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Does trade openness improve environmental quality?

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ABSTRACT

The literature on trade openness, economic development, and the environment is largely inconclusive about the environmental consequences of trade. This study treats trade and income as endogenous and estimates the overall impact of trade openness on environmental quality using the instrumental variables technique. We find that whether or not trade has a beneficial effect on the environment varies depending on the pollutant and the country. Trade is found to benefit the environment in OECD countries. It has detrimental effects, however, on sulfur dioxide (SO₂) and carbon dioxide (CO₂) emissions in non-OECD countries, although it does lower biochemical oxygen demand (BOD) emissions in these countries. We also find the impact is large in the long term, after the dynamic adjustment process, although it is small in the short term.

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1. Introduction

The environmental effect of trade openness has been one of the most important questions in trade policy for the past 10 years [9,27]. Empirical studies on the relationship between international trade openness and environmental quality have been accumulating (see, e.g., [1,7,14,17]). This study extends the literature by showing the sensitivity of results to differences between OECD and developing countries, dynamic adjustment process, and addressing the endogeneity problems.

Antweiler et al. [1] first provide the theoretical framework to empirically explore the determinants of emissions and to successfully decompose them into scale, technique, and composition effects. The scale effect refers to the effect of an increase in production (e.g., GDP) on emissions. The technique effect indicates the negative impact of income on emission intensity. This refers to the effect of more stringent environmental regulations, which promote the employment of more environmentally friendly production methods and which are put in place as additional income increases the demand for a better environment. The composition effect explains how emissions are affected by the composition of output (i.e., the structure of the industry), which is determined by the degree of trade openness as well as by the comparative advantage of the country. This effect could be positive or negative, depending on the country's resource abundance and the strength of

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its environmental policy. These are called the capital–labor effect (KLE), and the environmental regulation effect (ERE), respectively.¹

Since trade openness could increase production and income, it affects emissions through the scale effect and the technique effect [1]. Hereafter, we call these effects the trade-induced scale effect and the trade-induced technique effect. Antweiler et al. [1] estimate how trade openness (increase in trade intensity) and GDP (or per capita incomes) affect pollution by using data on sulfur dioxide (SO₂) concentrations. They find that SO₂ concentrations increase as GDP rises (i.e., positive scale effect), decrease as per capita income rises (i.e., negative technique effect), and decrease as trade openness rises (i.e., negative composition effect). Similarly, Cole and Elliott [7] analyze country-level emissions per capita of sulfur dioxide, carbon dioxide (CO₂), nitrogen oxides (NO_x), and biochemical oxygen demand (BOD)), and estimate the net of the scale effect and the technique effect, and the composition effect.²

However, these previous studies do not consider the endogeneity problem³ in production (or income) and, thus, do not treat the effect of trade openness on production (or income) explicitly. Therefore, the effects of trade openness on emissions via income and production changes (i.e., the trade-induced scale and technique effects) cannot be compared with the composition effect induced by trade. As a result, we cannot infer the overall environmental consequences of trade as a summation of these effects. For instance, in the case of Cole and Elliott's [7] finding on SO₂ emissions, in which an increase in income reduces emissions (i.e., negative net scale and technique effects) while trade openness increases emissions (i.e., positive composition effects), we are not able to judge whether the overall sign of the effect of trade on emissions is positive or negative.

Furthermore, we need to note that an increase in income (or production) associated with trade openness might affect the composition effect. For example, the composition effect resulting from the ERE might be larger under more stringent policies. However, since the endogeneity of income is not considered in these previous studies, estimates of the composition effect induced by trade do not include this effect.

To clarify the short- and long-term effects of trade on the environment, we also apply a dynamic model to consider an adjustment process. Since the former studies do not consider the dynamic adjustment process, we must consider their results primarily to be short-term effects. This may explain why the effects of trade on the environment that they calculate are rather small.

Our main findings are as follows:

- (1) Both the data coverage and the estimation method affect the estimation results. Thus, to obtain appropriate estimation results, it is important to address the endogeneity problems and to have more data coverage.
- (2) Trade openness decreases BOD emissions both in OECD and non-OECD countries. However, it increases SO₂ and CO₂ emissions in non-OECD countries, while it decreases them in OECD countries.
- (3) There is a distinct difference between the short- and long-term effects of trade openness on the environment, implying that it is important to take dynamics into consideration. The difference in the short- and long-term overall effect of the trade openness is large in the case of SO₂ in OECD countries and SO₂ and CO₂ in non-OECD countries. On the other hand, the difference is relatively small in the other case.

2. Model

2.1. Empirical strategy

Antweiler et al. [1] analyze SO₂ concentrations in 43 countries from 1971 to 1996. They find positive scale effects, negative technique effects, and negative trade-induced composition effects. Thus, since the technique effects dominate the scale effects on average, they conclude that trade openness is associated with reduced pollution. Similarly, Cole and Elliott [7] and Cole [8] analyze country-level emissions (SO₂, CO₂, NO_x, and BOD) and energy consumption per capita, and they

¹ Since there is a strong correlation between a sector's capital intensity and its pollution intensity [7], the capital-intensive goods can be considered as pollution goods. Therefore, countries where the capital–labor ratio is relatively high are expected to have a comparative advantage in capital-intensive goods and thus, to produce more emissions. Trade openness would strengthen the effects of this comparative advantage and of any between-country differences in environmental policy on the industrial structure. Therefore, more openness would increase the production share of the goods in which these countries have a comparative advantage (i.e., capital-intensive goods). On the other hand, trade openness would reduce the comparative advantage of capital-intensive goods in countries that have relatively strict environmental policies (i.e., higher income countries) while increasing the comparative advantage of such goods in countries with less stringent environmental regulations (i.e., laxity is a source of comparative advantage). As a result, the production of capital-intensive goods under more stringent regulations decreases, and the emissions decrease. This is called the ERE, or, in other words, the pollution haven effect. The net effect of the composition effect as a result of trade openness could therefore be positive or negative, depending on the relative sizes of the KLE and the ERE.

² The scale effect and the technique effect are not separated in [7,8] because real GDP per capita is used as a proxy for both production and per capita income level. Therefore, the net of the scale effect and the technique effect is estimated and named the scale-technique effect. We call the net of the trade-induced scale effect and the trade-induced technique effect as the trade-induced scale-technique effect.

³ It should also be noted that this problem causes the biased estimation results. Trade openness is also considered to be the source of the other endogeneity problem, which is not addressed in the previous studies.

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