Energy Policy 39 (2011) 7036–7048

Contents lists available at SciVerse ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Prioritizing towards a green export portfolio for India: An environmental input–output approach

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ARTICLE INFO

Article history:
Received 11 October 2010
Accepted 4 August 2011
Available online 16 September 2011

Keywords:
Green export portfolio
Emission intensity
Embodied emissions

ABSTRACT

Proponents of free trade have often hailed international trade as an engine of economic growth. However, the foreign trade sector, like many other sectors in developing countries, frequently involves these countries walking a tightrope between their developmental objectives and environmental goals. In this regard, prioritizing for developing a 'green' yet internationally competitive export portfolio provides a quintessential win–win solution to the problem. This study factors in both environmental benignity (indicated by total CO_2 emission intensity) as well as trade competitiveness (indicated by revealed comparative advantage index) in identifying the 'ideal' Indian export portfolio. The analysis calculates the level of direct and indirect emissions from the foreign trade sector (exports and imports) using the environmental input–output (EIO) matrix for 2003/04 for India that has been jointly developed by researchers from Keio University, Japan, and The Energy and Resources Institute (TERI), New Delhi. The derived basket is compared to the current portfolio to estimate the potential saving from compositional changes and to suggest directions for policymaking to emphasize or de-emphasize the export of certain categories of exports.

1. Introduction

In a scenario where global efforts are being made for reducing carbon emissions through various routes (e.g. energy efficiency, afforestation, etc.), heightened interest in greening of trade flows is not surprising. Traditionally, the export sector in developing countries has been extolled for its foreign exchange garnering abilities, economies of scale and specialization achievements as well as its transmission potential for global skills, knowledge and technology.

There is an important school of thought that highlights not just 'quantum' but also 'quality' of exports. Proponents advocate the benefits of diversification and changing the composition to achieve a 'superior' export mix such that economic growth can be achieved faster (Cuaresma and Wörz, 2005). However, the following paper modifies these assertion criteria of superiority of an export basket based not just on comparative advantage, but on global environmental considerations as well.

Studies use different tools to investigate the role of developed and developing countries' trade flows vis-à-vis their contribution to global carbon emissions. These papers see the energy and emission intensity of trade flows of that country and analyze the compositional effects of the trade basket. Input–Output (IO) analysis has emerged as a popular tool towards this end as it looks at both the direct and indirect (embodied) emission intensities of commodity exports and imports. However, despite the wide range of papers looking at trade flows using IO, these stop short of incorporating the development objectives of developing countries.

This paper looks at the magnitude of emissions resulting from trade flows for India using the environmental input–output (EIO) matrix for 2003/04. The Indian environmental input–output (EIO) matrix for 2003/04 has been jointly developed by researchers from Keio University, Japan, and The Energy and Resources Institute (TERI), New Delhi. The contribution as revealed by the embodied emission intensities of commodities exported and imported has been studied in depth.

National statistics show that in 2003/04 India exported goods and services worth approximately USD 64 billion, which accounted for about 11% of the gross domestic product (GDP) of India (GoI, 2004). Therefore, recognizing the fact that from a developing country perspective like India, environment would constitute only one among many criteria that would dictate the composition of the Indian exports, a revealed comparative advantage (RCA) approach is also used to study the composition of trade

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doi:10.1016/j.enpol.2011.08.008

(Yeats, 1990). Using both tools, i.e. EIO derived emission intensities and RCA index values, a prioritization of the export basket is done that would serve the twin benefits of greater specialization as well as environmental benignity.

Additionally, an alternate scenario is constructed using the derived prioritized export basket and compared against the existing export portfolio to estimate the emission avoidance potential of changes made in India's export composition.

2. Literature review of earlier studies

While the theory of exports led growth is not new, in recent times there has been resurgence in efforts aimed at looking into its compositional efforts. Early studies have looked into the growth promoting effects of trade-induced economies of scale, increased capacity utilization, increased competition, resultant technological upgrading and productivity gains, etc. (Amable, 2000; Bhagwati and Srinivasan, 1978; Feder, 1983; Grossman and Helpman, 1991; Hausmann et al., 2007; Krueger, 1980; Lall, 2000). A comparatively recent study by Greenaway, Morgan and Wright (1999) shows a strong positive relation between composition of exports and the strength of resultant growth. The study identifies fuel, metals and textiles exports to be important for developing countries' growth performance. Hausmann et al. (2007) show that physical and human capital, natural resources, good institutions and market failures are some important factors that affect the exports of a country. In fact, in the presence of market failures, there is a role for governments to spur export diversification. Thus, in view of the above, the government's push for substantial and diversified exports is not surprising.

As far as emission embodied in trade is concerned, it has been analyzed in input–output analysis using both single region as well as multi-region models. In single region models, emissions embodied in domestic exports and import substitutes are analyzed (Dietzenbacher and Mukhopadhyay, 2006; Machado et al., 2001; Mäenpää and Siikavirta, 2007; Mongelli et al., 2006; Munksgaard and Pedersen, 2001; Tunç et al., 2007). Multi-region models, on the other hand, use the technology matrices of both the importing as well as exporting countries/regions to evaluate the embodied emission levels (Ahmad and Wyckoff, 2003; Lenzen et al., 2004; Nakano et al., 2009; Peters and Hertwich, 2006; Roca and Serrano, 2007).

The difference between the two types of models is that while one talks about imports (taking into account the technology and emission coefficient relevant for the exporting country), the other one talks about import substitutes (i.e. if the imports had instead been produced in the domestic economy with the same technological profile what would be the resulting emissions).

While the methodology used in these two types of models is slightly different, many of these regional models have studied the applicability of pollution haven principle for various countries. These studies look at the net pollution (global and/or local) embodied in the exports and import flows of developed and developing countries to investigate whether or not the country is serving as a pollution haven. Additionally, some papers have used the multi-regional input–output model to study the impact of bilateral trade amongst countries and ascertain whether a change in the composition and level of trade flows between countries resulted in reducing their combined emission levels (Ackerman et al., 2007; Li and Hewitt, 2008; Liu et al., 2010; Shui and Hariss, 2006).

3. India's foreign trade: volume and composition

While the above-mentioned studies on export composition and growth provide a theoretically sound analysis of the impact of trade flows for developing countries, an environmental perspective is missing from most of these studies. For developing countries, while the necessity of meeting their developing goals to serve their poor masses is crucial, climate change is a new and important challenge that they need to face as global citizens.

Since the aspiration of "moving up the ladder" is present and worked towards by all developing countries, India too has been trying to increase its export volume to reap in these trade benefits. In 2003/04, which is the base year of the analysis, India exported and imported goods worth USD 63.8 billion and USD 78.1 billion, respectively. During that year the services exports and imports were to the tune of USD 16.4 billion and USD 12.8 billion, respectively.

A look at the composition of commodity exports shows that manufactured goods constituted the bulk (76.0%) of total exports (see Appendix Table A1). The rest was primarily composed of primary products (15.5%) and petroleum products (5.6%). Among the manufacturing exports, important sectors were textiles (19.0%), engineering goods (19.4%) and gems and jewelry (16.6%). The composition of imports in the Indian case was dominated by imports of petroleum, oil and lubricant imports (26.3%). Other important import categories were capital goods (13.3%), pearl, precious and semi-precious stones (9.1%) and electronic goods (9.6%) (Appendix Table A2).

As regards the trade-GDP ratio, exports constituted 10.8% of GDP_{MP} (Gross Domestic Product at Market Price) in 2003/04 while imports composed of 13.3%. Thus, trade flows constituted a sizable part of the Indian GDP in 2003/04. However, India played a much smaller role as far as global trade flows are concerned. The share of India in world exports was a mere 0.8% in 2003 (GoI, 2004).

4. Methodology for environmental input–output analysis

To study the environmental impact with respect to the CO_2 emissions from the above-mentioned trade flows, EIO analysis has been used. Input–Output analysis is a powerful tool that can be used to calculate the embodied emission in trade flows. The analysis was first developed by Wassily Leontief in the late 1930s. Following the circular flow of income, the balance between the total output produced by different industries and different commodities consumed as inputs by other industries and final consumers is represented by this model. The model is used to understand the complex and interrelated interactions that take place within any economy and to study the impact of changes in any one sector upon the whole economy. The model uses a system of linear equations to describe the relationships between different sectors (Miller and Blair, 2009).

This system of linear equations can be described as follows:

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{y}, \tag{1}$$

where $\mathbf{x}$ is the total output, $\mathbf{y}$ is the final demand and $\mathbf{A}$ is the technological matrix whose coefficients represent the outputs of sectors purchased as input by other sectors to produce one unit of its monetary output.

The above system can also be written as

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{y^d} + \mathbf{y^{ex}} - \mathbf{y^{im}}, \tag{2}$$

where $\mathbf{y^d}$ is the domestic final demand (household, government and investment), $\mathbf{y^{ex}}$ is the exports demand and $\mathbf{y^{im}}$ is the imports demand.

The technological matrix $\mathbf{A}$ is derived from the commodity by industry technical coefficient matrix (or the use matrix) and the industry by commodity market share matrix (or the make matrix) using the industry technology assumption.