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Review of Analytical Tools for Assessing Trade and Climate Change Linkages

By

Truong P. Truong

Truong P. Truong is Honorary Professor of Sustainable Transport Systems, The Institute of Transport and Logistics Studies, The University of Sydney, Australia and an advisor of ARTNeT for work on Trade and Climate Change Linkages. This paper was prepared as part of the Asia-Pacific Research and Training Network on Trade (ARTNeT) initiative on building research capacity in the area of Trade and Climate Change Linkages. The technical support of the United Nations Economic and Social Commission for Asia and the Pacific is gratefully acknowledged. The opinions are the responsibility of the author and should not be considered as reflecting the views or carrying the approval of the United Nations, ARTNeT, or the University of Sydney. Any errors are the responsibility of the author, who can be contacted at T.Truong@itls.usyd.edu.au

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Executive Summary

Trade and climate change are clearly among the most important economic and political issues facing the global community. Although it is generally agreed that the two areas are closely related, the nature and outcome of these linkages are still debatable. On the one hand, there is a view that trade can contribute negatively to the problem of climate change because of its impacts on the level of economic activities and the impact on international transport. On the other hand, there is also the contrary view that trade is not only helpful, but may even be necessary, for the development, diffusion and transfer of technologies which can help in the combat against climate change. To assist in the understanding of the nature of these complex interrelationships and to assess their overall impacts on the economy and the environment, especially with respect to the problem of climate change, it is important that we understand the theories behind these interrelationships and use the practical models which are built to represent these linkages in the analysis of climate change and trade policies. In this paper, we briefly refer to the essential elements underlying the theoretical linkages between trade, economic development, and climate change and review the analytical tools which are used to describe these linkages. We look specifically at a particular type of analytical tool called computable general equilibrium (CGE) models; consider their strengths and limitations when used as a tool for the analysis of these trade and climate change linkages. The paper finds that the tool have been more useful than 'misused', and this explains for the popularity of its use in the past. Looking to the future, to increase the usefulness of the tool in the area of policy analysis, there will need to be continuing training for the policy analysts in the modern and expanding techniques of CGE modelling. Such training will include not only the surveying and reading of the literature and understanding the basic theories but also 'hands on' experience on its practical applications. This survey paper therefore is only an important first step towards that ultimate direction.

> *Insofar as trade leads to growth, and growth leads to an increased willingness and ability to pay for a cleaner environment, freer trade and investment flows will enable countries to adapt better to any adverse effects of climate change and to mitigate emissions.* Sallie James (2009). p.14.
>
> *Globalization...has been a major driver behind global warming. This trade model has promoted the production and consumption of goods regardless of their impact on our environment, excessive and wasteful shipping of goods globally, depletion of natural resources at a break-neck pace...Free trade has most significantly contributed to global warming ...*Sierra Club (2008) p. 2
>
> *Trade...can - at best - offer no more than part of the answer to climate change. It is not in the WTO that a deal on climate change can be struck, but rather in an environmental forum, such as the United Nations Framework Convention on Climate Change*. Pascal Lamy, WTO Director- General, Bali, December 2007

1. Introduction

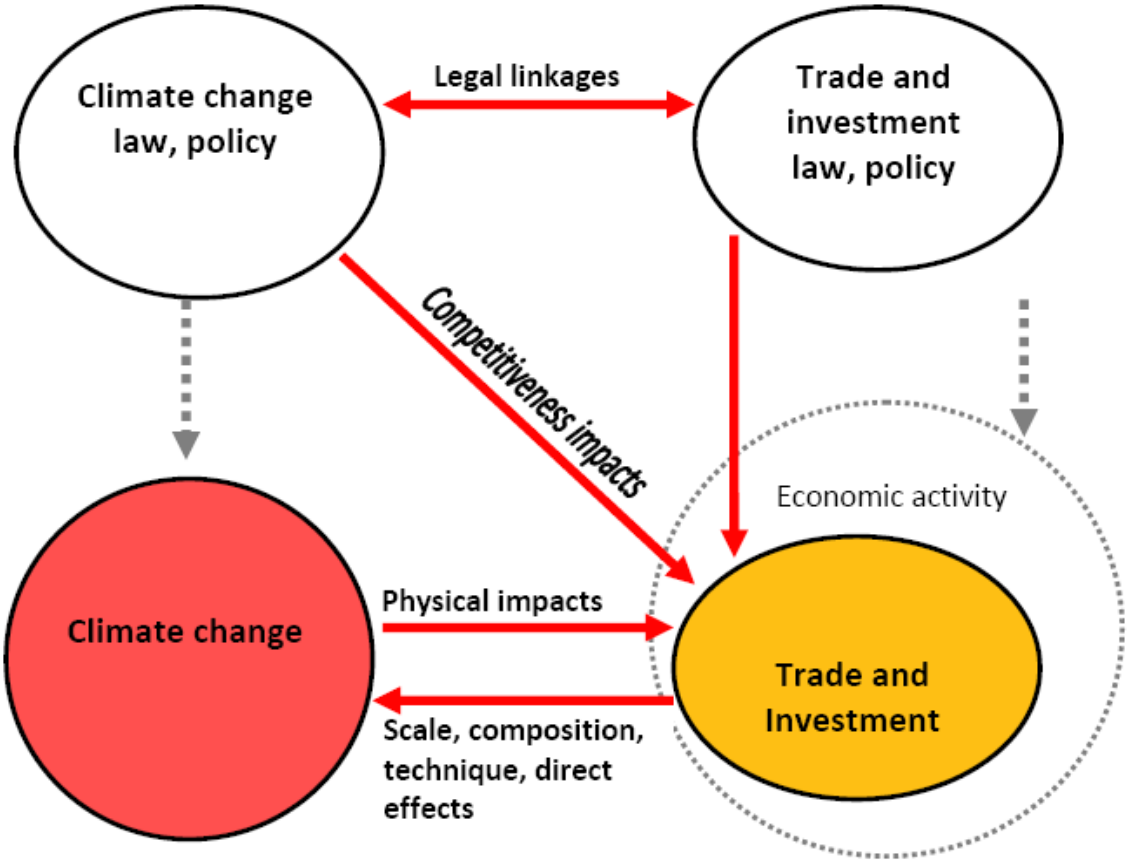
Trade and climate change are clearly among the most important economic and political issues facing the global community. Although it is generally agreed that the two areas are closely related, the nature and outcome of these linkages are still debatable. On the one hand, there is a view that trade can contribute negatively to the problem of climate change because of its impacts on the level of economic activities and the impact on international transport (Sierra Club, 2008). On the other hand, there is also the contrary view that trade is not only helpful, but may even be necessary, for the development, diffusion and transfer of technologies which can help in the combat against climate change (see, for example, James (2009)). To assist in the understanding of the nature of these complex interrelationships and to assess their overall impacts on the economy and the environment, especially with respect to the problem of climate change, it is important that we understand the theories behind these interrelationships and use the practical models which are built to represent these linkages in the analysis of climate change and trade policies. In this paper, we briefly refer to the essential elements underlying the theoretical linkages between trade, economic development, and climate change and review the analytical tools which are used to describe these linkages. We look specifically at a particular type of analytical tool called computable general equilibrium (CGE) models; consider their strengths and limitations when used as a tool for the analysis of these trade and climate change linkages.

The plan of the paper is as follows. Section 2 explains the theoretical linkages between trade and climate change issues. Section 3 looks at the analytical tools used in the analysis of these linkages. Section 4 looks more closely at a particular type of analytical tool: CGE models, and assesses the strengths and limitations of this tool. Section 5 gives some examples of the use of CGE models in the analysis of trade and climate change linkages. Section 6 concludes.

2. Trade and Climate Change Linkages – Theoretical Hypothesis

Trade and climate change can be assumed to be linked in several ways. Figure 1 shows a schematic diagram of these linkages.

Figure 1: Trade, investment and climate change linkages



Source: Cosbey (2007)

2.1 Impacts of Trade on Climate Change: Scale, Composition, Technique and Direct effects

The impacts of trade and investment policy on climate change can be summarised in terms of four different components[1]: scale effects, composition effects, technique effects, and direct effects. In practice, these different components are closely intertwined and it's hard to separate them out, but from a theoretical viewpoint, it is useful to distinguish between these components so that we can have a better understanding of the nature of the interrelationships.

- *Scale effect*: this is the effect that trade (and investment) policy can have on climate change via a change in the scale of production and consumption activities. For example, if trade results in an increase in the level of economic activities in certain sectors of an economy, and/or certain parts of the world, and if these increased activities result in higher levels of GHGs emissions, then trade can be said to have a negative impact on climate change. The scale effect is almost always negative; therefore, criticisms of the current trading system often resort to this scale effect to point to the negative impact of globalisation on the environment and especially on climate change.

- *Composition effect*: trade and climate change policies can also have impacts on the patterns of production and consumption activities in different countries. For example, through trade opening,

[1] "Scale, composition, and technique effects" were first used by Grossman and Kruger (1991) and others to describe the impacts of the North American Free Trade Agreement (NAFTA) on pollution levels in North America. The precise definitions of these terms in the context of a general equilibrium model were subsequently given in Copeland and Taylor (1994).

the income level of trading countries can increase and if we assume that the environment is a normal good, then an increase in income level will lead to an increase in demand for this good. The pressure of demand for more environmental good means the patterns of production and consumption activities will have to change and shift gradually from a reliance on environmentally 'dirty' goods (such as steel, cement, and chemicals) towards 'cleaner' goods (such as electronics, telecommunications, and other services)[2]. These composition effects can have a beneficial impact on climate change. However, this depends also on other factors. For example, if climate change regulations in rich countries are not matched by similar regulations in other poorer countries, then the 'leakage effects' implies the beneficial composition effects in the former countries will be offset by the negative composition effects in the latter countries.

- *Technique effects*. Trade liberalization (and investment agreements which may go with it) can bring about changes in production techniques which are often more energy efficient, and hence emit less GHGs per unit of output. The changes in production techniques can come about from the autonomous pressure of competition but can also be induced by policies. For example, the European Union climate policy of targeting the share of renewable energy in production and consumption activities of the European Union in the year 2020 to a level of 20% may have the effect of inducing climate friendly technological change in the European Union. Currently within the Doha Round, there are discussions about how to use trade liberalisation in the area of so-called environmental goods and services (EGS) to help in the diffusion and transfer of climate friendly technologies between countries.[3] The analysis of these climate and trade policies linkages may require further research using tools which can capture the essential elements of these linkages.

- *Direct effects*: free trade increases the demand for international transport of goods. Transport currently uses fossil fuels and hence this will increase the overall emissions of GHGs. The direct (negative) effects of trade and transport on the environment and climate change, however, must be considered in the context of trade and transport are only a means to an end ('margin' commodities) rather than an end in itself (i.e. final commodities). Therefore, although the direct effects of trade and transport on the environment are always negative, this does not mean these activities are not necessary or useful for other activities. Negative direct effects are only part of the overall scale, composition and technique effects considered previously.

2.2 Impacts of Climate Change on Trade: Productivity changes, Changes in Comparative Advantages

The impacts of climate change on trade can be summarised under two headings:(i) physical impacts of climate change on the natural resource endowments of a particular country which then affects the comparative advantage of the country in international trade, and (ii) policy impacts of climate change policies on comparative advantage or competitiveness of firms in these countries.

- *Physical impacts*: with rising temperature, changing level of precipitation, increased level of CO_2 concentration in the atmosphere, productivity of the agricultural sector may be affected. It has been estimated (see Cline (2007) for example) that agricultural productivity in some regions such as India, South East and South West Plains of the United States, Mexico, South Africa, Ethiopia can be reduced by these aspects of climate change by as much as -20% to -30%. Some other regions, however, may gain: For example, China, the United States (other than South East and

[2] This is also the main hypothesis underlying the so-called 'Environmental Kuznets Curve' (EKC) (see World Bank (1992), Grossman and Kruger (1995)). It has been suggested (see WTO (2009, p.52)) that although the hypothesis may work well for the case of a local environmental good attached to a specific country, it may not apply well to the case of a global environment issue such as GHGs emissions because in this case the bulk of the costs of GHGs emissions are borne by other countries and hence there is always very little incentive left for the polluting country to reduces its own emissions even if its income are rising.

[3] See WTO (2009).

South West Plains), Canada, Germany, Spain, Russian Federation can gain in agricultural productivity, and these gains can range from about 5% to 12%. The increase in temperature as well as other aspects of climate change such as the bleaching of coral reefs, forest die-off, and fundamental ecological changes can also affect other sectors of the economy such as tourism and infrastructure (harbour, shipping docks, etc.).

- *Policy impacts*: climate change policies can affect the comparative advantage of a country and the competitiveness of firms in various sectors of an economy. One of the principal concerns when countries try to implement unilateral climate change policies is the fact that such policies may not be effective from the global environmental viewpoint. This is because of the problem of so-called 'leakage': environmental goods in one country are offset by environmental bads in other countries due to a lack of international policy co-ordination. Another important concern is the impacts of such unilateral policies on the relative comparative advantages of a country in international trade, and also the relative competitiveness of different firms in different sectors of the economy in domestic trade. To deal with these concerns, there have been suggestions that some border tax adjustment (BTA) measures such as environmental tariffs could be applied. However, the effectiveness of such policy measures can be doubtful and the impacts of such measures on the world economic and trading systems can also be unpredictable. Therefore, there is a need for further research into these trade-climate change policy linkages before such policies measures could be adopted.

3. *Trade and Climate Change Linkages – Empirical Analytical Tools*

The most common tools which are used in applied analysis of trade-climate change linkages are (i) econometric techniques, and (ii) applied (or computable) general equilibrium models[4].

3.1 Econometric techniques

Generally, these are used to establish partial statistical relationships between certain environmental or climate change variables (temperature, humidity, precipitation, wind velocity, etc.) and some specific socio-economic variables. For example, in the study of the (partial or direct) impacts of climate change on health issues, regression analysis can be used firstly to establish a statistical relationship between morbidity or mortality rates (dependent variable) and maximum daily or average weekly temperature, humidity ratio, wind velocity, etc. (independent variables). This statistical relationship is then fed into some other micro-simulation or computable general equilibrium models to estimate more generally the overall impact of a particular temperature (climate change) scenario on the health condition of a particular region.[5] Similarly, in the analysis of the impact of