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Decoupling or delusion? Measuring emissions displacement in foreign trade

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ABSTRACT

In a world where climate goals are global but action remains firmly in the hands of states, reliable methods are needed to ensure that emissions reductions on a national level are not offset by carbon leakage. Appropriate indicators are needed to help policy makers set accurate targets for the carbon balance of their foreign trade and monitor the development of trade in a meaningful way. This paper proposes a new displacement indicator – the technology adjusted balance of emissions embodied in trade – that improves on existing ideas by separating out the effects of scale and composition of trade from the effects of different technologies and energy systems. The new indicator is calculated for Swedish and UK trade from 1995 to 2009, a period when both countries have reported decreasing territorial emissions together with sustained economic growth. One key finding is that, for both countries, outsourcing of emissions is less serious than what conventional analysis of emissions embodied in trade suggests. For Sweden, the technology adjusted balance of emissions embodied in trade is positive throughout the studied period, implying that its exports reduce emissions abroad more than what is generated by its imports. However, we also find that both countries have changed the composition of their imports and exports during this period: imports have become more carbon intensive and, exports less so, compared to the world economy at large.

1. Introduction

Over the last few decades several industrialized countries, among them the UK and Sweden, have reported substantial reductions in territorial carbon emissions in combination with sustained economic growth. This has been interpreted as a successful decoupling of economic growth from carbon emissions (Andersson and Lövin, 2015; Evans, 2015; Aden, 2016).

Many studies, however, (Barrett et al., 2013; Davis et al., 2010; Peters et al., 2011; Li and Hewitt, 2008; Peters and Hertwich, 2008; Wiedmann et al., 2010) have shown that industrialized countries, including the UK and Sweden, are large net importers of carbon emissions embodied in traded goods. It has been suggested that the observed reductions of territorial emissions are largely the result of displacement rather than examples of real decoupling (Davis et al., 2010; Aichele and Felbermayr, 2015; Peters et al., 2012; Baiocchi and Minx, 2010).

To determine to what extent emissions reductions are due to actual decoupling and to what extent they result from displacement we need a reliable method for analyzing carbon transfers in international trade flows. In this paper, we argue that established methods fail to distinguish properly between different drivers of imbalances in flows of embodied emissions and are therefore potentially misleading. We propose a new method that is better suited to the task. We calculate the indicator for two representative countries to shed new light on the decoupling versus displacement controversy.

The issue is important for many reasons. If countries can meet their emissions targets by outsourcing carbon intensive production this may seriously undermine the efficiency of global climate policy. Conversely, widespread suspicion that national climate mitigation efforts are offset by carbon leakage may undermine the legitimacy of ambitious climate policies.

Spotting carbon leakage has been one motivation behind the development of consumption based carbon accounting methods in recent years (Davis et al., 2010). But the fact that a country is a net importer of emissions embodied in trade is not by itself evidence of emissions displacement.

Emissions displacement means that a country's foreign trade contributes to

i reduced domestic emissions and
ii increased emissions abroad

compared to a no-trade scenario with the same domestic and foreign consumption.

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If a country's domestic production, and hence its export, is dominated by light (i.e. low carbon intensity) industry while heavy (i.e. high carbon intensity) industrial goods are imported, this will cause a net increase in direct emissions abroad and a net decrease in domestic emissions, compared to a no trade scenario with the same consumption pattern, and it can therefore be characterized as emissions displacement.

Net embodied imports or exports can also result from general differences in the carbon intensity of production between trading partners that do not contribute to increased emissions abroad. If a country has a more carbon-efficient production or energy system than its trading partners, even an exchange of exactly identical bundles of goods will result in a deficit in emissions embodied in trade (Jakob and Marschinski, 2013).

Kander et al. (2015) show that this latter case holds even if the more carbon-efficient country specializes in more energy intensive goods than what it imports. The exchange thereby results in a net reduction of the trading partner's as well as total global emissions. Clearly, it would be misleading to characterize this type of international exchange as emissions displacement.

To correctly identify emissions displacement, we must separate the effects of scale and composition of exports versus imports from the effects of general differences in carbon intensity between trading partners. Structural decomposition analysis provides a useful tool for this purpose (Copeland and Taylor, 1994; Xu et al., 2011; Xu and Dietzenbacher, 2014; Zhang, 2012; Pan et al., 2008). Jakob and Marschinski (2013) identify four determinants of the flow of embodied emissions in international trade: (i) trade balance; (ii) trade specialization; (iii) average energy intensity of production in the entire economy, compared to that of trading partners; and (iv) average carbon intensity of energy in the entire economy, compared to that of trading partners.

We will argue, however, that decomposing the balance of emissions embodied in trade in this way is not sufficient to solve the problem. This has to do with the definition of trade specialization. On the export side, specialization is defined as the ratio between the carbon intensity of exports and the carbon intensity of the domestic economy at large. On the import side, it is the ratio between the carbon intensity of the imported goods and the carbon intensity of the world economy minus the importing country.

This definition of trade specialization corresponds to standard usage in international trade theory, and would be unproblematic in the present context if the relative differences in carbon intensity between sectors were the same for all countries, and if export constituted the same share of each country's economy. But clearly this is not always the case. As a result, exchange of identical goods between two countries may technically be considered as trade specialization, given that the carbon intensity of the traded goods, relative to the rest of the exporting country's economy, differs. But clearly such exchange does not contribute to increased emissions in any of the two countries, and hence does not amount to emissions displacement.

For example, Sweden has a very carbon efficient energy system compared to the world average. But 10 per cent of domestic emissions and 20 per cent of emissions embodied in Swedish exports are not energy related but result from industrial processes, particularly in the steel and cement industries. In the steel industry, the major source of carbon emissions is the use of coke as a reduction agent in the production of pig iron from iron ore. The same reduction process is standard in steel industries all over the world, but due to Sweden's low carbon energy system, process related emissions make up a much larger share of total carbon emissions in the Swedish steel industry. As a result, even if the absolute carbon intensity in the Swedish steel industry is lower than the world average, its relative carbon intensity compared to the Swedish economy at large is substantially higher than the corresponding relative carbon intensity of the average steel industry compared to the world economy.

An exchange of identical steel products between Sweden and the world market will therefore be considered as Swedish trade specialization in carbon intensive goods on the export side and less carbon intensive goods on the import side. But such exchange of identical goods will not, of course, affect carbon emissions neither in Sweden nor outside. Trade specialization in this sense, therefore, is not a reliable indicator of carbon displacement.

To avoid this problem, and cancel out noise stemming from general differences in carbon efficiency between countries, we propose an analysis where relative carbon intensities of exports and imports are standardized by using the world average carbon intensity for each sector (cf. Kander et al., 2015; Domingos et al., 2016; Kander et al., 2016), and both imports and exports are compared with the carbon intensity of the world economy. In this way, any imbalances in trade related emissions can be attributed to either scale or composition of exports and imports.

This can provide policy makers with options for setting targets for the carbon balance of their foreign trade, and to be able to monitor the development of trade related emissions transfers in a meaningful way.

The technology adjustment suggested here could be seen as a correlate to factor adjustments that have been proposed in international trade theory in order to align theoretical predictions on factor content of trade with empirical observations in the presence of differences in factor productivity between countries (Choi and Krishna, 2004; Davis and Weinstein, 2001; Jakob and Marschinski, 2013; Maskus and Shuichiro, 2009; Reimer, 2006; Trefler and Zhu, 2010).

In our context, the "factor content" – carbon emissions – is an external cost and the idea is not primarily to test trade theoretical hypotheses. The adjustment suggested here serves instead to align national carbon accounting with effects on global emissions, in order to provide better feedback for policy makers.

To test the method, we apply it to Sweden and the UK. The reason for focusing on these two countries is that they have been put forward in the debate as examples of countries that have successfully decoupled economic growth from carbon emissions, providing evidence that a transition to a low carbon economy can be achieved without large economic sacrifice. For example, the Swedish government has claimed that the Swedish case "provides strong evidence that decoupling GDP growth from CO_2 emissions is possible" (Andersson and Lövin, 2015).

Sweden and the UK are similar in many respects, but there are also important differences in energy mix, production technologies and export composition, suggesting that a comparison between them may both shed light on the general decoupling/displacement controversy and generate relevant insights into how these differences affect displacement effects.

Table 1 shows that, regarding carbon intensity of energy and energy intensity, the UK is very similar to the average European Union country, whereas Sweden has a much more energy intensive economy, more similar to the world average than to other European countries. At the same time the carbon intensity of the Swedish energy mix is less than half of that of the UK, the EU or the world average.

Trade also makes up a very large share of the Swedish economy, compared to the UK, the EU or the world at large, and since a large proportion of Swedish export is in energy heavy basic industrial products such as steel and forestry, differences in carbon intensity of energy could have a great impact on the carbon balance in trade.

2. Methods

2.1. Environmentally extended input-output framework

The study is conducted within the framework of environmentally extended input-output analysis. Data on trade flows and carbon emissions intensities in different production sectors and countries were retrieved from the World Input Output Database, WIOD (Timmer et al., 2015; Dietzenbacher et al., 2013), which contains detailed information