



# Firm ownership, China's export related emissions, and the responsibility issue



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## ABSTRACT

China's CO<sub>2</sub> emissions and those embodied in its exports have been extensively studied. One often neglected aspect is the prevalence of foreign-invested enterprises (FIEs) in China's exports, for which a substantial portion of benefits return to the investing countries. In this paper, we revisit China's export-related CO<sub>2</sub> emission responsibilities by viewing them from a "new", gross national income perspective. Using a recently developed environmental input–output framework, one which distinguishes firms by ownership and trade mode, we find that China's CO<sub>2</sub> emissions responsibility for each Yuan of national income from FIE exports, is actually higher than that attributable to Chinese owned enterprise (COE) exports. The result has a somewhat surprising implication: it suggests another source of conflict between China's and global interest in reducing CO<sub>2</sub> emissions. From a purely Chinese (as opposed to global) standpoint, a higher share of exports by COEs rather than FIEs is favorable, even though COEs emit more CO<sub>2</sub> when producing each unit of exports. This finding should sound an additional warning to those who still think that global climate change mitigation can be effectively pursued by allocating country-by-country emissions responsibility.

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## 1. Introduction

In recent years, carbon dioxide emissions embodied in international trade have attracted a great deal of interest from academic researchers and policymakers. International trade generates a geographic separation between the carbon dioxide content of goods used or consumed in a country (i.e. consumption-based responsibility) and the carbon dioxide emitted by a country in the production process (i.e. production-based responsibility). Not surprisingly, the gap between these two responsibility domains can be substantial. Peters et al. (2011), for example, estimated the total CO<sub>2</sub> emissions embodied in global international trade has increased from 4.3 Gt in 1990 (20% of global CO<sub>2</sub> emissions) to 7.8 Gt in 2008 (26% of global CO<sub>2</sub> emissions).

Among all countries, China's liability has been accentuated due to its dual role as the world largest exporter and the world largest emitter of CO<sub>2</sub> (see, e.g. Ahmad and Wyckoff, 2003; Peters et al., 2007; Yan and Yang, 2010; Liu and Ma, 2011; Shui and Harriss, 2006; Su et al., 2010, 2013; Liu and Ma, 2011; Su and Ang, 2013, 2014). A general finding is that the rapidity with which China became the world's leading CO<sub>2</sub>

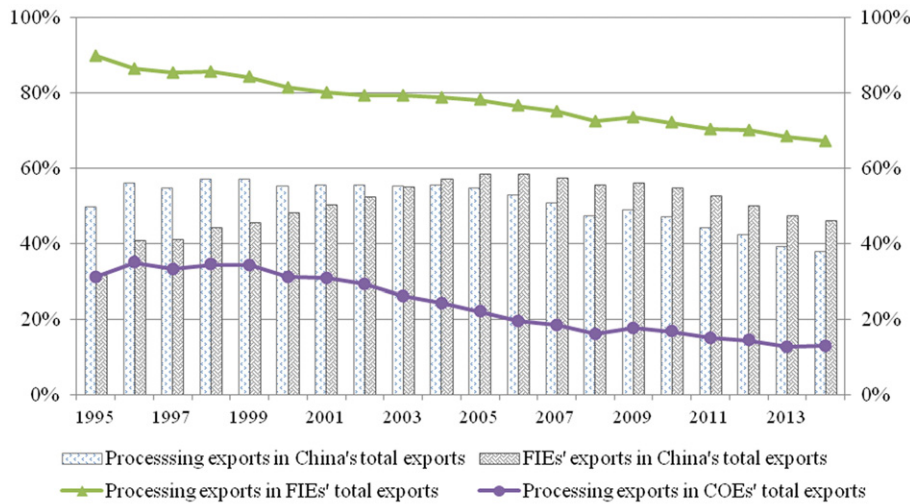
emitter is in good part attributable to the size and composition of its net exports. Su and Ang (2013), for example, found that the export-linked CO<sub>2</sub> emissions accounted for 18.1%–27.8% of China's total emissions in 1997–2007. Jiang et al. (2015a) estimated that net exports of manufactured goods accounted for between 15% and 20% of China's annual CO<sub>2</sub> emissions over the period 1997–2007.

One often neglected fact is that a substantial share of China's exports is attributable to foreign-invested enterprises (FIEs).<sup>1</sup> The share of FIEs in China's total exports peaked around 55% during the years 2005–2006; since then the share has slowly decreased reaching 45% in 2014 (Fig. 1).

There are two reasons why CO<sub>2</sub> emissions linked to FIE exports matter. First, up to 50% of the economic benefits generated by FIEs' exports return to the home countries (Ahmad and Ribarsky, 2014). Ma et al. (2015), for example, found that in 2007 foreign content accounted for 52.9% of the value-added generated by exports of FIEs' based in China,

<sup>1</sup> The current Chinese statistical system divides enterprises into three main types by their registration status, those that are Chinese owned enterprises (COEs); Hong Kong, Macao and Taiwan-invested enterprises (HMTs); and Foreign-invested enterprises (FIEs). More specifically, FIEs represent the enterprises whose foreign capital accounted for more than 25% of registered capital. HMTs are defined in a similar manner as FIEs. In the present paper, HMTs and 'pure' FIEs are referred to as FIEs since they have similar technologies.

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Data Source: China Customs.

Fig. 1. Processing exports and FIEs' exports in China (1995–2014).

whereas foreign content accounted for only 24.9% of the value-added generated by COE exports.<sup>2</sup> Therefore, CO<sub>2</sub> emission responsibilities embodied in each unit of national income from exports may differ significantly from the picture based on traditional emission intensity per unit of exports. Thus from a national-income-based perspective, it is both important and relevant to (i) compare the extent to which China is responsible for CO<sub>2</sub> emissions embodied in the exports of FIEs as compared to when they are produced by COEs, and (ii) suggest some potential implications for China and for global emissions policies.

Second, current estimation of emission levels does not distinguish firm ownership, which may lead to a distortion of China's exports-related CO<sub>2</sub> picture. For example, based on a firm-level dataset, Jiang et al. (2014) found that FIEs in China emitted less (sulfur dioxide, burned dust, and industrial soot) than did their domestic counterparts when producing the same kind and amount of outputs. Based on a "new" input–output table that distinguishes firm ownership (Chinese owned and foreign-invested enterprises, (COEs and FIEs) and trade mode (processing exports and normal use), Jiang et al. (2015b)) found that the total energy intensities of COEs in the industrial sector are generally 5%–35% higher than that of FIEs within the same industry group and production type. It is logical to assume that the same may apply to CO<sub>2</sub> as well, since most of these emissions are generated from combusting fossil fuels. If it does apply then unless the production activities of FIEs and Chinese owned enterprises (COEs) are appropriately distinguished, ignoring firm ownership may lead to an overestimation of China's exports-related CO<sub>2</sub> emissions. Due to a lack of official statistics on energy consumption and CO<sub>2</sub> emissions by firm ownership, there is little or no literature, to our knowledge, that has estimated the extent to which the FIEs are responsible for the CO<sub>2</sub> emissions embodied in China's exports.

There is another important distinction to be made. China's exports are characterized by a high proportion of export processing or what is termed "processing trade". As Fig. 1 indicates, processing exports persistently accounted for about half of China's total exports since the early 1990s. Using a tripartite Chinese IO table capturing processing trade, Dietzenbacher et al. (2012) found that the contribution of exports to China's CO<sub>2</sub> emissions in 2002 was overstated in the scholarly literature. The overstatement is attributable to a failure to distinguish between processing exports and normal

production, because the former mainly involves assembly and packaging activities with low CO<sub>2</sub> emissions. Su et al. (2013) also found that CO<sub>2</sub> emission intensity embodied in each unit of processing exports is much less than that in non-processing exports. As a result, they suggested that one should distinguish the production activities of processing and non-processing exports when evaluating the contributions of exports to China's CO<sub>2</sub> emissions.

An important implication of the foregoing is that the emission intensity advantage of FIEs over COEs might be at least partly attributable to the high proportion of processing exports by FIEs. In the 2000s, 70%–80% of FIEs' exports were attributable to processing exports, for which emission intensities are relatively low (Dietzenbacher et al., 2012; Su et al., 2013; Weitzel and Ma, 2014). In contrast, only 15%–25% of COE exports are attributable to processing exports (Fig. 1). Therefore, in this paper, to capture both the ownership and trade type distinctions, we employed the input–output that distinguishes firm ownership and trade mode that is used by Jiang et al. (2015b), and compiled a corresponding carbon emissions dataset, to estimate the CO<sub>2</sub> emissions embodied in China's corresponding exports by production type and compare the CO<sub>2</sub> emission intensities per unit of national income from exports by firm ownership.

Despite of the similar methodology and dataset, by introducing a national income perspective and focusing on CO<sub>2</sub> emissions rather than embodied energy, the findings and policy implications of this paper are significantly different from that of Jiang et al. (2015b). Jiang et al. (2015b) mainly investigated the energy saving potentials associated with the firm ownership-related differences in energy efficiency. Its major implication is that from a global energy saving perspective, FIEs appear to be a very efficient channel to encourage advanced energy-saving technology spillovers or transfers from developed to developing countries. In this paper we find that China's CO<sub>2</sub> emissions responsibility for each Yuan of national income from FIE exports is actually higher than that attributable to COE exports. It thus suggests a conflict between China's and global interests in reducing CO<sub>2</sub> emissions. From a purely Chinese (as opposed to global) standpoint, a higher share of exports by COEs rather than FIEs is favorable, even though COEs emit more CO<sub>2</sub> when producing each unit of exports. This finding provides a warning for the policy-making of global climate change mitigations that mainly focused on allocation of emission responsibility.

The paper is organized as follows: in Section 2 we introduce the basic model and the data compilation; in Section 3 we estimate CO<sub>2</sub> emissions embodied in China's exports by firm ownership and trade mode, and

<sup>2</sup> On the one hand, COEs may have foreign capital as well, as long as the foreign capital accounted for less than 25% of registered capital; On the other hand, COEs may import intermediates; in that respect foreign countries would benefit from COEs' exports as well.

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