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The relationship between trade and sustainable transport: A quantitative assessment with indicators of the importance of environmental performance and agglomeration externalities

Laura Márquez-Ramos*

Department of Economics and Institute of International Economics, Universitat Jaume I, Campus del Riu Sec, 12071 Castellón, Spain

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ABSTRACT

This paper analyses the effect of international trade, environmental performance and agglomeration externalities on CO_2 emissions arising from goods transport. It is an indicator that could be used for monitoring progress on the integration of the principles of sustainable transport into national policies. Firstly, we calculate a global transport emissions indicator using existing CO_2 emission data. Secondly, given that sea transport is on average less polluting than terrestrial and air transport with regards to greenhouse gas emissions, we calculate a trade-weighted distance indicator that allows for the relative growth of maritime exports. Thirdly, we analyse the relationship between trade and global transport emissions based on existing environmental performance levels by examining both a *narrow* and a *broad* environmental performance indicator. Lastly, we examine the role of agglomeration externalities. Comparing different regions within Spain and their trading partners over the period 2000–2008, we are able to plot two different shapes to represent the relationship between trade and global transport emissions, one of which is an inverted-U shape that represents trade with trading partners with a lower environmental performance. Our results show that environmental performance reduces trade-related global transport emissions. Negative externalities for the environment derived from transport facilities agglomeration co-exist too, although these might be partially offset by national regulations that ensure commitment towards a *clean* environment.

1. Introduction

Increasing trade liberalisation has increased exports and imports of goods and, hence, transport emissions. It is worth noting that transport is one of the most contaminating economic activities in terms of CO_2 emissions, although levels of pollution differ from one mode of transport to the next (Zafrilla et al., 2012). The World Ocean Review recently published the following (2014): "according to International Maritime Organization (IMO) estimates, world shipping is responsible for about 3 per cent of global CO_2 emissions. Of the total emissions from the transportation sector, shipping accounts for 10 per cent, road traffic 73 per cent and air traffic 12 per cent. Losses from pipelines contribute 3 per cent, and rail traffic 2 per cent. Experts predict that, unless further measures are taken to protect the climate, emissions from the transportation sector will double by 2050. From shipping they could approximately treble." In this vein, Cristea et al. (2013) have shown that international transport emissions will rise faster than trade due to a rise in long-distance trade and the expansion of air cargo. Their results predict that rail and road usage will fall substantially while international aviation and maritime transport will undergo a sharp rise.[1]

The lack of a framework to test the relationship between trade and sustainable transport leads to erroneous claims in policy circles. For example, when discussing the convenience of trade integration among BRICS countries at the Economic Policy Forum recently held in Rio de Janeiro,[2] it was stated, *vis-à-vis* carbon miles and the environment, that looking at a "closer" integration among countries might be preferred.

* Tel.: +34 964387166; fax: +34 964728591.
E-mail address: lmarquez@eco.uji.es

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[1] Interestingly, technological change in ocean shipping was a critical input to growing trade in the first era of globalisation, while technological change in air shipping and the declining cost of rapid transportation has been a critical input into the second era of globalisation (Hummels, 2007).

[2] BRICS and their Neighbours: Inclusive Regional Economic Relations, 12–14 March 2014. http://www.economic-policy-forum.org/.

In this paper, we argue that the relationship between distance and environmental emissions might be non-linear, as the greater the distance between countries, the greater the likeliness that a more efficient mode of transport will be used. So although from a sustainable transport perspective it might appear that international trade is harmful to the environment, it is worth noting that earlier related research ignored changes in modal usage within a particular trade flow over time. Likewise, Esty and Porter (2001) highlighted that limiting trade is a "recipe for environmental failure" given that economic growth is a key mechanism for improving environmental results. As pointed out by Moldan et al. (2012) "the objective, then, is to conserve natural resources to ensure continued development and to support all life" (page 5) and it goes on to state that sustainable transport is one of the European Union's (EU) primary environmental goals.

In order to shed some light on the relationship between trade and sustainable transport,[3] we focus on the role of exports instead of intra-national trade as there is emerging micro-level evidence showing that exporters have lower CO_2 emission intensity, measured as the ratio of emissions to value added, than comparable domestic firms (Forslid et al., 2012). The present paper therefore analyses the determinants of global transport emissions in a multi-regional and multi-country framework. We account for changes in modal usage, environmental performance and agglomeration externalities[4] in Spain.

The critical issue of country identification warrants further discussion. On the one hand, Spanish goods transport within Europe is road intensive (Tarancón and del Río, 2007). For example, 76.62% of total exports from Spain to France were transported by road in 2008, while only 15.77% were transported by sea.[5] On the other hand, Spain's main trading partners are EU members[6] so the modal shift that we analyse in this research paper is possible:[7] increased trade over shorter distances might be bad for the environment if goods are mainly transported by road. In this case, the difference between absolute and relative emissions is important. den Boer et al. (2011) provide an overview of aggregated air emissions per unit of performance for different modes of freight transport at an EU level. The authors rely on both data on vehicle use and vehicle technology and they provide some indication of emission factors per tonne-kilometre to compare maritime and land transport pollution.[8] Tarancón and del Río (2007) quantify the contribution of transport sectors to the overall CO_2 emissions in Spain in 2000, accounting separately for emissions from households, with 3.63% for terrestrial transport, 1.86% for air transport and 0.86% for sea transport. It is also important to highlight here that although sea transport is less polluting than terrestrial and air transport for CO_2 (and thus climate change), for other pollutants (e.g. SO_2), the picture is quite mixed. For example, electric freight-train transport with a high degree of renewable energy production is less polluting than maritime transport (den Boer et al., 2011). Although this could be relevant for other European countries, in Spain's case, the rail option might prove limited for export.

The latest literature to quantify the effect of trade liberalisation on transport-related CO_2 emissions uses a general equilibrium framework (CGE) (Cristea et al., 2013; Vöhringer et al., 2013) with the results dependent on parameter assumptions. In contrast, we focus on partial equilibrium by taking into account regional and country data, as well as transport CO_2 data provided by the International Transport Forum (ITF) that include emissions from international aviation and international maritime bunkers.

Methodologically speaking, our first step is to use trade data (total and maritime) and geographical distance among trading partners to calculate a trade-weighted distance indicator. We use this measure to study whether there is a turning point for which increasing long-distance trade does not imply higher trade-related transport emissions. We then focus on existing environmental performance, as we expect that the abovementioned constructed trade-weighted distance will have a different effect on trading partners committed to a *clean* environment. To account for variability over time as well as regional and country heterogeneity, we examine both *narrow* and *broad* environmental performance indicators. Lastly, spatial econometrics techniques are used to allow for the importance of agglomeration externalities, i.e. the agglomeration of transport investment that might have substantial spillovers on emissions (agglomeration effect). In this regard, Spain is an interesting case-study as it is characterised by an extensive network of roads, railways, rapid transit, air routes and ports (Márquez-Ramos, 2014) and in which the different levels of government, in particular, the autonomous communities, have taken advantage of the State's passivity and have introduced their own environmental taxes, with varying degrees of success (IEB, 2014).

Our paper is organised as follows. In Section 2, we present the main hypotheses with links to the existing literature. Section 3 and 4 include explanations about the methodology and indicators used, respectively. The main results and simulations are presented in Section 5 while the final section contains our conclusions and policy implications.

2. Hypotheses and links to literature

Two main streams of literature have a bearing on the interdependences between international trade and sustainable transport. Firstly, the literature that deals with the relationship between trade and the environment and, secondly, the literature that analyses the role of regional spillovers by introducing spatial lags in autoregressive trade models.

With regards to the former, early trade and environmental literature focused on identifying how comparative advantage influenced the effect of trade liberalisation on reducing local pollutants such as sulphur dioxide that were primarily associated with industrial production. With competing pollution haven and factor endowment effects, some countries gained and some countries lost.

[3] Note that this refers to a *narrow* view of transport sustainability, as sustainable transport encompasses a wider range of conditions (Litman, 2014). According to the European Conference of Ministers of Transport (ECMT, 2004) a sustainable transport system is one that is accessible, safe, environmentally-friendly, and affordable.

[4] The term "transport externalities" is generally used to indicate economic transaction spillover effects and is defined as a cost or benefit, not transmitted through prices, incurred by a party who did not agree to the action causing the cost or benefit (Laffont, 2008). In the context of transport, this term is therefore associated with negative consequences of emissions (climate change and air pollution), accidents, noise, soil contamination, interference in the ecological system, damage to infrastructure, visual nuisance, congestion and externalities which are connected to so-called up and downstream processes. In this paper, the term is used to indicate a totally different concept of agglomeration effects. Therefore, we use the term "agglomeration externalities" or more specifically "(transport hub) agglomeration externalities."

[5] Source: Datacomex (2014). Note that the series of regional trade in Spain are compiled from data provided by the Customs and Special Taxes Office of the Tax Agency. Data from intra-EU trade is based on the Intrastat statistical declaration, as since 1993 there are no customs formalities between the countries of the EU.

[6] Main export partners: France 16.8%, Germany 10.8%, Italy 7.7%, Portugal 7.1%, the UK 6.5% (in 2012). Source: CIA (2014).

[7] The modal shift is usually only possible for intra-continental trade, whereas for intercontinental trade, only maritime and air transport are feasible and modal shift is generally not an option. Note that there are some examples of intercontinental modal shift, such as trials with rail traffic from China to Europe (Rodemann and Templar, 2014).

[8] See, for example, Figure 4 in den Boer et al. (2011): *Comparison of CO_2 emissions 2009 and 2020 for selected vehicle types.*