Ecological Pricing analyses of the Kyoto Protocol mechanisms

suggesting ways to improve policies
to deal with climate change

Abstract

- Shift greenhouse gases (GHG) generated activities
- Analyse the impact of GHG generation from 1995 to 2009 associated to value chains.
- Methodology of the subsystems or vertically integrated sectors
- Analysis of the Kyoto Protocol market-based mechanisms considering GVCs and the role of international trade in the evolution of GHG generation
- Evaluating the Kyoto Protocol market-based mechanisms

Introduction

- Human economy is embedded in nature (open system inside closed system)
- Each generation would have the right to enjoy the services from natural assets
- Flow of primary commodities from poorer to wealthy countries (developed countries import biocapacity from developing countries)
- ‘comparative advantage’ leads to ‘race to bottom’
  - fewer incentives to reduce total material throughput in developed countries
  - globalized world: growing demand for resources is being satisfied through international trade

Introduction

- Global value chains (GVCs) as a special case of vertically integrated production
- Concept of subsystems or vertically integrated sectors to:
  - calculate the ecological pricing of generation of GHGs.
  - analyse the impact of GHG generation from 1995 to 2009
- World Input-Output Database (WIOD): 41 regions x 35 industries, as well as satellite accounts

Climate Change

- 1972 - United Nations Conference on the Human Environment, held in Stockholm
  - the creation of the United Nations Environment Program (UNEP)
- 1983 - World Commission on Environment and Development was established
  - 1987 - Our Common Future, known as the Brundtland Report, was lauched

Climate Change

- 1998 - Intergovernmental Panel on Climate Change (IPCC)
- 1992 - United Nations Framework Convention on Climate Change (UNFCCC)
- 1997/2002 – Kyoto Protocol
  - Clean Development Mechanism (CDM)

Critical analysis of the Kyoto Protocol market-based mechanisms

- ecologically unequal exchange
  - consumption/environmental degradation paradox'
- reduced GHG emissions are global public goods
  - Free trade exacerbates global warming because
  - international agreements on reducing emissions, like Kyoto Protocol
- Creating the international climate regime
  - market could provide a mechanism for mitigating climate change

Critical analysis of the Kyoto Protocol market-based mechanisms

- There are three main criticisms to Kyoto protocol:
  - Production-based X consumption-based approach
  - International market prices X flow of biophysical resources
  - Direct flows X indirect and embedded flows
- subsystems or vertically integrated sectors
  - estimate the amount of GHG directly and indirectly necessary to the economic system as a whole to obtain a physical unit of commodity

Methodology

- World Input-Output Database (WIOD): 41 regions x 35 industries, as well as satellite accounts, from 1995 to 2009
- Subsystems or vertically integrated sectors to estimate the amount of GHG directly and indirectly necessary to the economic system as a whole to obtain a physical unit of commodity

Methodology

- **R** is the proportion of the activity of each branch that comes under the various subsystems

$$R = \hat{x}^{-1}(I - A)^{-1}\hat{y}$$

- Where:
  - **x^** is the diagonalized vector of gross output
  - **A** is the matrix of domestic input-output coefficients and
  - **y^** is the diagonalized vector of final demand.

Methodology

- **G** is the amount of gases generated, directly and indirectly of each sector that comes under the various subsystems

$$G = \hat{g}R$$

- Where:
  - **g^** is the diagonalized GEE vector generated by sector

Table 1 - Carbon dioxide emissions by countries from 1995 to 2009

- USA, Japan, Russia and European Union present stable emissions.

Countries	Sector		D%	Subsystem		Δ%	Sector/Subsystem	
	1995	2009	1995/2009	1995	2009	1995/2009	1995	2009
CHN	2.513,1	5.836,2	6,20%	2.723,1	6.213,4	6,07%	0,92	0,94
RoW	3.382,1	4.632,5	2,27%	3.377,2	4.641,0	2,30%	1,00	1,00
USA	4.423,9	4.473,3	0,08%	4.342,2	4.187,7	-0,26%	1,02	1,07
JPN	1.196,8	1.045,6	-0,96%	1.024,3	953,7	-0,51%	1,17	1,10
IND	685,4	1.515,1	5,83%	720,8	1.501,8	5,38%	0,95	1,01
RUS	1.046,6	997,4	-0,34%	1.412,3	1.410,5	-0,01%	0,74	0,71
EU	3.736,1	3.652,8	-0,16%	3.380,6	3.161,9	-0,48%	1,11	1,16
BRA	191,4	278,3	2,71%	175,0	251,3	2,62%	1,09	1,11
Other	1.771,2	2.438,8	2,31%	1.791,0	2.548,7	2,55%	0,99	0,96
Total	18.946,6	24.870,0	1,96%	18.946,5	24.870,0	1,96%	1,00	1,00

- consumer-oriented CO2 generation: Russia and China
- production-oriented CO2 generation: European Union, Brazil, and Japan

Table 2 – Growth rate of composition of CO2 (carbon dioxide) emissions from 1995 to 2009

- China's sectors had the largest growth rate of CO2 generation among all aggregations' subsystems, except by China's subsystem where India's sectors had the largest growth rate.

	CHN	RoW	USA	JPN	IND	RUS	EU	BRA	Other	Total Sector
CHN	5,9%	14,3%	9,6%	11,9%	17,8%	9,6%	10,0%	23,7%	12,2%	6,2%
RoW	8,2%	1,8%	-1,0%	2,0%	5,1%	8,1%	2,7%	5,4%	5,8%	2,3%
USA	8,2%	3,0%	-0,2%	-0,4%	4,0%	0,6%	-0,5%	3,9%	1,1%	0,1%
JPN	2,0%	0,7%	-5,3%	-1,0%	-6,5%	-2,7%	-4,0%	-1,9%	-1,3%	-1,0%
IND	16,6%	11,9%	7,0%	5,0%	5,5%	2,0%	2,9%	12,1%	11,3%	5,8%
RUS	13,4%	1,0%	0,0%	8,4%	0,6%	-0,4%	0,0%	1,8%	5,1%	-0,3%
EU	7,2%	3,3%	-0,6%	2,2%	4,3%	-1,8%	-0,7%	3,6%	3,8%	-0,2%
BRA	12,6%	4,1%	0,7%	5,2%	9,7%	7,5%	2,1%	2,2%	3,7%	2,7%
Other	7,8%	3,9%	-0,7%	2,3%	7,9%	-1,6%	0,2%	4,2%	2,2%	2,3%
Total Subsystem	6,1%	2,3%	-0,3%	-0,5%	5,4%	0,0%	-0,5%	2,6%	2,6%	2,0%

- China's subsystem had the largest growth rate of CO2 generation among all aggregations' sectors, except by China's sectors - where Brazil's subsystem had the largest growth rate, and Other's sectors, where India's and China's subsystem had approximately the same growth rate

Conclusions (provisional)

- China become the greatest GHG generator and have the greatest growth rate of GHG generation, followed by India. Developed countries have GHG generation reduced or stable.
- China has the growth rate of increasing GHG generation from worldwide, followed by India (except of Russia and European Union).
- Brazil's GHG generation grew faster than world average GHG growth rate. Production-orientation of Brazilian GHG generation contrasts with Chinese and Indian orientation.

Conclusions (provisional)

- Russia's GHG generation grew slower than world average GHG growth rate. Consumption-orientation of Russian GHG generation was the greatest one and became larger.
- Next steps:
  - Sector and subsystem analysis
  - Bilateral relationship between countries

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