HOW DO ENVIRONMENTAL REGULATION AND ENERGY TRANSITION SHAPE THE GLOBAL VALUE CHAINS? THE THRESHOLD EFFECT AND A SECTORAL PERSPECTIVE

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Overview

Globalisation has fostered the interconnection of countries, but also a wave of predatory behaviour, coming mainly from developed countries. Neoclassical theories of international trade treat countries' endogenous characteristics as defining trade patterns; at least they did so after the Cold War. Briefly, although the debate varies between specialising in Comparative Advantage (CA) or absolute advantage, what is common to all neoclassical theories is that countries should specialise in the production of the good in which they have a cost advantage. Nowadays, international trade patterns can be seen mainly as a strategic behaviour by countries to maximise their benefits.

In addition to developing countries' lower relative wages, which can be deemed an absolute advantage (Machado & Trigg, 2021), their lax Environmental Regulations (EReg) allow them to produce goods that undervalue the environment, and price them bellow the social marginal cost, thus having a cost advantage. This phenomenon is commonly known as ecological dumping, as the cost of a good does not internalize all environmental externalities (Zheng et al., 2023). Consequently, trade can be considered unfair, and often developing countries embark on a race-to-the-bottom to further lower national EReg (Acharyya and Kar, 2014), thus neglecting the urgency of climate change. The pressure on developed countries for climate action incites them to take advantage of developing countries to circumvent their strict EReg.

The more relaxed environmental stringency of developing countries is considered by Duan et al., (2021) as a source of CA. Indeed, the international outsourcing of labour-intensive but low-skilled production stages through Global Value Chains (GVC) represents a major dimension of current globalisation (Acharyya and Kar, 2014). These activities are generally more downstream than upstream (Najarzadeh et al., 2021), which may explain the downstream position of developing countries (H. Zhang et al., 2022). This often occurs due to carbon leakage driven by unilateral EReg. Nevertheless, the environmental impact of trade is a combination of scale and intensity effects (Ma & Wang, 2021). The former suggests that an increase in economic activity can boost pollution via energy consumption, while the latter exposes that international trade can reduce pollution through the inclusion of greener technologies that incite energy efficiency. This stresses the potential role of energy transition in predicting international trade flows.

EReg reduce export volume perhaps due to increased environmental compliance costs (Du and Li, 2020), which can harm countries' industrial competitiveness (Wu and Lin, 2022). Developing countries face a trade-off between remaining pollution havens and benefit from export trade growth and environmental protection. However, the former assumption regarding the perceived loss of industrial and international competitiveness, based on the neoclassical Heckscher-Ohlin theory, seem to neglect the potential effect of EReg to drive technological changes, as well as the associated efficiency gains. Indeed, according to the Porter's Hypothesis, EReg can encourage firms to improve production technology and increase international competitiveness to promote exports. But beyond what level of environmental regulation can this provoke a shift in the definition of trade patterns and thus provoke technological development to offset these restrictions?

Methods

Trade liberalisation urges trade of intermediate goods and are directly related to increased pollution in developing countries (J. Zhang, 2020). Therefore, this study analyses what are the main drivers and deterrents of the fragmentation of polluting production from developed to developing countries through the use of imports of both final and intermediate goods of 26 Organisation for Economic Co-operation and Development (OECD) countries from 21 developing countries, from 2000 to 2018. To provide an in-depth discussion, this study also analyses the imports of the four most prominent sectors in international trade: agriculture, electricity, manufacturing, and services.

This study pays particular attention to the role of EReg (market-based and command-and-control/non-market-based) and the energy transition. Briefly, market-based EReg is mainly related to the cost of pollution, while non-market-based EReg is more related to the setting and enforcement of environmental standards (Hassan & Rousselière, 2021). EReg is measured through several indicators commonly used in the literature, namely: Environmnetal Policy Stringency Index both market-based (EPSI_m) and non-market-based (EPSI_nm), environmentally related tax revenue (TAX_R), Feed-in Tariffs (FIT), number of environmental policies (ended and in force) (POL), Regulatory Quality (RQ) index, and Government Effectiveness (GE) index.

To assess the potential nonlinear relationship between EReg and imports of final and intermediate goods for a given level of Carbon Dioxide (CO_2) emissions, this study conducts the Panel Threshold Model proposed by Hansen (1999), where CO_2 emissions are the threshold variable and EReg indicators are the regime-dependent variables.

Results

Globally, trade openness increases imports of final and intermediate goods. The results also reveal that energy transition plays a relevant role in reducing imports of both final and intermediate goods. In fact, by reducing dependence on fossil fuels (even increasing external energy dependence) the level of pollution can diminish and the transfer of industries may no longer be required to meet climate targets. Electrification of the economy is the key to the energy transition, even considering that energy transition may jeopardize energy security, given the intermittent nature of energy production from renewable sources. The results reveal that electricity intensity should not only be seen as the core of the energy transition, but also to avoid fragmentation of production.

CA in environmental goods, i.e., goods that have been modified to be environmentally friendly, stimulates imports of intermediate goods in all sectors except agriculture and electricity, where it reduces imports. This suggests that developed countries should maintain and strengthen this CA, specially in these sectors.

Regarding the threshold analysis, most EReg indicators appears to be more effective in deterring pollution fragmentation for relatively lower levels of pollution. For higher levels, EReg plays only as a driver. The agriculture and electricity sectors are the exception as, after the threshold, EPSI_m reduces imports of final goods from agriculture sector, RQ and GE reduces imports of final goods from electricity sector. Government effectiveness, i.e., the quality of policy formulation/implementation, and the credibility and commitment of government to such policies plays a crucial role in deter polluting production fragmentation in all sectors for all given level of CO_2 emissions.

Conclusions

International trade, amid all its benefits, increases the propensity and willingness of countries to bend the rule, especially environmental ones. EReg is essential to achieve the sustainable development goals and should not be seen as an opportunity to increase economic benefits (in developing countres, through increased exports. This study exposes that whether EReg are market-based or non-market-based directly influences their impact on international trade patterns.Furthermore, EReg has been shown to be more effective in preventing the relocation of industries when CO_2 emissions levels are relatively low. After the threshold, EReg acts mainly as a driver of the fragmentation of polluting production.

Some sectors, as agriculture and electricity, seem to be more relevant to avoid the fragmentation of polluting production. Indeed, energy transition appears to play a vital role in avoiding the fragmentation of polluting production such as does the electricity intensity. This suggests that to avoid carbon leakage, countries should primarily focus on energy transition and the electrification of the economy, since this can reduce the countries' pollution level and, consequently, the need to transfer polluting industries.

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