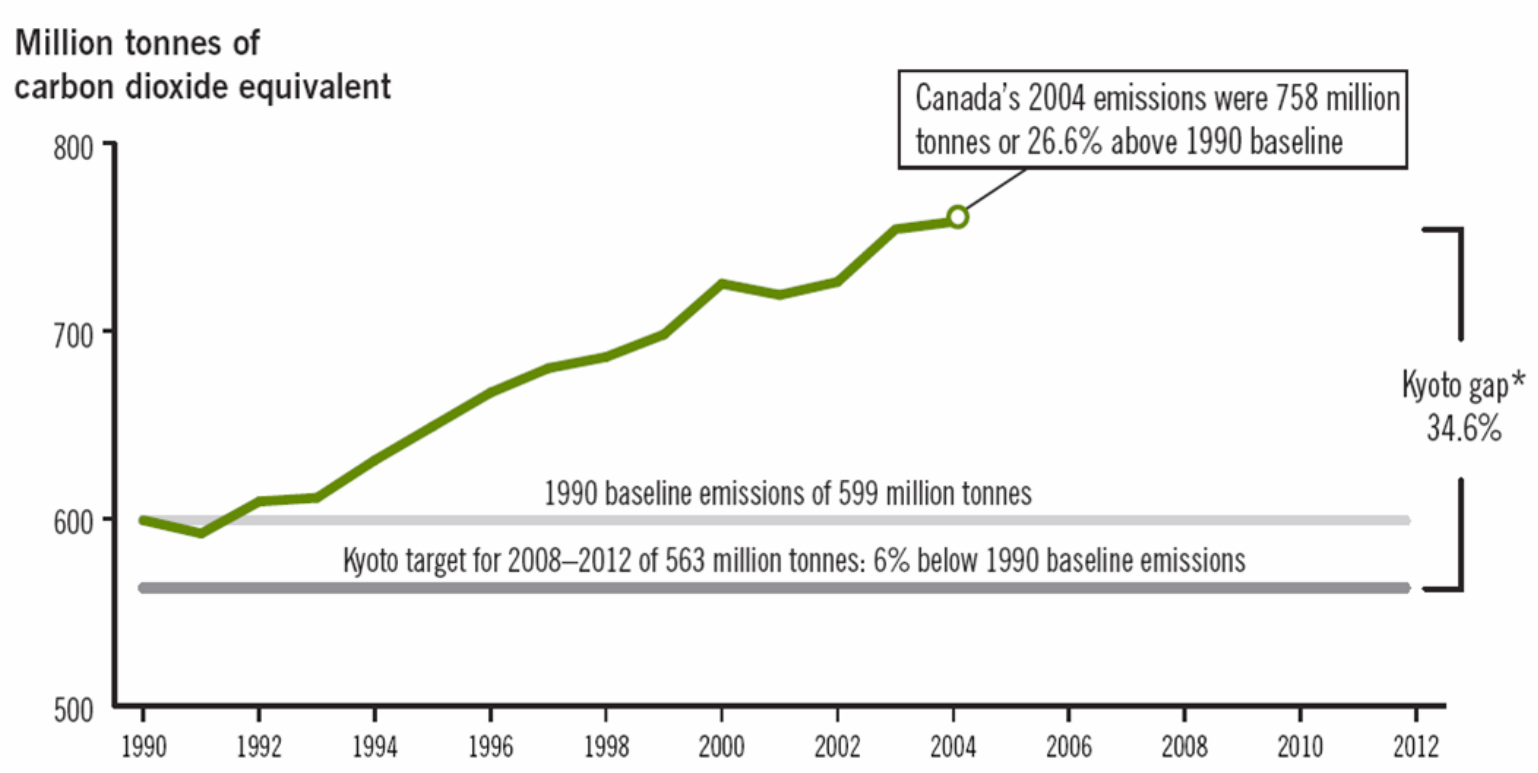
Results

Based on quantitative evidence for the EU, U.S., and Canadian economies, we find little economic rationale for commonly observed tax exemptions for energy-intensive manufacturing sectors.

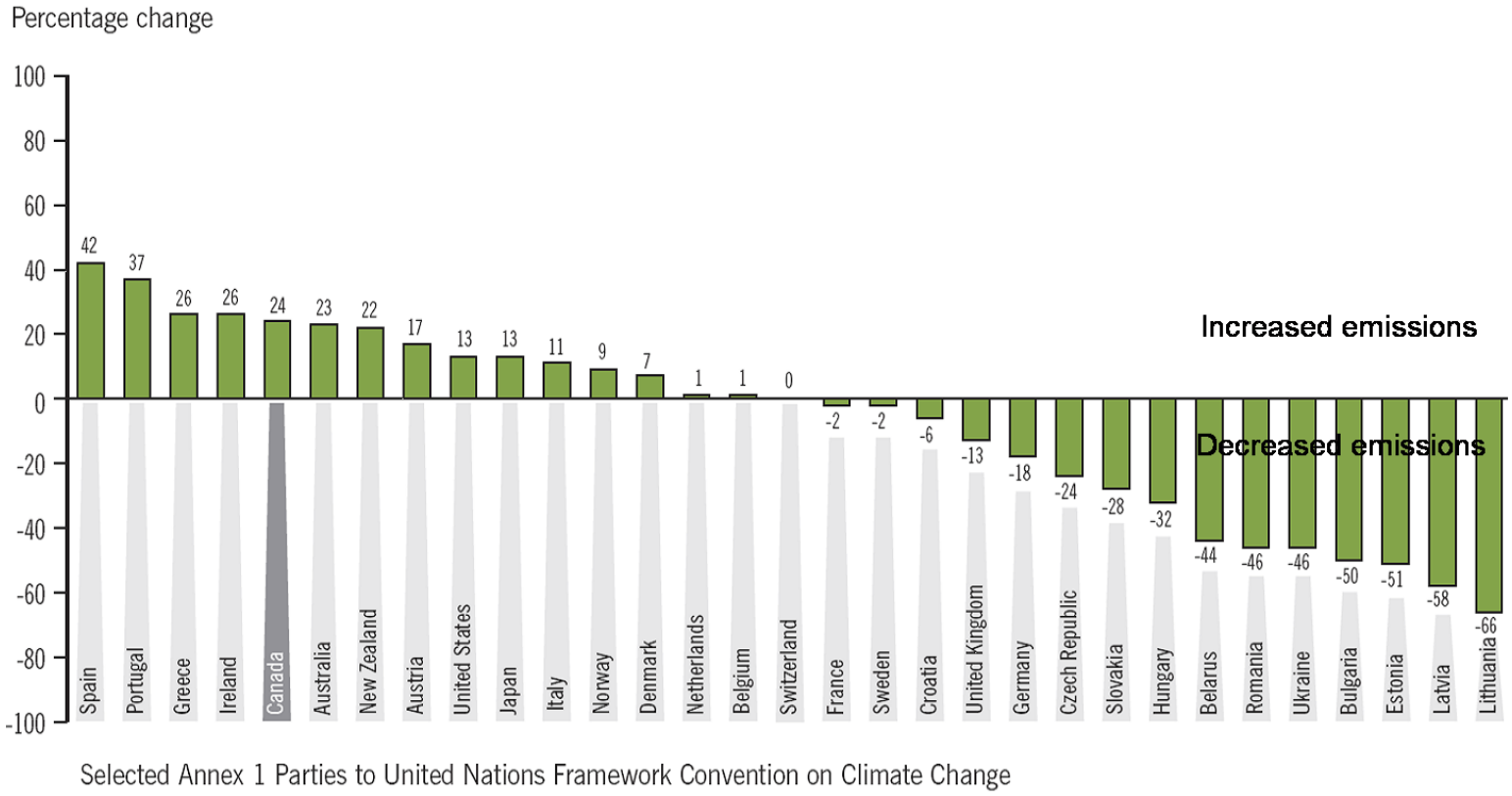
The Canadian Climate Policy Context

Report of the Commissioner of the Environment and Sustainable Development to the House of Companions (2006)

Canada is not on track . . .



. . . , but Canada is not alone



Selected Annex 1 Parties to United Nations Framework Convention on Climate Change

Modeling Framework

$$\max_{t} \; H(z) \quad \text{s.t.} \quad F(z;t) = 0$$

$z \in R^n$ is a vector of endogenous variables that is determined by the equilibrium problem, i.e. $z = \{p, y\}$, where p are prices and y are activity levels,

$t \in R^m$ is a vector of policy instruments (e.g., permit allocations)

$F : R^n \rightarrow R^n$ is a system of equations representing the general equilibrium conditions

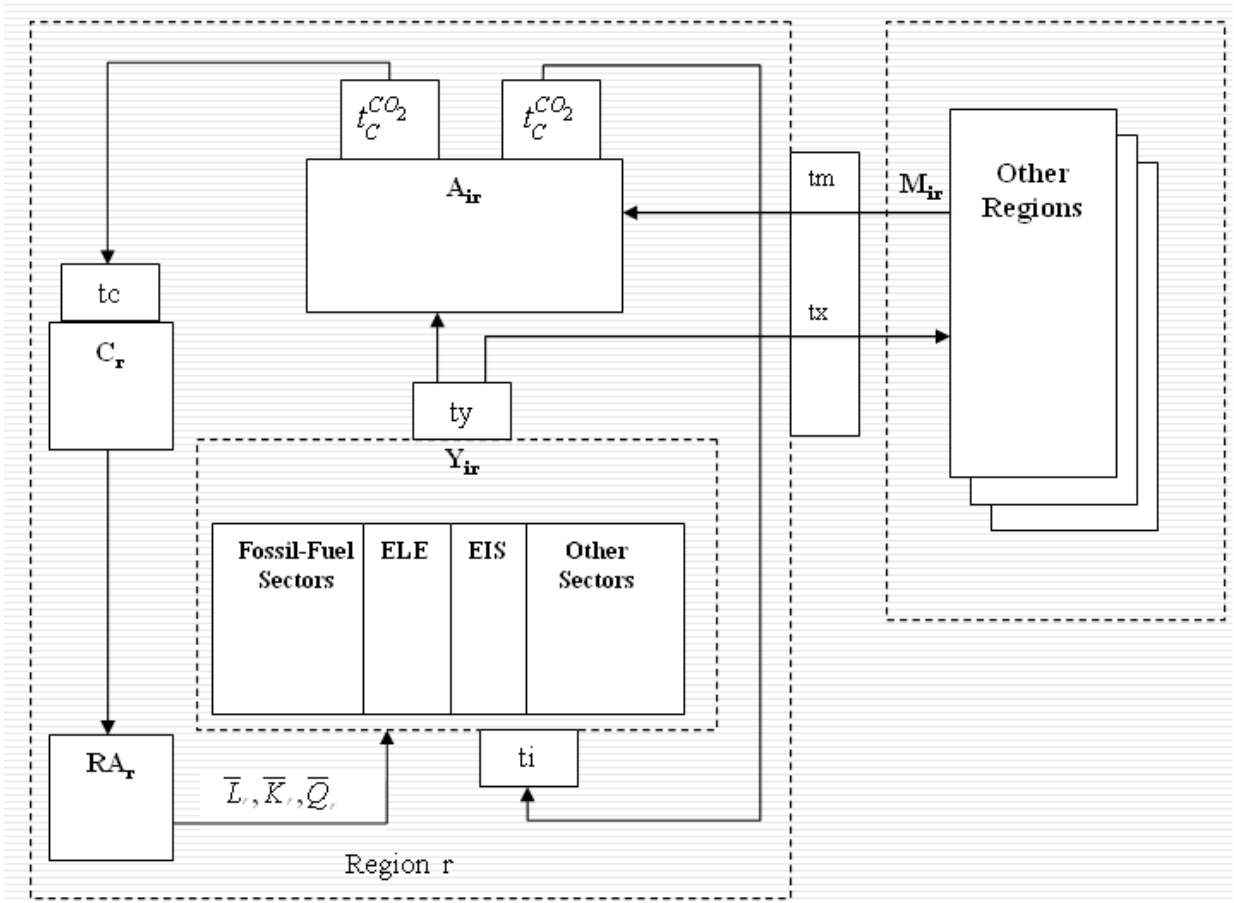
$H(z)$ is the policy objective.

Concrete Implementation

t represents a vector of *carbon taxes* which may be differentiated across four segments of the economy:

- `EIS` energy-intensive production
- `ELE` electricity
- `Other` other goods and services
- `Final` final consumption demand

Diagrammatic Overview of Model Structure



Sectors

Coal (`col`)

Crude (`cru`)

Natural gas (`gas`)

Refined oil products (`oil`)

Electricity (`ele`)

Energy-intensive sectors (`eis`)

Other goods and services (`roi`)

Regions

Canada

Europe (EU15, EFTA)

Japan

United States

Former Soviet Union and Eastern Europe

Australia and New Zealand

Asia

Mexico and OPEC

Rest of World

Factors

Labor

Capital

Fossil fuel resources (oil, gas, coal)

Decomposition of Factors Underlying Differentiated Taxes

L domestic emission target is adjusted endogenously to compensate for net emission increase in other (non-abating) regions

T compensating transfers which assure no adverse effects on trading partners (BaU welfare level)

Constrained Policy Choice

$$\max_{t_{\hat{r}}} \; U_{\hat{r}}$$

s.t.

Economic consistency:

$$F(z, U; t) = 0$$

Leakage-compensated emissions target (L):

$$\sum_{r} e_r(z) = \bar{E} - 0.2\bar{e}_{\hat{r}}$$

Terms of trade compensating (T):

$$U_{r'} \geq \bar{U}_{r'} \qquad \perp \mathcal{T}_{\hat{r},r'}$$

Approach

- Assess results for US, EU and Canada.

- Maximize regional welfare subject to a 20% abatement in in regional carbon emissions.

- Consider four scenarios:

  Ref Reference abatement scenario in which domestic tax instruments neglects leakage and exploits terms of trade.

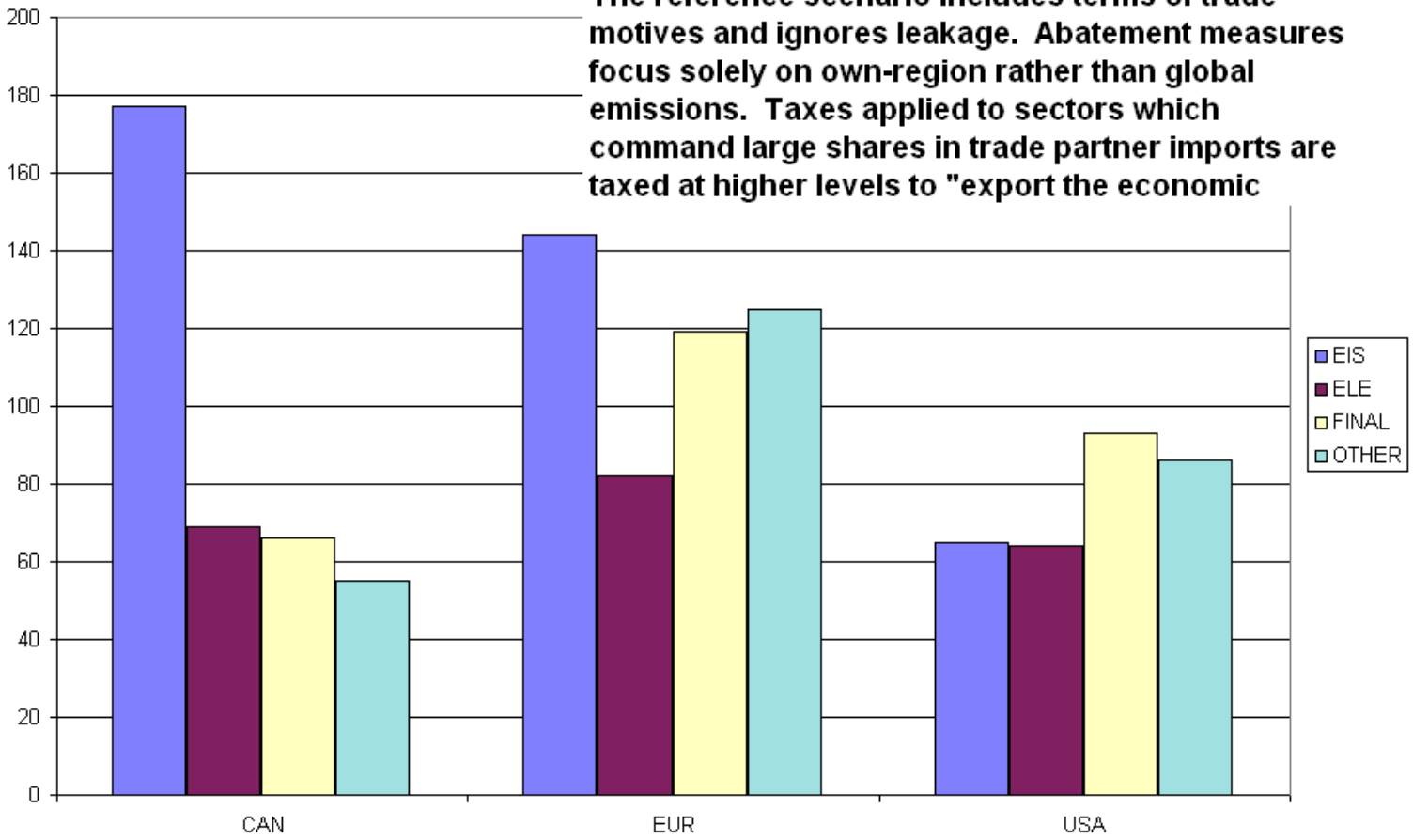
  L Includes a "leakage adjustment" in which domestic emissions are targeted to a level which accounts for induced increases in emissions by other regions

  T Includes a "terms of trade adjustement" in which compensating transfers removes economic motivation for exploiting terms of trade.

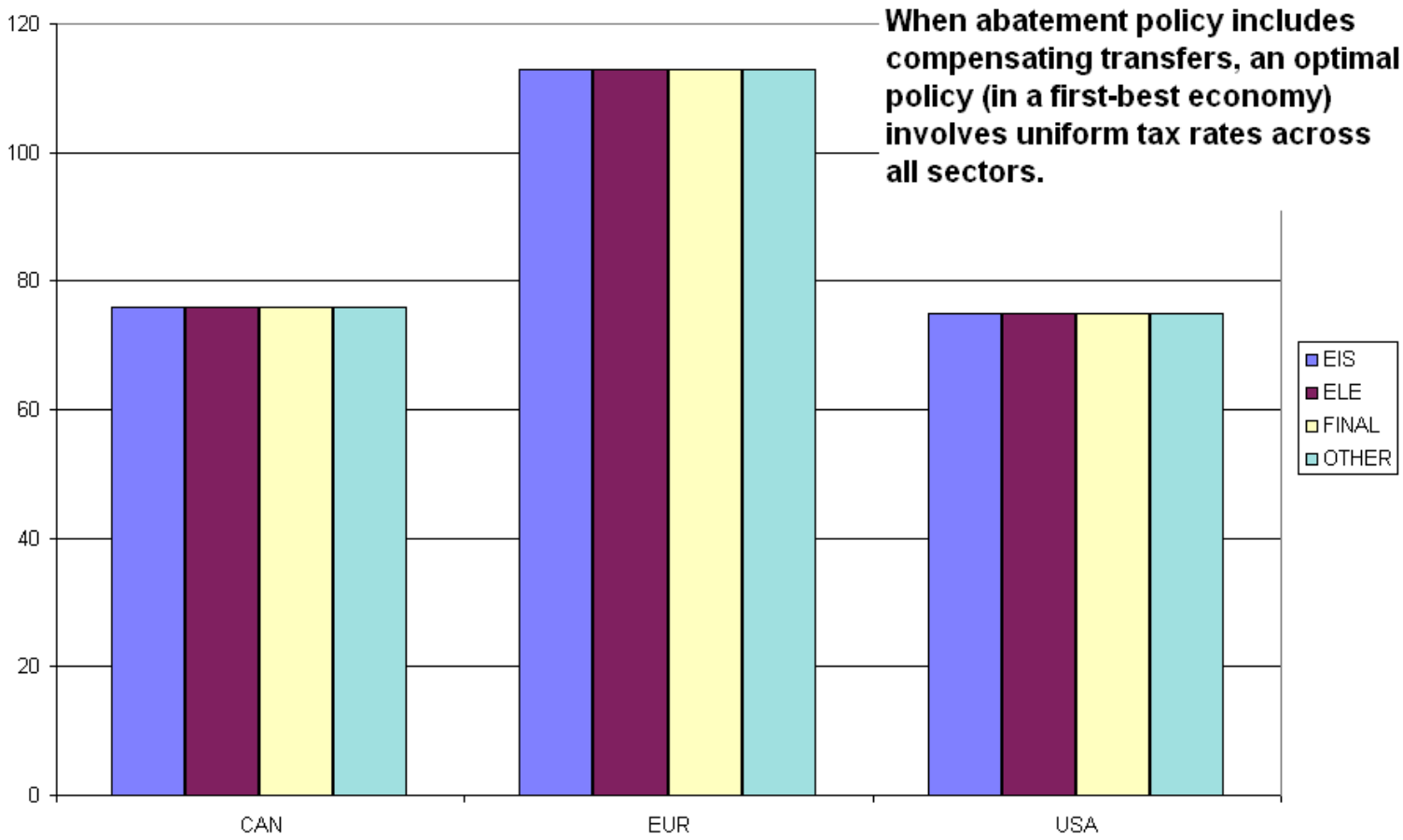
  L,T Includes both leakage and terms of trade adjustment constraints.

"Optimal" Tax Differentiation

The reference scenario includes terms of trade motives and ignores leakage. Abatement measures focus solely on own-region rather than global emissions. Taxes applied to sectors which command large shares in trade partner imports are taxed at higher levels to "export the economic

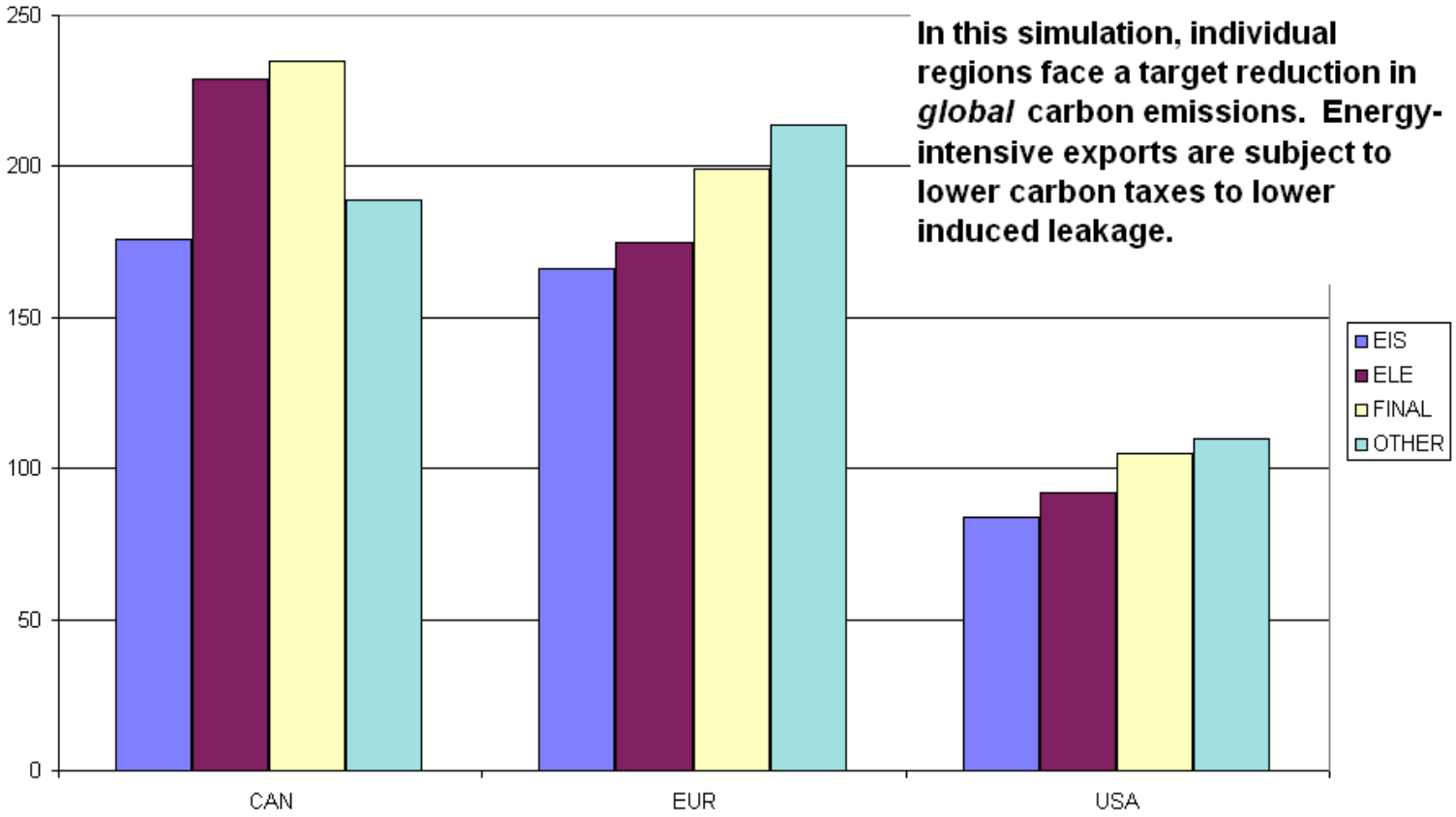


Uniformity is Optimal when Terms of Trade Motive is Suppressed



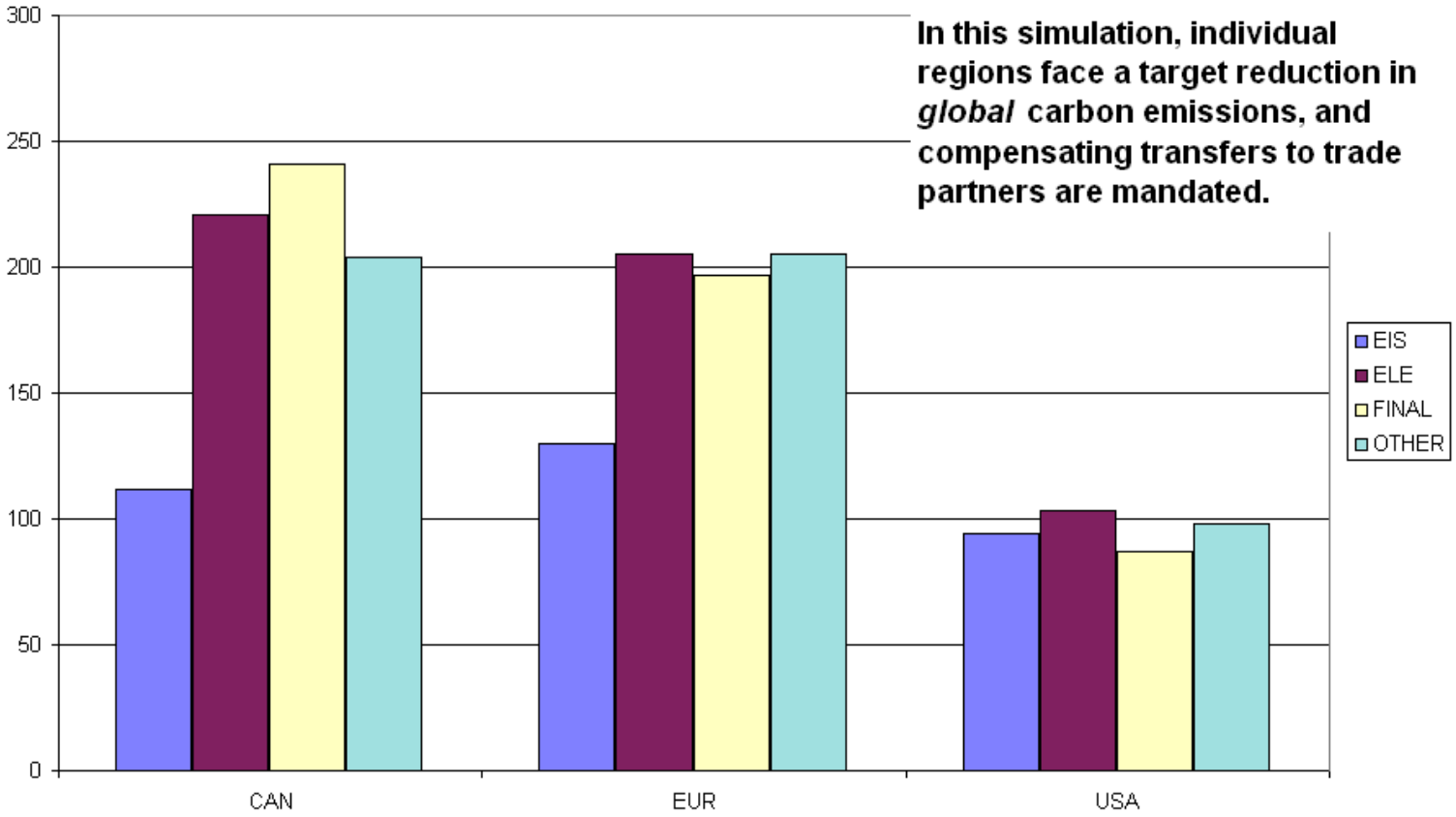
When abatement policy includes compensating transfers, an optimal policy (in a first-best economy) involves uniform tax rates across all sectors.

Energy Intensive Goods Face Lower Taxes in a Leakage-Compensated Policy



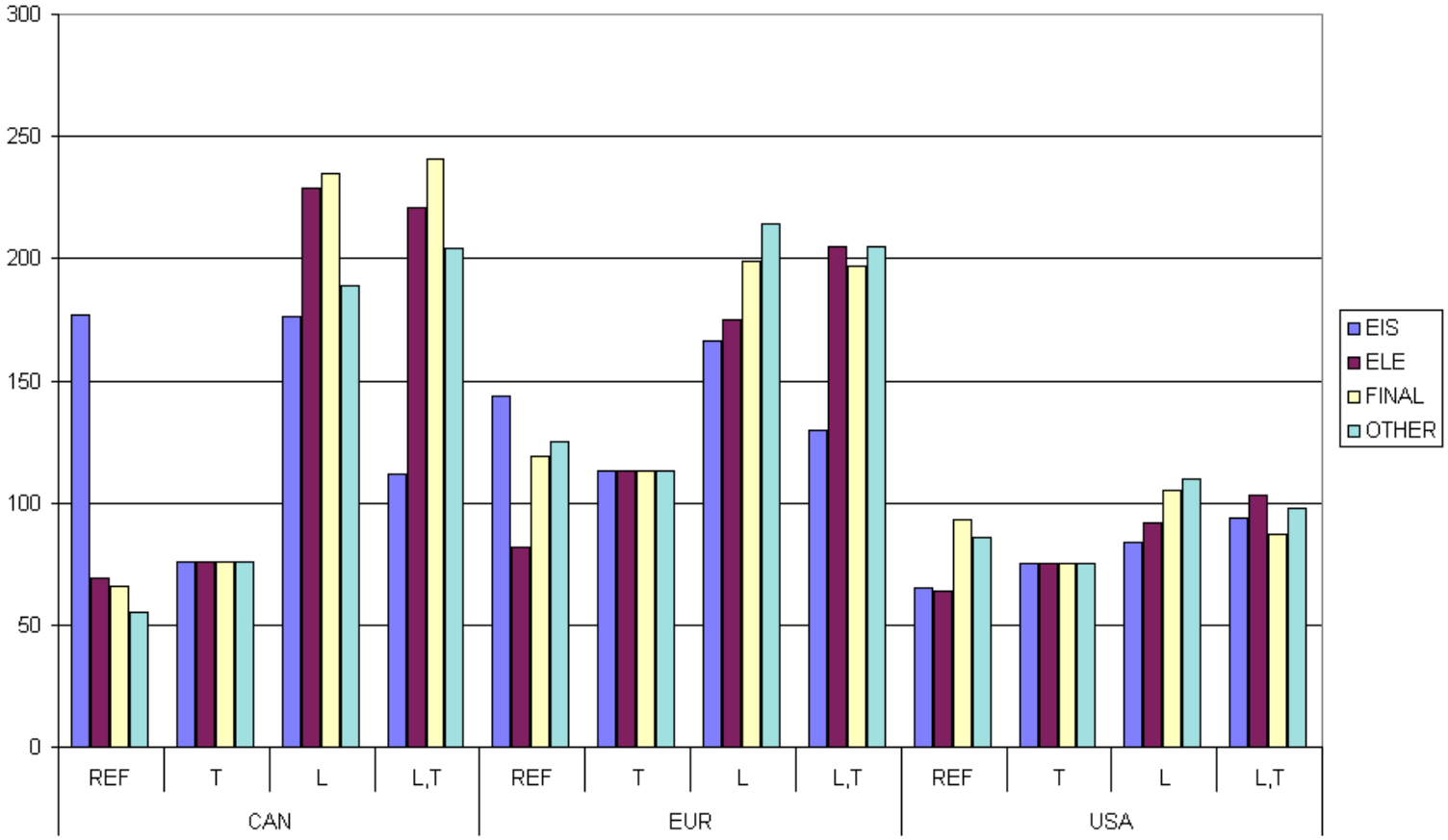
In this simulation, individual regions face a target reduction in *global* carbon emissions. Energy-intensive exports are subject to lower carbon taxes to lower induced leakage.

Tax Rate Differentiation is Less Pronounced with Both Leakage and Beggar thy Neighbor Motives are Suppressed

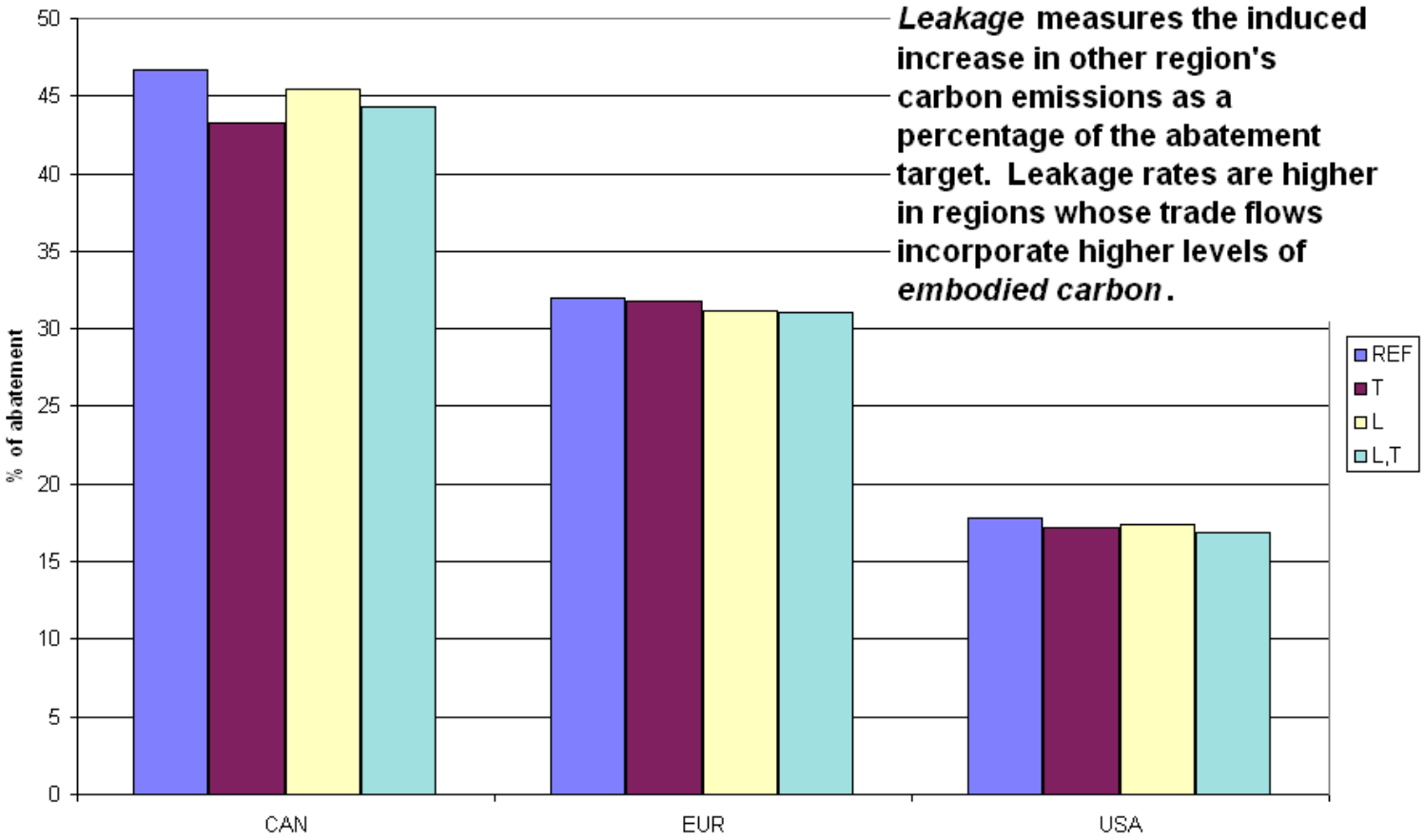


In this simulation, individual regions face a target reduction in *global* carbon emissions, and compensating transfers to trade partners are mandated.

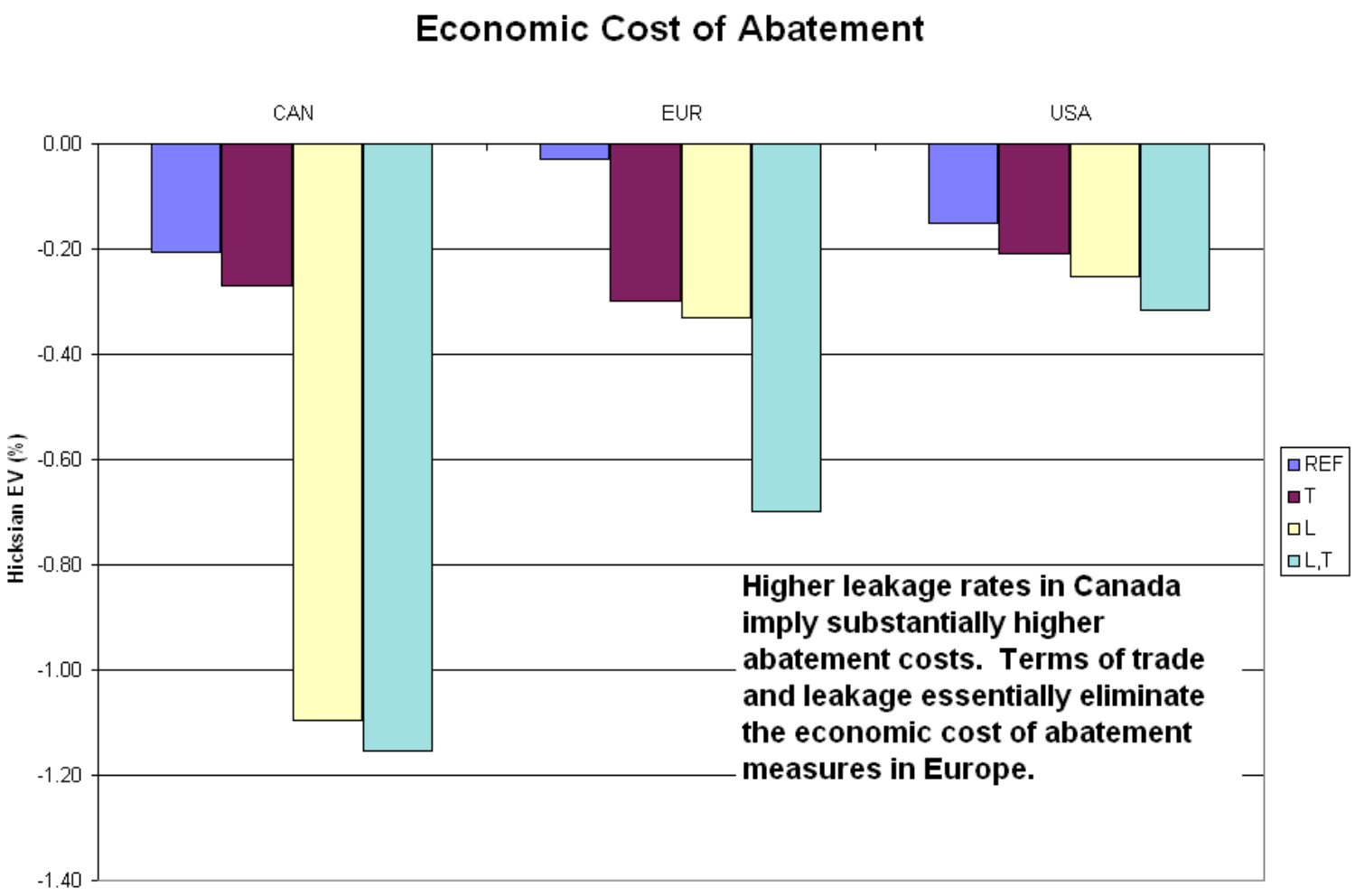
Comparison of Tax Rates Across Scenarios



Leakage Rates



Leakage **measures the induced increase in other region's carbon emissions as a percentage of the abatement target. Leakage rates are higher in regions whose trade flows incorporate higher levels of *embodied carbon*.**


Economic Cost of Abatement
CAN
EUR
USA
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
-1.20
-1.40
Hicksian EV (%)
REF
T
L
L,T
Higher leakage rates in Canada imply substantially higher abatement costs. Terms of trade and leakage essentially eliminate the economic cost of abatement measures in Europe.

Conclusions

Theoretical arguments for environmental tax discrimination in favor of energy-intensive industries fail when tested in a calibrated model:

- Concerns about global environmental effectiveness provide only limited basis for tax discrimination in favor of energy- and export-intensive industries.

- Strategic burden shifting does not support lower taxes for energy-intensive industries (or even exemptions).