



Research article

International trade and carbon emissions: The role of Chinese institutional and policy reforms



Fredrik N.G. Andersson

Department of Economics, Lund University, Box 7082, 220 07 Lund, Sweden

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ABSTRACT

The carbon dioxide embodied in Chinese exports to developed countries increased rapidly from 1995 to 2008. We test the extent to which institutional reforms in China can explain this increase. We focus on five areas of reforms: trade liberalization, environmental institutions, legal and property rights, institutional risk and exchange rate policy. Our results show that trade liberalization, weak environmental institutions, exchange rate policy, and legal and property rights affect emissions. Our results also indicate that the lack of reform in the utilities sector is an important factor in the rapid increase in embodied emissions.

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1. Introduction

Carbon dioxide (CO₂) emissions emitted by developed countries have moderately increased or declined since the mid-1990s (IPCC).¹ The emissions embodied in the goods and services consumed, however, have increased more rapidly. For example, CO₂ emissions emitted in the United States increased 5% from 1995 to 2008 whereas the emissions embodied in its final consumption increased by 15% (World Input-Output Database²). A main contributing factor of the increase in consumption-based emissions is increased trade with China (Weber et al., 2008; Yunfeng and Laike, 2010). Chinese firms are less carbon efficient than those in developed countries (Druckman and Jackson, 2009; Peters et al., 2012), which has caused consumption-based emissions to increase when trade with China increases. China's imports from developed countries have also increased. However, the CO₂ content of Chinese imports is only one tenth as large as the CO₂ content of its exports. In this paper, we focus on the gross imports of carbon from China by developed countries.

The rapid increase of carbon imports from China by developed countries is often explained by China's entry into the World Trade Organization in 2001 (Vennemo et al., 2008) and weak Chinese

environmental institutions (Babiker, 2005; Ren et al., 2014). Although there is empirical support for these explanations, other factors may also have played important roles. A growing body of literature shows that institutions such as the independence of the legal system, property rights, and quality of regulations affect the level and composition of foreign trade (see, e.g., Costinot, 2009; Nunn, 2007; Ma et al., 2010).³ Trade between developed and developing countries respond positively when the quality of institutions improves in a developing country (Francois and Manchin, 2013). China has undergone major institutional and policy transformations since the 1990s, transforming the economy from a state-planned and controlled economy into a socialist market economy that increasingly protects property rights and relies on free market institutions (see, e.g., Nee and Opper, 2012; Coase and Wang, 2013). The contribution of various Chinese institutional reforms to the increase in emissions embodied in its exports remains an unexplored issue.

This paper disentangles how various institutional reforms in China have affected the CO₂ emissions embodied in its exports to 19 developed countries from 1995 to 2008. Five sets of institutional reforms are considered: environmental institutions, trade

E-mail address: ngf.andersson@nek.lu.se.

¹ <http://www.ipcc-data.org/>.

² http://www.wiod.org/new_site/home.htm.

³ We use the word institutions to indicate “the rules of the game” (see North, 1990), which include policies. There is a theoretical difference between institutions and policies but it is difficult to separate the two in practice. Thus, we include policies in the term institutions.

liberalization, regulatory and legal reforms, institutional risk and institutional inefficiencies, and exchange rate policy. Our results show that trade liberalization and environmental institutions are the most important factors but legal reforms and greater protection of property rights also contributed to increasing emissions. An additional result from our analysis is that most emissions embodied in Chinese exports originate from the utilities sector. This sector is dominated by state-owned firms and is heavily subsidized (Zhang, 2014). Extending free market institutions to this sector will likely lead to more competition, greater efficiency and fewer emissions.

The remainder of the paper is organized as follows: Section 2 outlines our hypotheses, Section 3 discusses the data and method, Section 4 contains the results, and Section 5 presents the paper's conclusions.

2. Trade, carbon emissions, and institutional reforms: five hypotheses

China is the largest emitter of CO₂ in the world. In 2008, approximately one-third of its emissions were emitted while producing goods for the export market (Weber et al., 2008; Yunfeng and Laike, 2010). Approximately 10 and 15 percent of emissions embodied in developed countries' consumption was emitted in China (WIOD). The emissions that a country's exports and imports contain depend on the level and composition of trade. More trade increases emissions and trade of heavy manufacturing goods causes more emission than trade in services. The volume of trade depends on factors such as the size of the trading economies, their geographical closeness, and the value of their respective exchange rates (Overman et al., 2003). The composition of trade is affected by countries' comparative advantage, which is linked to its endowment of natural resources, labor, capital, and technology (Helpman and Krugman, 2002).

Institutions play an important role in facilitating foreign trade (Levchenko, 2007; Nunn, 2007; Ranjan and Lee, 2007) and determining a country's comparative advantage (Feenstra et al., 2013; Nunn and Trefler, 2014) and thus the composition of trade. Countries with liberalized trade institutions trade more than countries that impose various forms of trade restrictions. Strong contract law and an independent judicial system also increase trade (Nunn, 2007; Ma et al., 2010). Developed and de-regulated financial markets enhance manufacturing exports (Beck, 2002), especially capital-intensive manufacturing exports (Rajan and Zingales, 1998). De-regulated labor market regulation improves the allocation of labor and skills between firms and increases the complexity of the goods a country exports (Costinot, 2009). All these institutions have an indirect effect on CO₂ emissions through their effect on trade flows.

Based on the literature on institutions and foreign trade, we identify five sets of institutions and institutional reforms that likely affected the CO₂ embodied in developed countries' final consumption originating from production in China. These institutions are (i) environmental institutions, (ii) trade liberalization, (iii) the quality of market regulation, (iv) institutional risk, and (v) the Chinese exchange rate policy.

2.1. Environmental institutions and their enforcement

Relatively stringent environmental institutions in one country can cause direct or indirect outsourcing of dirty production to countries with weaker environmental institutions (Cole, 2004). In the direct case, firms in countries with stronger institutions will re-allocate their production to countries with weaker institutions. In the indirect case, firms in countries with weaker institutions will

increase their global market share at the expense of firms in countries with stringent institutions. However, there is no physical re-allocation of firms.

In China, policy makers prioritized economic development ahead of environmental concerns at least until the 11th Five-Year Plan between 2006 and 2011 (He et al., 2012). Chinese environmental institutions have remained relatively weak despite some tightening after 2006. Contributing to the weakness of the environmental institutions is their sporadic enforcement; local authorities responsible for implementing environmental laws and regulations (Carter and Mol, 2007) are rewarded based on their economic performance, not on the state of the environment (Landry, 2005; Bo, 2004; Li, 1998). Personal rewards are obtained by attracting foreign firms and investments by refraining from implementing existing environmental laws and regulations, reducing the effect of existing institutions (Long et al., 2013). Moreover, state-owned enterprises often have a sizeable political influence over local authorities, which they sometimes use to reduce or avoid environmental taxes and regulations (Wang et al., 2003; Wang and Jin, 2007; Wang and Wheeler, 2003). State-owned enterprises are more likely to be active in heavy manufacturing than light manufacturing (China Statistical Bureau⁴), further reducing the effect of existing environmental institutions on emissions.

Environmental institutions in developed countries have become more stringent since the 1990s (Botta and Kozluk, 2014). A notable example of the strengthening of environmental institutions is the European Union's Emission Trading System (EU ETS), which began its first trading period in 2005. The differences in environmental institutions and their enforcement between China and the developed world are large and diverged well into the 2000s (Botta and Kozluk, 2014). Weaker environmental institutions have reduced the cost of production in China, especially in CO₂-intensive industries such as the metal and chemical industries, giving China a competitive advantage in these industries.

Our first hypothesis is as follows:

H1. *Relatively weak environmental institutions and enforcement in China compared to those in developed countries have increased the CO₂ embodied in Chinese exports to these countries.*

2.2. Trade liberalization

China pursued a policy of self-sufficiency after the communist revolution in 1949 until the beginning of economic reforms in 1978 (Young, 2000). For example, only 12 state-owned firms were allowed to engage in foreign trade in 1978 (Imbruno, 2016). An open-door policy was initiated in the 1980s, leading to the creation of a few special economic zones in provinces along the east coast where foreign firms were allowed to trade (Vennemo et al., 2008; Démurger et al., 2002). Trade barriers were drastically reduced in the 1990s and more than 35,000 firms were engaged in foreign trade by the mid-1990s (Imbruno, 2016). The trade liberalization process culminated with China's entry into the World Trade Organization (WTO) in December 2001 (Vennemo et al., 2008).

Trade volumes increase following trade liberalization. Starting from a low level, the growth in trade is likely to be high initially, especially after China's entry into the WTO, until a new equilibrium is reached. The rapid growth of imported emissions from China reflects a transition phase between two equilibriums.

Our second hypothesis is as follows:

⁴ <http://www.stats.gov.cn/english/>.

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