Energy Policy 92 (2016) 205–213

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Opinion paper

# Bi-lateral $CO_2$ emissions embodied in Australia–China trade

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## HIGHLIGHTS

- Primary (Australia) and manufactured (China) exports are a unique combination.
- Quantifies $CO_2$ emissions embodied in bi-lateral trade between Australia and China.
- Global emissions reduce because China consume Australian primary.
- Australia is energy efficient producer of primary products relative to China.
- Results support more trade with appropriate trade composition and volume.

## ARTICLE INFO

*Article history:*
Received 12 May 2015
Received in revised form
3 February 2016
Accepted 5 February 2016

*JEL Codes:*
F18
C67
L51

*Keywords:*
Carbon leakage
Australia–China bilateral trade
Input–output table

## ABSTRACT

This paper quantifies the $CO_2$ emissions embodied in bi-lateral trade between Australia and China using a sectoral input–output model. The results revealed: (1) that China performs lower than Australia in clean technology in the primary, manufacturing, energy sectors due to their overuse of coal and inefficient sectoral production processes, and (2) that China had a 30.94 Mt surplus of bi-lateral $CO_2$ emissions in 2010–2011 and (3) overall global emissions were reduced by 20.19 Mt through Australia–China trade in 2010–2011. The result indicates that the greater the energy efficient a country among the trading partners the lower will be the overall global $CO_2$ emissions. Global emissions decreased mainly because China consumed Australian primary products rather than producing them. Australia is an energy efficient producer of primary products relative to China. The bilateral trade compositions and trade volume played an important role in lowering global emissions and therefore one can view proposed China Australia Free trade Agreement positively in reducing global emissions. However, for the sustainable development, China should strengthen clean energy use and both countries should adopt measures to create an emission trading scheme in order to avoid protectionism in the form of future border price adjustments.


## 1. Introduction

China ranks as the biggest trading partner for Australia and Australia remains the eighth largest trade partner for China since 2008. Australia's export of goods and services to China are mainly primary and they have grown rapidly with an average annual growth rate of around 25%, whereas imports from China are mainly manufactured products that have grown around 8% during the 2005–2012 period. The primary exports of Australia and the manufactured goods of China are the primary focus of the Australia–China bilateral trade agreement that deviates from the USA–China bilateral trade composition. Those assessments of the causes and consequences of the Australia–China bilateral trade focused primarily on the economic and political factors and paid almost no attention on the environmental implications. By rank, China is the 1st top emitter of $CO_2$, and Australia is around the 14th emitter in the world. Estimating $CO_2$ embodiments in Australia–China bilateral trade is one of the ways of capturing the environmental implications of international trade that are not addressed and where the research gap prevails. Decreasing domestic $CO_2$ emissions may not be effective if imports continue to contribute to domestic consumption (Wyckoff and Roop, 1994) because this will result in increased $CO_2$ embodiments via imports and undermine every effort being made to address global warming.

Both countries are under pressure on climate change negotiations to reduce their greenhouse gas emissions by imposing credible measures. If these calls are to be heeded, appropriate statistical evidence of all aspects, including bilateral sectoral carbon leakage, must first be made available. Despite those facts, only

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http://dx.doi.org/10.1016/j.enpol.2016.02.011
0301-4215/

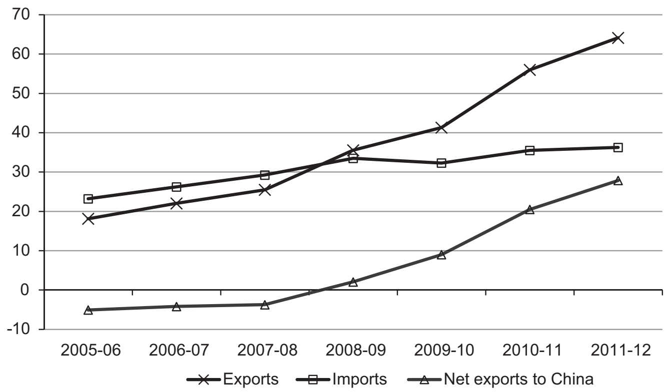


**Fig. 1.** Australia's Trade with China: 2005 – 2006 to 2011 – 2012 (billion A$, 2005 prices). *Source:* ABS (2013b).

Tan et al. (2013) examined the $CO_2$ emissions embodied in the Australia–China trade in bilateral context using Emissions Embodied in Bilateral Trade (EEBT) and concluded that bilateral trade contributed to a reduction of the global carbon emissions during the period 2002–2010.[1] Trade between these two countries has been expanding rapidly since 2009 (Fig. 1) and a China Australia Free trade Agreement (ChAFTA) has been signed recently. This study will not only fill this existing research gap on bilateral carbon leakage, it will also take Australia and China bilateral trade as a special case for exploring the nature of $CO_2$ embodiments for primary and manufactured trade.

### 1.1. Australia–China bilateral trade

In late 2007, China surpassed Japan as Australia's biggest trading partner. In 2009, China was promoted as Australia's biggest export destination. Being Australia's first biggest trading partner, China might have a significant effect on the Australian economy and environment by any changes to these liberal trade policies. Prior studies of bilateral trade between Australia and China have generally concluded that each country's individual comparative advantages drive the trade (Sheng and Song, 2008). Australia's exports to China are mainly primary products such as mineral, agricultural, and energy related goods, while China's exports to Australia are manufactured goods. Bilateral trade flows have generated a high degree of trade complementarity between Australia and China, showing that freer trade will tend to increase their mutual trade gains (McDonald et al., 2005). The authors estimated the revealed comparative advantage (RCA)[2] indices and applied global trade and environment model (GTEM) in their analysis.

Australia's export of goods and services to China have grown rapidly from A$18.14 billion in 2005–2006 to A$64.13 billion in 2011 – 2012, with an average annual growth rate of 25%, while the total imports from China increased from A$23.20 billion in 2005–2006 to A$36.26 billion in 2011–12, which represents around an 8% annual growth rate (Fig. 1). Because of a substantial increase of primary exports to China, especially from 2008–2009, net exports from Australia have grown rapidly, mainly due to the increased rate of growth of Australia's exports to China. The majority of exports to China are primary goods such as iron ore, coal, gold, and crude petroleum, while the majority of imports from China are manufactured goods such as metal, non-metallic minerals, machinery and equipment, wood, paper, petroleum, clothing, and furniture. The rapid growth of industries, construction, and transportation in China has driven the energy demand from Australia (Zhao and Wu, 2006). The ChAFTA was signed off in 2015 after a decade long negotiations. If this agreement is fully implemented, then 95% of Australian exports (mainly primary products) will be tariff free in China and allow greater access in China's market for Australian goods and services, increase investment in Australian industry and infrastructure and access for cheaper Chinese manufactured goods in Australia.

Since 2014, China's GDP growth began falling to around 7% and recorded its lowest level of growth since the economic reforms were introduced in the early 1980s. As a consequence, one can observe a reducing role of commodity-based infrastructure sectors in the economy and shifting investments on more consumption-based sectors in future. The expectation is that this hinders Australian resource exports to China but not ruling out exports of agriculture, services, tourism and education. In the meantime, if a ChAFTA is implemented successfully and appropriately then there will be a rapid increase in primary exports from Australia and manufacturing imports from China. Such a structural change in bilateral trade composition and trade volumes has implications in bilateral energy use, bilateral emissions and overall global emissions in future.

### 1.2. Carbon leakage

Greater global integration increases the division between the location of production and consumption and requires sophisticated methods for accounting global emissions in order to reach agreements in reducing $CO_2$ emissions on global climate change negotiations. These concerns have resulted in a call for the Kyoto protocol. The Kyoto protocol is fundamentally a non-discriminatory global policy to simultaneously and significantly reduce carbon leakage and loss in competitiveness. Any sub-global policies to reduce greenhouse gas emissions are potentially sensitive to both carbon leakage and loss in competitiveness for carbon constrained countries because they discriminate against carbon constrained and non-carbon constrained countries.

Carbon leakage may be defined as the displacement of carbon emissions as a consequence of a shift in their environmental policy by a sector/industry and/or country. In the recent past industry perspective carbon leakage across countries has been linked to competitiveness, where the competitiveness of an industry reflects its ability to maintain profits and market share. Carbon constraint nations are likely to import from nations with lesser environmental standards and as a result end up uncompetitive in an industry with pollution concentrated products (Antweiler et al., 2001). Thus, non-carbon constrained countries gain the upper hand in pollution intensive industries relative to carbon constrained countries.

If these concerns are to be heeded, appropriate statistics of carbon leakage and loss of competitiveness must first be estimated upon global and bilateral trade by nations. The traditional production based approach in our Australia–China bilateral trade example means that China is made accountable for their emissions despite the fact that some of their production is consumed in Australia. A consumption based approach to account for greenhouse gas permits emissions to be allocated to individual nations in a reliable manner, based on their final consumption (Wiedmann, 2009). This method estimates $CO_2$ emissions regardless of where they were produced and promotes equity by allocating the reductions appropriately while avoiding carbon leakage, by increasing the option of mitigation (Peters and Hertwich, 2008).

[1] Peters and Hertwich (2008) studied both China and Australia but not at bilateral context. By incorporating 87 countries authors find that globally there are over 5.3 Gt of $CO_2$ embodied in trade and that Annex B countries are net importers. There are considerable variations in the embodied emissions based on country size variables and geographic locations.

[2] RCA is defined as observed trade patterns that show both relative costs and variation of factor intensities. This measure is an indirect measure to resolve the difficulties in measuring comparative advantage.