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The Potential Impacts of Carbon Border Adjustment Mechanism on Carbon Neutrality of China

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Carbon emissions neutrality has been a strategic target of many countries. Most of them have set the deadline at around the middle of this century in spite of very few already achieved. Different kinds of policies and strategies have been made during the past years, including the Carbon Border Adjustment Mechanism (CBAM) from the EU. The CBAM is a carbon tariff on carbon emissions intensive products, such as cement and some electricity. It was imported by the EU currently being legislated as part of the European Green Deal and will to take effect in 2026 with reporting starting in 2023. As the largest economic partner of the EU, China export a large number of products to the EU every year. China has also promised achieving the carbon neutrality target by 2060. It could be predictable that the CBAM would have significant impact on the industrial activities, exportation and the progress of the carbon neutrality of China. However, it is not clear that what impacts and how significance it would be. It is crucial and urgent to explore the impacts of CBAM on the carbon emissions of China and relevant policies. This work makes a review on the state of the art on this topic, the development of CBAM and potential impacts on the carbon neutrality target of China, providing support for relevant research in the future.

1. Introduction

Carbon Border Adjustment Mechanism (CBAM) aims to level the playing field and reduce carbon leakage through import taxes and/or export subsidies based on the carbon content for products from countries with different levels of carbon policy stringency (Zhong and Pei, 2023). The introduction of an EU CBAM has triggered a lively debate on its potential impacts, especially among developing countries. The European Union has been working on the legislative process for a new tariff on carbon emissions intensive and energy-intensive products imports. The cross-border climate regulation, called CBAM, will cover goods imports for five industrial sectors, including iron and steel, cement, fertilizer, aluminium and electricity generation (Lin and Zhao, 2023). CBAM would have significant impacts on the rest of the world in terms of economic activities, international trade, inter-regional policies, and environmental performance. In 2020, the report of “Carbon Border Adjustment Mechanisms and Their Economic Impact on Finland and the EU” was published and it addressed CBAM and its economic implications (Kuusi et al., 2020). In the report, it put that while a CBAM is proposed as a solution to the EU’s carbon leakage problem, it is acknowledged that there are several ways to implement CBAMs, with varying combinations of technical difficulties, administrative burden, legal risks, and risks of political backlash. Different scenarios were constructed in which the CBAM is designed based on feasibility considerations and compare them with broader, but also more complex, alternatives.
China has promised to reach the peak of carbon emissions before 2030 and achieve carbon emissions neutrality before the year of 2060, which very much depends on the energy structure transformation, energy storage technologies improvement, regional cooperation, carbon sequestration progressing, etc.(Wang et al., 2022b).

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As the largest energy consumer and primary consumer, China consumed around 145 EJ in 2020, which was far more than that was consumed by the US and India, which ranked second and third place in the list (Wang et al., 2021). Fossil fuels, especially coal and oil, are still the pillar of energy in China, despite increasing renewables. The direct consumption of a large amount of fossil fuel has been resulting in a serious environmental burden, including GHG emissions, particulate matter emissions, and other air pollutant emissions (Wang et al., 2022a). China is also one the largest exporters worldwide, especially to the EU with iron and steel and relevant products. It is predictable that the CABM policy would significantly exert impacts on the international trade between China and the EU. It has been revealed that EU has been the second largest region that transits embodied carbon emissions to China, as it imports a huge number of products during the inter-regional trade, especially that between China and the EU countries like Germany, France and Italy, as it is shown in Figure 1.

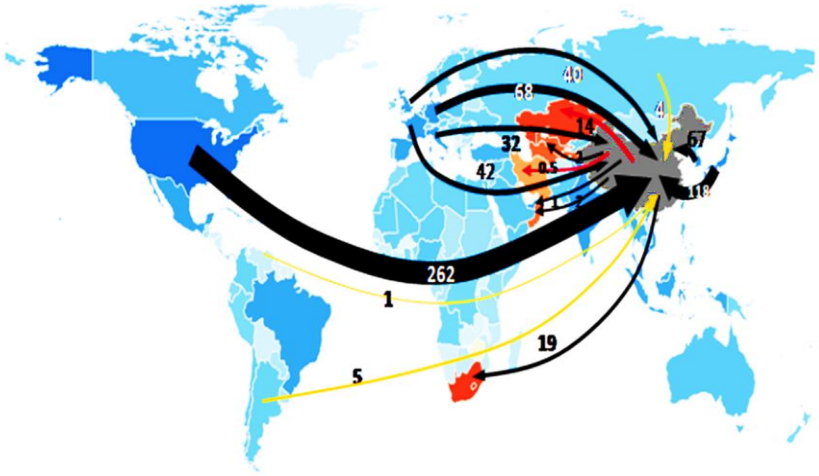

Figure 1: Net emission flows embodied in international trade among China and the rest of the world, as shown by the black arrows (Adopted from (Wang et al., 2020))

Based on the contribution from Kuusi et al. (2020), the CBAM may face major implementation hurdles in its deployment going forward. The proper way with limited administrative challenges would be to test its use with a narrow set of imported products that are emission intensive. After considering a feasible alternative, it is revealed that the CBAM would serve more as a signal of the EU's determination to resolve the carbon leakage problem rather than as a true solution to it, and the economic and environmental impact of such a narrow tariff would most likely be small (Kuusi et al., 2020).
The real consequences are still not clear for the whole world if the CABM would be implemented, and especially for China. For clearly understand the state of the art on the topic of CABM and its potential effects, this paper aims at reviewing the development track of CABM, the reaction of different countries or regions, and its potential impacts on the carbon neutrality target of China.

2. CBAM development

A successful fight against climate change requires a considerable decrease in the use of carbon-based materials, especially in the various ways they are used to produce energy in production and transportation. By raising the relative price of carbon-intensive production, consumption patterns and thereby production itself will adjust and the use of carbon (oil, coal, natural gas, etc.) and thereby CO_2 emissions will decline. The Emissions Trading Scheme of EU was constructed in order to make it more costly to emit CO_2 in production (Efthymiou and Papatheodorou, 2019). If the producer does not decrease the CO_2 intensity of its product, the product's relative price increases and it loses market shares. This is the principle of CBAM. CBAM has been significantly developed during the past years and there are some key matters that contribute to its progress, as shown in Table 1. The CBAM was firstly officially endorsed by the EU on 11 December 2019, in the Communication on the European Green Deal, which features the proposal for CBAM for energy-intensive sectors as a central component of its future climate action plans. Until 10 January 2023, the CBAM has been decided that it will enter into force in its transitional phase as of 1 October 2023, while the obligation for importers to pay a levy will kick in as of 2026. It will initially apply to imports of certain goods and selected precursors whose production is carbon intensive and at most significant risk of carbon leakage: cement, iron and steel, aluminium, fertilisers, electricity and hydrogen.

Table 1: Key matters of the CBAM legislative process

Date	Key matters
11.12.2019	The EU officially endorsed its Communication on the European Green Deal, which features the proposal for CBAM for energy-intensive sectors as a central component of its future climate action plans.
19.10.2020	The European Commission Work Programme 2021, "A Union of vitality in a world of fragility," was proposed, and planned to propose CBAM. It aims to encourage foreign producers and EU importers to decrease carbon emissions while maintaining a fair-trade environment in accordance with World Trade Organization (WTO) regulations.
10.03.2021	The introduction of CBAM was supported by the European Parliament, mentioned that it is compatible with WTO rules and EU free trade agreements (FTAs).
14.07.2021	The European Commission presented its blueprint for a regulation establishing CBAM. It aims at mitigating the risk of carbon leakage resulting from the mismatched climate policies between the EU and non-EU nations.
15.03.2022	The Council of the European Union reached an agreement on CBAM and released its compromise text. The European Parliament, Council and Commission will enter trialogue negotiations.
22.06.2022	The European Parliament adopts its position on the regulation establishing CBAM with 450 votes for, 115 votes against, and 55 abstentions.
13.12.2022	The Council of the European Union and European Parliament came to a provisional agreement on the final text of a CBAM regulation. The compromise text was released to the public in January 2023.
10.01.2023	The CBAM will enter into force in its transitional phase as of 1 October 2023, while the obligation for importers to pay a levy will kick in as of 2026. It will initially apply to imports of certain goods and selected precursors whose production is carbon intensive and at most significant risk of carbon leakage: cement, iron and steel, aluminium, fertilisers, electricity and hydrogen.

*The table is developed based on the information from the European Parliament (2023), publication of Lin and Zhao (2023), and (European Commission, 2023).

The CBAM has been drawn significant increasing attention worldwide. By searching keywords "Carbon Border Adjustment Mechanism" or "Border Tax Adjustment" or "Carbon Tariff" and must include keyword "Carbon" in the Web of Science, there is a very impressive shoot up from 2020 in the number of relevant publications, as shown in Figure 2.

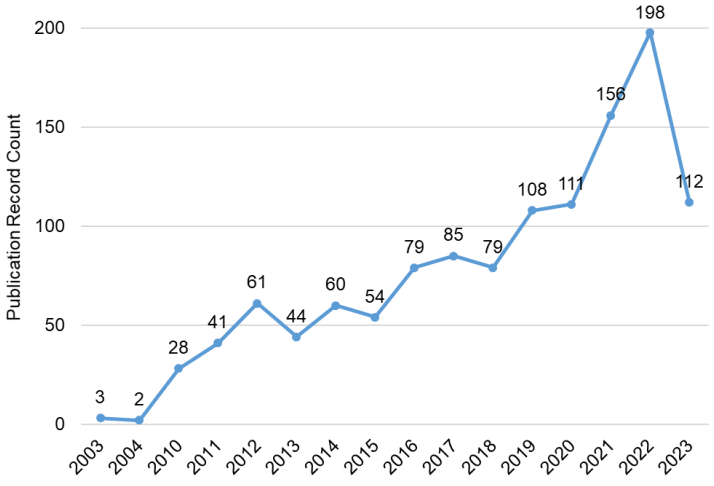

Figure 2: Publications of CBAM and relevant

Interesting thing is that, the earliest paper with this keyword was published in 2003 by Krause et al. (2003), when was much earlier than that CBAM was proposed. In their study, how an integrated least-cost implementation of the Kyoto Protocol in the United States would affect US. competitiveness and jobs were examined. The authors analysed integrated emission reduction strategies based on a $ 50/ton carbon tax (including border tax adjustments), a payroll tax cut, energy-productivity-oriented market reforms, and

international flexibility mechanisms (Krause et al., 2003). It also compared the policy portfolios to conventional approaches that omit market and fiscal reforms and found that the percentage increase in the price of exports or in domestic products relative to imports depends on whether a border tax adjustment is implemented. The analysis shows that relative to purchasing international emission rights, productivity-raising domestic market, institutional, and fiscal reforms offer much broader advantages for trade-exposed industries. Though allowance purchases alone increase export prices of manufactured goods and services, an integrated no-regrets strategy reduces export prices for the large majority of industries and limits the impact of climate protection policies on the few most energy-intensive basic materials industries to very small levels.

From 2020, when the CBAM was widely mentioned, an increasingly number of works have been conducted by range of authors. It has been a hot topic and drawing increasing attention worldwide, especially that from the developing countries/regions and the top one is China, as shown in Figure 3. As China is one the biggest international trade partners of the EU, the CBAM would definitely release significant impacts on China's industries and market, which is also the reason that so many authors from China pay big attentions to the topic. China is followed by England (or the UK), which is because of the Brexit and it very much concern about the potential impacts of CBAM. The USA is also the top tier economic partner of the EU, contributing the third most publications about CBAM.

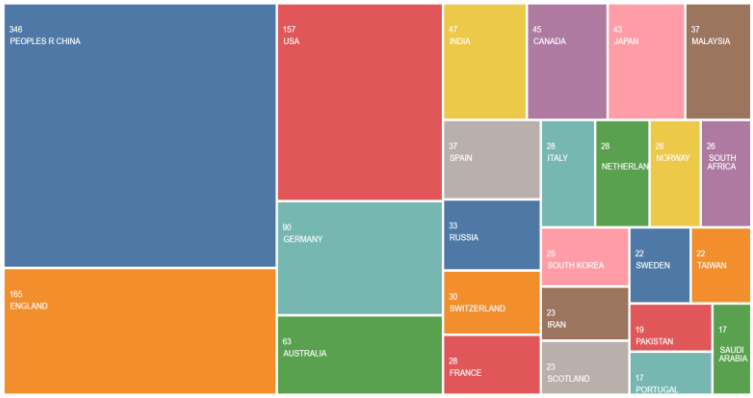

Figure 3: Publications by countries/regions

Regarding the top affiliations that with the most relevant publications, two of them from China lead the list, namely are the Chinese Academy of Sciences with 31 publications and the North China Electric Power University with 29 publications, and seven of the top 20 affiliations are from China, as shown in Figure 4. Most of the top 20 ones are from China, the UK and American.

Figure 4: Publications by affiliations

3. Potential impacts of CBAM on carbon neutrality of China

In fact, introducing CBAM is not a new idea. A number of works have been conducted and investigate this policy over the last decade, especially those from China and exploring the potential impacts of CBAM on carbon neutrality target of China.

Against this backdrop, Zhong and Pei (2023) conducts a systematic literature review of the most recent studies of CBAM and provides an exhaustive synthesis. They synthesize findings on how policy design and characteristics of an economy lead to different levels and types of effectiveness of a CBAM and contrast alternative policy designs across various objectives. Armed with this systematic review of the literature, the insights and challenges in formulating effective CBAM polices are spelt out. It is suggested that there is no one-size-fits-all approach to design and implement CBAM to tackle competitiveness and carbon leakage, policy design and characteristics of the economy matter. In formulating sound CBAM policies, competitiveness, carbon leakage and welfare evaluation are central economic concerns. However, consistency with the latest international climate policy architecture and fairness issues should also be addressed.

The potential impact of the CBAM based on the GTAP Model was conducted by Siy et al. (2023). It reveals that the progressive emergence of a new international trade system driven by “climate change actions”, “carbon peaking”, and “carbon neutrality”, which will have a broad and far-reaching impact on international trade, including China’s foreign trade industry. As more industries are being covered by the CBAM, it will exert a negative impact on the social welfare and export of China as well, the largest trading partner of the EU, even though the existing mechanism has only limited economic impact on China’s energy industry.

Lin and Zhao (2023) evaluated the current effects of upcoming CBAM on China's steel and aluminium market, providing a strong evidence of a significant decrease in returns for steel rebar and aluminium futures. However, there exists a stronger effect on aluminium futures than steel rebar due to the higher export intensity and carbon emission of aluminium products. It also finds that the CBAM event subsidized aluminium’s carbon dioxide emissions by around 24 RMB per metric ton by quantifying the effect size of the event on the futures prices. Shortening the implementation lag of climate policies and limit the potential for new production capacity are reasonable approached for stakeholders and policymakers.

Ren et al. (2023) analysed the effect of CBAM on the interregional plastic trade between China and the EU, revealing that CBAM would exacerbate the economic-carbon inequality in the plastic trade. They also found that China and the rest of Asia and the Pacific would burden the most CBAM costs in all cases, and Russia would be the country most affected. CBAM would exacerbate the economic-carbon inequality in the plastic trade by reducing the trade profits of developing economies with higher ratios than those of developed economies.

In this study, the potential impact of CBAM on the iron and steel industry of China was preliminarily predicted by the authors, using the Grey GM (1, 1) model, as shown in Figure 5. The results show that, both of the total carbon emissions and carbon emissions intensity of iron and steel industry in China would decrease in the future because of the EU CBAM policy. Good thing is that the carbon emissions intensity would be significantly promoted, from 1.3 to 0.7 tCO2 per ton iron and steel product. However, based on the output, the export amount of iron and steel products from China to the EU would decrease as well, which would drop from 3,8 Mt to 1.3 Mt from 2021 to 2030. This would have very significant and uncertainty effect on the international trade between China and the EU, and the rest of the world as well.

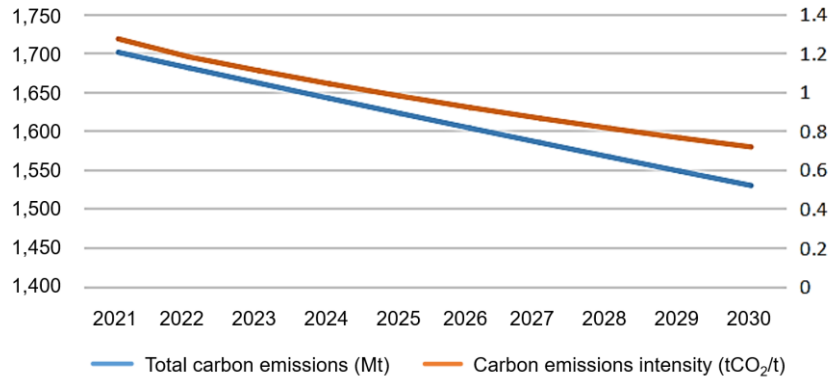

Figure 5: Potential impact of CBAM on the iron and steel industry of China, developed by the authors

China has promised achieving the carbon neutrality goal by 2060, which is a crucial target and big effort has been making for progressing it. The CBAM was proposed aims at reducing carbon leakage through import taxes and/or export subsidies based on the carbon content for products from countries with different levels of carbon policy stringency, which would benefit the EU significantly. However, its potential impacts on the developing countries, including China, are uncertain. All stakeholders and policy-makers should make policies and strategies from the global view.

4. Conclusions

For understanding the state of the art of the CBAM development and it potential impacts on the carbon neutrality target of China, this study makes a systematically review in terms of CBAM development, number of relevant publications, top relevant publication regions and affiliations and potential impacts of CBAM on carbon neutrality of China. The potential impacts of CBAM on different industries in China were preliminarily reviewed as well, especially on the iron and steel industry. It can be concluded that: 1) the CBAM policy has been significantly developed during the past years, especially from 2019 to 2023. It has been a very hot topic with booming relevant publications; 2) The top countries/regions that most concern about CBAM and contribute most relevant research publications are China, the UK and the US. And the top affiliations are Chinese Academy of Sciences and the North China Electric Power University; 3) CBAM would have significant impacts on the international trade and the carbon neutrality target of China, especially the carbon emissions intensity industries, such as iron and steel and aluminium. It is predicted by the authors that the carbon emissions intensity of iron and steel industry in China would be significantly promoted, from 1.3 tCO_2 to 0.7 tCO_2 per ton iron and steel product. However, based on the output, the export amount of iron and steel products from China to the EU would decrease significantly as well, from 3,8 Mt to 1.3 Mt from 2021 to 2030. This would have very significant and uncertainty effect on the international trade between China and the EU, as well as the rest of the world.

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