

# ENERGY EMBODIED IN INTERNATIONAL TRADE: THE CASE OF BRAZIL

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BRAZIL

## INTRODUCTION

- ◆ The debate on the trade-environment relationships is not new
- ◆ It is complex and embraces various aspects/issues:
  - ◆ Industrial pollution control, competitiveness and ecological dumping
  - ◆ Environmental protection, international technical barriers and neo-protectionism
  - ◆ Sustainable development and the international order
  - ◆ Free riding, “leakage” and multilateral environmental agreements enforcement
- ◆ Trade-environment debates reached top priority on the international agenda in the 70’s due to the natural resources scarcity perspectives and industrial pollution control effects on international trade
- ◆ It has been revitalized in the 90’s by global environmental concerns
- ◆ There are evidences that international trade might be an important source of “carbon leakage” from non-Annex I countries to Annex I countries
- ◆ The globalization process in course makes this debate even more relevant
- ◆ This debate is going beyond the technical and official frontier, and it is reaching the common citizens (Seattle on November, 99 WTO meeting)
- ◆ The confluence of scientific, economic, social and political pressures will certainly force the international community to have a broad and deep debate about this issue “sooner rather than later”

## OVERVIEW OF THIS WORK

- ◆ The objective is to assess the impacts of foreign commerce on energy use and CO<sub>2</sub> emissions of Brazil for policy purposes

- ◆ A commodity-by-industry IO model in hybrid units is applied to the Brazilian economy for the year 1995
- ◆ Total energy and carbon intensity coefficients are derived and applied to the exports and imports vectors of Brazil to appraise the energy and carbon embodied in the non-energy foreign commerce of the country
- ◆ Effects of recent trade liberalization practices on the patterns of energy use and CO<sub>2</sub> emissions of Brazil are discussed

#### **METHODOLOGY, ASSUMPTIONS AND DATA PREPARATION**

- ◆ The fundamental principle for assessing total energy and carbon emission embodied in the foreign commerce is to multiply total energy and carbon intensity coefficients by foreign commerce vectors
- ◆ First task: to estimate total energy and carbon intensity coefficients from the IO tables
- ◆ A commodity-by-industry IO model in hybrid units is applied to the 1995 IO tables
  - ◆ Hybrid units: energy commodities are expressed in physical units, while non-energy commodities are expressed in monetary units
  - ◆ Basic idea behind a hybrid model is to substitute energy rows expressed in physical units for energy rows valued in monetary terms in the IO tables, and then to recalculate the Leontief inverse matrix

#### **FINDINGS**

**Table 1 Total Energy and Carbon Intensity Coefficients of Non-Energy Goods of Brazil in 1995**

Code	Commodity	<i>Energy</i> (MJ/US\$-95)	<i>Carbon</i> (g C/US\$-95)
7	Agriculture and Livestock	8.36	131.44
8	Mining and Quarrying (except Fuels)	21.38	304.72
9	Non-Metallic Mineral Products	27.51	518.06
10	Iron and Steel	60.97	1328.16
11	Non-Ferrous Metals and Other Metallurgical Products	23.81	391.58
12	Pulp and Paper	28.12	449.24
13	Chemical	34.34	424.24
14	Foods and Beverages	13.27	145.66
15	Textiles	7.73	93.35
16	Other Products	8.35	128.59

Sources: Monetary flows based on IBGE (1999), energy flows based on MME (2000), conversion factors from energy to carbon based on IPCC (1996) and Schechtman *et al.* (1999)

**Table 2. Exports and Imports of Non-Energy Goods by the Brazilian Economy in 1995**

Code	Commodity	Exports		Imports		Net Balance
		Millions of US\$-95	(%)	Millions of US\$-95	(%)	Millions of US\$-95
7	Agriculture and Livestock	776	1.8	2,454	5.0	-1,679
8	Mining and Quarrying (except Fuels)	2,578	6.0	538	1.1	2,040
9	Non-Metallic Mineral Products	540	1.3	447	0.9	94
10	Iron and Steel	4,025	9.4	640	1.3	3,386
11	Non-Ferrous and Other Metallurgical Products	3,062	7.1	1,863	3.8	1,198
12	Pulp and Paper	2,401	5.6	697	1.4	1,704
13	Chemical	2,688	6.3	6,253	12.7	-3,564
14	Foods and Beverages	10,852	25.3	3,196	6.5	7,655
15	Textiles	1,311	3.1	2,349	4.8	-1,037
16	Other Products	14,670	34.2	30,678	62.5	-16,008
	Total	42,903	100.0	49,115	100.0	-6,212

Source: Based on IBGE (1999)

**Table 3. Energy and Carbon embodied in the Exports and Imports of Non-energy Goods in 1995**

Code	Commodity	Energy Embodied (PJ)			Carbon Embodied (ktC)		
		Exports	Imports	Net	Exports	Imports	Net
7	Agriculture and Livestock	6.5	20.5	-14.0	101.9	322.6	-220.6
8	Mining and Quarrying (except Fuels)	55.1	11.5	43.6	785.6	164.0	621.6
9	Non-Metallic Mineral Products	14.9	12.3	2.6	279.9	231.4	48.4
10	Iron and Steel	245.4	39.0	206.4	5,346.4	849.9	4,496.5
11	Non-Ferrous and Other Metallurgical Products	72.9	44.4	28.5	1,198.9	729.7	469.2
12	Pulp and Paper	67.5	19.6	47.9	1,078.8	313.1	765.6
13	Chemical	92.3	214.7	-122.4	1,140.5	2,652.7	-1,512.2
14	Foods and Beverages	144.0	42.4	101.6	1,580.6	465.6	1,115.0
15	Textiles	10.1	18.2	-8.0	122.4	219.2	-96.8
16	Other Products	122.6	256.3	-133.7	1,886.4	3,944.9	-2,058.5
	Total Non-Energy Goods	831.3	678.9	152.5	13,521.4	9,893.1	3,628.3

Sources: Monetary flows based on IBGE (1999), energy flows based on MME (2000), conversion factors from energy to carbon based on IPCC (1996) and Schlechtman et al. (1999)

**Table 4. International Terms of Trade on Energy and Carbon for Non-Energy Goods in 1995**

Average energy-intensity of exports of non-energy goods ( $e^X$ )	19.4 MJ/US\$-95
Average energy-intensity of imports of non-energy goods ( $e^M$ )	13.8 MJ/US\$-95
International terms of trade on energy for non-energy goods ( $e^X/e^M$ )	1.40
Average carbon-intensity of exports of non-energy goods ( $c^X$ )	315 gC/US\$-95
Average carbon-intensity of imports of non-energy goods ( $c^M$ )	201 gC/US\$-95
International terms of trade on carbon for non-energy goods ( $c^X/c^M$ )	1.56

Sources: Monetary flows based on IBGE (1999), energy flows based on MME (2000), conversion factors from energy to carbon based on IPCC (1996) and Schechtman et al. (1999)

## **CONCLUSIONS AND POLICY IMPLICATIONS**

- ◆ The average energy and carbon intensity coefficients of the Brazilian exports are higher than the average intensity coefficients of imports.
- ◆ Although Brazil faced a trade deficit in 1995, it registered positive net balances for both energy and carbon embodied in non-energy products traded.
- ◆ Currently, Government aims at reducing the country's vulnerability on the Balance of Payments by paying the huge current accounts deficits (US\$ 35 bn in 1998 and US\$ 24 bn in 1999 and 2000) with huge trade accounts surpluses.
- ◆ Net balance on energy and carbon embodied in the non-energy trade accounts are likely to increase, unless Brazil implements aggressive energy efficiency measures, or policy measures to shift the country's current commodity mix away from energy and carbon intensive goods.
- ◆ As a consequence, particular arrangements seem to be needed to harmonize trade and environmental policies' aims: freer trade alone does not seem to be good enough.