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The Carbon Border Adjustment Mechanism (CBAM): A New Approach to Climate Change Regulation and Its Implications for National Security, Labour, Trade, and Data Flows

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Abstract: The Carbon Border Adjustment Mechanism (CBAM) is tool designed to address the challenge of reducing greenhouse gas emissions while ensuring fair competition for industries within the EU. The paper analyses the CBAM' for regulating climate change and its broad ramifications. The CBAM is expected to limit greenhouse gases and contribute to global efforts to combat climate change. This article explores key features of the mechanism, looking at its guiding principles, expected advantages, and potential drawbacks. The analysis concludes that the European Union's Carbon Border Adjustment Mechanism (CBAM) exerts a negative impact on industries, highlighting the necessity of integrating the CBAM within the overarching framework of allowance allocation. Such integration would ensure the design of an allowance allocation system that preserves cost efficiency across sectors. Furthermore, the study suggests that a higher, more consistent carbon price in China could serve as an effective countermeasure to mitigate the adverse effects of the EU CBAM, thereby stabilizing the cost-effectiveness of various industries. Notably, the impact of the EU CBAM on industry cost efficiency would significantly diminish once the Chinese carbon price reaches 60 RMB per ton. Lastly, the research indicates that, beyond a certain export volume threshold to the EU, efforts to limit exports become increasingly ineffective in reducing the CBAM's impact

Keywords: Carbon Border Adjustment Mechanism (CBAM), Trade

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1. Introduction

As global temperatures continue to rise at an unprecedented rate—with the world having already warmed by approximately 1.2°C since pre-industrial times, the need for urgent, transformative action on climate change has never been clearer. One such policy response, the European Union's Carbon Border Adjustment Mechanism (CBAM), is designed to curb carbon leakage and incentivize cleaner industries worldwide. However, a closer examination reveals several significant implications for both international trade and industrial competitiveness. The international community has significantly stepped-up efforts to deal with climate change. In recent years after realising the urgent need for collaborative efforts to reduce the damage to the environment and slow the rise in global temperatures (Chovancová, Popovičová, & Huttmanová, 2023). Due to the extensive global effects of climate change, immediate and productive solutions from all countries around the world is required (Barnett, 2003). The Carbon Border Adjustment Mechanism (CBAM) is a key strategy for reducing these effects (Zhong & Pei, 2023). CBAM's backgrounds can be related to earlier studies investigating border carbon adjustments. CBAM is an example of a modern strategy that connects environmental goals to the complex web of international trade (Kuo & Chou, 2023).

A pivotal study conducted by Khurshid, Qayyum, Calin, Saleem, and Nazir (2022) explored into the concept of placing carbon taxes on imports, with the aim of terminating the migration of carbon emissions to other regions. The findings of this study highlighted the efficacy of such measures in incentivizing local industries to adopt cleaner production practices. Building on this mechanism, a subsequent study led by Gronau, Hoelzen, Mueller, and Hanke-Rauschenbach (2023) focus on the potential impact of individual nations imposing carbon taxes on imports. Their research demonstrated a substantial potential for emission reduction through this approach.

Furthermore, the increasing recognition of climate change as a critical threat to our planet has spurred discussions on novel strategies to mitigate its effects while fostering sustainable economic growth (Kuo & Chou, 2023; Ibn-Mohammed, Mustapha, Godsell, Adamu, Babatunde, Akintade, & Koh, 2021). The CBAM aims to internalize the external costs of carbon emissions in international trade by imposing carbon-related costs on imported goods based on their embedded carbon footprint (Grubb, Jordan, Hertwich, Neuhoff, Das, Bandyopadhyay, & Oh, 2022). This mechanism effectively creates an economic incentive for both domestic and foreign producers to reduce their emissions, aligning economic interests with environmental responsibilities (Chen, Yang, Wang, & Choi, 2020). The CBAM is poised to reshape the landscape of international trade, fostering a shift towards more sustainable production processes across borders (Leal-Arcas, Hast, Sperka, Mittal, Kasak-Gliboff, & Prakash, 2022).

To strengthen the previous statement, according to Lehmen (2021), one such approach that has gained attraction in recent years is the Carbon Border Adjustment Mechanism (CBAM), a multifaceted policy tool designed to bridge the gap between environmental responsibility and economic vitality (Lehmen, 2021). Moreover, the CBAM represents a paradigm shift in climate change regulation by addressing a central dilemma: reconciling global environmental goals with the competitiveness of domestic industries. As the adverse impacts of carbon leakage become increasingly evident, concerns about the relocation of carbon-intensive industries to regions with lax emission standards have amplified (Rübbelke, Vögele, Grajewski, & Zobel, 2022). This has created a compelling case for the CBAM's adoption, aimed at ensuring that imported goods are subject to the same carbon pricing principles as those produced domestically (Zhong & Pei, 2023). The CBAM thereby seeks to establish a level playing field that discourages carbon leakage while incentivizing the reduction of greenhouse gas emissions across the global supply chain (Rübbelke, Vögele, Grajewski, & Zobel, 2022).

Further, National security considerations have entered the dialogue due to the intricate connections between climate change, resource scarcity, and geopolitical stability (Barnett, 2003). As climate-induced phenomena such as extreme weather events, water shortages, and food insecurity amplify, the potential for increased migration flows and conflicts over limited resources becomes evident. The CBAM could potentially play a role in mitigating such risks by encouraging countries to internalize the security implications of their carbon emissions, thereby fostering a more resilient and stable global order (Hancock & Wollersheim, 2021).

In recent decades, the international community has witnessed an unprecedented surge in efforts to combat climate change, with the Paris Agreement of 2015 emerging as a pivotal milestone (Monasterolo, Battiston, Janetos, & Zheng, 2017; Sachs, 2019). However, despite these commendable endeavors, the complex dynamics of global trade and production have led to an intricate challenge: how to prevent the "carbon leakage" phenomenon. Carbon leakage occurs when stringent climate regulations in one jurisdiction indicate to the relocation of carbon-intensive industries to areas with lax environmental standards, effectively transferring emissions rather than reducing them (Koch, 2018; Rübbelke, Vögele, Grajewski, & Zobel, 2022). This concerning trend not only undermines the efficacy of localized climate actions but also exacerbates the overarching global climate crisis.

By studying previous literature, CBAM seeks to guarantee that nations with strong climate policies are not at a competitive disadvantage in the global market by imposing carbon taxes on imported products based on their embedded carbon content. According to Baldwin et al. (2021), these actions support the Paris Agreement's guiding idea of common but differentiated responsibilities. By putting CBAM into practise, nations would be encouraged to implement stricter climate regulations and trading partners would be enticed to increase their environmental obligations as well (Lehmen, 2021). In addition, labor markets, too, stand to be significantly influenced by the CBAM's implementation (Kuo & Chou, 2023). The transition to low-carbon industries may lead to job displacement in carbon-intensive sectors, necessitating the development of strategies to reskill and upskill the workforce for roles in emerging sustainable sectors.

Furthermore, by looking at CBAM's effects, economic and security concerns are notably important. A study by Cui et al. in 2022 suggests that CBAM could change how countries relate to each other in terms of trade and geopolitics. Also, we need to think about its impact on jobs. Hoekstra and van den Bijgaart's analysis in 2021 shows that CBAM might cause changes in production, which could affect employment in specific industries. CBAM will definitely change how trade works, and a study by Brandi et al. in 2021 says that it's crucial for countries to work together when creating and using CBAM. The World Trade Organization (WTO) also pointed out in its report in 2023 that there might be disagreements about trade because of CBAM, so it's important to be clear and open when applying it.

In addition, international trade dynamics are not immune to the ripple effects of the CBAM. Trade frictions may arise as countries with differing carbon pricing schemes grapple with harmonization efforts and compliance challenges. This underscores the importance of international cooperation and negotiations to ensure a smooth and cohesive implementation of the CBAM, minimizing disruptions to global trade flows. The evolving landscape of data governance and cross-border information exchange poses questions about how the CBAM might interact with these emerging considerations, potentially influencing the design of the mechanism and its associated regulations.

Above mentioned studies and their combined implications make it clear that the Carbon Border Adjustment Mechanism is a ground-breaking method of regulating climate change, with the potential to impact national security, data governance, international trade, and the labour market. A healthy and fair future for the global economy and our environment will depend on our ability to navigate the intricacies and possible effects of CBAM.

In this article, we explore key features of the Carbon Border Adjustment Mechanism, looking at its guiding principles, expected advantages, and potential drawbacks. Our research will cover the complex interactions between labour markets, national security, commerce, and data flows, illuminating how this new climate policy tool can alter the dynamics of the global economy. Furthermore, the article in hand provides readers with a thorough and impartial understanding of the CBAM's transformational potential through a careful analysis of its possible effects on global cooperation, labour practises, trade agreements, and data governance.

1.1 Background on Climate Change and the CBAM

Since the United Nations Conference on Environment and Development in 1992, climate change has become a global issue. The UN Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement were established to address this issue and encourage countries to take action (Monasterolo, Battiston, Janetos, & Zheng, 2017). The EU has been actively involved in discussions on climate change and has set ambitious goals to become the first climate-neutral continent by 2050 through initiatives like the European Green Deal (European Commission, 2019).

The CBAM is an extension of the EU's efforts to combat climate change. It aims to prevent carbon leakage, which occurs when companies relocate to countries with less stringent environmental regulations (Rübbelke, Vögele, Grajewski, & Zobel, 2022). The CBAM proposes imposing a carbon border tax on imported goods to ensure that they meet the same environmental standards as EU-produced goods. This mechanism is seen as a way to level the playing field and prevent unfair competition. The CBAM has been introduced as a measure to address the challenge of reducing greenhouse gas emissions while ensuring fair competition for industries within the EU. It aims to prevent carbon leakage, where businesses transfer production to countries with lax emission regulations, and to promote a level playing field for EU industries (Rübbelke, Vögele, Grajewski, & Zobel, 2022). The implementation of CBAM is expected to curtail greenhouse gases and contribute to global efforts to combat climate change. However, concerns have been raised regarding its compatibility with the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO) rules. The CBAM's imposition of unilateral tariffs could lead to trade conflicts and retaliation, potentially undermining the existing international trade system.

1.2 CBAM Impact on Labor

The implementation of the CBAM may have implications for labor markets, particularly in industries affected by the mechanism (Kuo & Chou, 2023). The increase in costs associated with the CBAM could potentially lead to job losses or shifts in employment patterns. However, it is also important to consider the potential opportunities for job creation in industries that prioritize decarbonization efforts (Clausing & Wolfram, 2023).

1.3 Effects on Data Flows

The CBAM may also impact data flows, particularly in terms of the information required for compliance with the mechanism. Importers will need to collect and monitor emissions data for covered goods, which may require the sharing of sensitive information. It is important to ensure that data privacy and security measures are in place to protect the confidentiality and integrity of data exchanged between nations (Lim, Hong, Yoon, Chang, & Cheong, 2021).

1.4 Mitigating the Impact of the CBAM

To mitigate the impact of the CBAM, countries like China can take proactive measures. This includes conducting a comprehensive assessment of the goods traded with world importers to identify the sectors and products most likely to be affected (Magacho, Espagne, & Godin, 2023).

1.5 Legal Issues and Compatibility with GATT/WTO

One of the major challenges surrounding the implementation of CBAM is its compatibility with the GATT and WTO rules (Lim, Hong, Yoon, Chang, & Cheong, 2021). The CBAM's imposition of unilateral trade barriers through the carbon border tax raises questions about its compliance with the principles of non-discrimination and free trade. This has the potential to evoke trade conflicts and retaliation from affected countries. The EU argues that the CBAM is not a tariff but rather a mechanism to ensure fair competition and support the development of energy technology (Leonelli, 2022). However, its unilateral nature and potential impact on trade make it difficult to reconcile with the current GATT and WTO framework.

1.6 Trade Controversy and Potential Retaliation

The introduction of the CBAM is likely to generate international controversy and trade disputes. The imposition of new unilateral tariffs through the carbon border tax can be seen as a form of trade barrier, potentially leading to retaliatory measures by affected countries (Oxford Analytica, 2021). This could disrupt global supply chains, reduce trade flows, and have a significant impact on the functioning of the WTO. The Appellate Body crisis, combined with the CBAM conflict, may further weaken the WTO's role in resolving trade disputes (Sun, Mi, Cheng, Coffman, & Liu, 2023).

1.7 Implications and Challenges of the CBAM

The implementation of the CBAM raises several implications and challenges. Firstly, there are concerns about the compatibility of these measures with international trade rules, particularly the GATT and WTO. The CBAM could be considered as new trade barriers, potentially leading to trade conflicts and retaliation (Chase & Pinkert, 2021; Bacchus, 2021; Lim, Hong, Yoon, Chang, & Cheong, 2021). The legal issues surrounding these measures need to be carefully addressed to ensure their compliance with international trade rules.

Secondly, the CBAM could have significant economic consequences (Eicke, Weko, Apergi, & Marian, 2021). Trade retaliation resulting from the imposition of these measures could lead to reconfigured global supply chains and reduced trade flows. Emerging markets and developing countries, which have industries with high carbon emissions, may face welfare losses and reduced trade opportunities (Kuusi, Björklund, Kaitila, Kokko, Lehmus, Mechling, & Wang, 2020). It is crucial to assess the potential economic impact of these measures and find ways to mitigate any negative effects.

2. Literature Review

The Carbon Border Adjustment Mechanism (CBAM) is a new approach to climate change regulation that aims to address the carbon leakage issue and ensure a level playing field for industries in different countries (Rübbelke, Vögele, Grajewski, & Zobel, 2022). To understand the potential impacts of the CBAM, it is important to consider the broader context of trade, economic growth, and environmental policies. Stern's seminal (2004) discuss the relationship between trade, growth, and the environment, providing insights into the environmental consequences of economic growth and international trade. They highlight the need for further research to evaluate ongoing policy debates in this area.

The relationship between carbon emissions and typical lifestyles has not been sufficiently investigated in prior studies on household carbon emissions. However, several nations have taken steps to encourage energy efficiency and carbon reduction in response to the requirement for adjustments based on living expenditures. Examples include the Performance Achievements and Trading Scheme, Tokyo's Emissions Trading Scheme, and the UK's Carbon Reduction Commitment Energy Efficiency Scheme (Bertoldi, Labanca, Rezessy, Steuwer, & Oikonomou, 2013). In 2020, 1,159 additional enterprises declared their plan to implement Internal Carbon Pricing (ICP), bringing the total number of ICP implementations globally to 853 (Suvajit & Banerjee, 2021). Maksym and Chepeliev in 2021 provide a quantitative assessment of the European Carbon Border Adjustment Mechanism (CBAM) implementation and find limited impacts of the CBAM for most European Union (EU) trading partners (Bartlett, Coleman, & Schmidt, 2021). Over 130 nations worldwide made an announcement at COP27 that they will attain net-zero carbon emissions by the year 2050. As a result, cross-border methods to carbon pricing are receiving more attention, and several nations are exploring using international commerce to solve "carbon leakage". The majority of nations attempt to solve this problem by granting exemptions, carbon tax offsets, or carbon emission quotas to impacted businesses.

Since the CBAM idea, several research have used dynamic CGE models among others (Bellora, & Fontagné, 2022; Lim, Hong, Yoon, Chang, & Cheong, 2021; Shapiro, 2021). Additionally, a lot of researchers are now examining the effects of the CBAM on the entire nation and industry. For example, Bellora (2021) assessed the CBAM as a way to cut carbon emissions. The problem of carbon leakage, where corporations move manufacturing to nations with lenient carbon emission regulations, was thoroughly examined by Aichele and Feibermayr. Prior research on the carbon border tax has usually concluded that changing the industrial structure and applying import taxes on export goods from nations with lax carbon emission restrictions will reduce global carbon emissions and carbon leakage (Shapiro, 2021).

Harro, van, Asselt., Michael, and Mehling in 2020 introduced the concept of border carbon adjustments and explain how they have featured in policy discussions thus far and examine the compatibility of the border carbon adjustment with World Trade Organization (WTO) law. In addition, the impact of carbon adjustment on emission reduction and the macroeconomy of the country was investigated by using simulation experiments under the production-based accounting (PBA) and alternatively proposed consumption-based accounting (CBA) framework (Suvajit & Banerjee, 2021). Furthermore, the implications of border carbon adjustment (BCA) imposition on the exports from a developing country under a territorial consumption-based alternative framework and find that the closer the rates of BCA (**Border Carbon Adjustment (BCA)**: BCA is a trade-related policy mechanism aimed at addressing carbon leakage and ensuring a level playing field for domestic industries subject to carbon pricing. It imposes a carbon cost on imported goods based on their embedded emissions, aligning their carbon costs with those faced by domestic producers) and the DCA(**Domestic Carbon Adjustment (DCA)**, DCA refers to internal carbon pricing mechanisms within a country, such as carbon taxes or emissions trading systems, the more effective the carbon adjustment schemes are to reduce the emission intensity of energy use.

The purpose of the article is to examine how the CBAM, and international trade are related. In order to achieve the goals of global decarbonisation, CBAM not only encourages nations to show their commitment to carbon reduction and align their carbon emissions with EU standards, but it also provides governments with advice on how to design fair carbon taxation systems and motivates companies to invest in clean technologies.

3. Methodology

Environmental sustainability, economic expansion, social advancement, and the availability of energy will all be affected by climate change. Due to the present economic growth in China and the effects of CBAM, this research seeks to include all the factors that have an impact on the business models of Chinese multinational enterprises.

3.1 Sample

China's exports and CO_2 emissions (CO_2e) from 2011 to 2022 are used as analytical data in this study. Although China is the second-largest exporter of iron and steel and aluminium, it is most exposed to the EU CBAM in these sectors. However, domestic carbon pricing tools may lessen the impact of the mechanism on China's economy. China has eight regional ETS pilots, the most of which were started between 2013 and 2014. These pilots nearly entirely cover the iron, steel, and aluminium industries in those regions. China's national ETS started operating in 2021, controlling more than 2,200 power firms and initially accounting for 40% of the country's carbon emissions. During China's 14th Five-Year Plan (2021–25), the national ETS is also anticipated to be expanded to encompass iron, steel, and aluminium, increasing the number of installations subject to a carbon price.

Although China's costs for carbon are rising quickly, they are still far lower than the EU ETS. In contrast to the average secondary spot prices in the EU, which were $28.28 in 2020, permit prices in China's regional ETSs ranged from $3.28 to $12.62 on average. This pricing disparity has grown as the price of EU ETS allowances increased in 2021. Such discrepancies raise concerns about the extent to which China's carbon pricing mechanisms will protect it from the EU CBAM but given that only 1.6% of its CBAM-covered goods are exported to the EU, even relatively high EU border payments may not have a material impact on the Chinese economy initially.

China is one of the biggest exporters to the EU, but its exports from these industries to the rest of the world exceed its CBAM-covered exports to the EU. Only 9% of China's exports of aluminium are bound for the EU; the remaining 91 percent are going to non-EU nations. Similar to this, 92% of China's exports of iron and steel are sent to non-EU nations while 8% are sent to the EU.

3.2 Model and Variables

Carbon dioxide equivalent (CO_2e) is the most used unit of measurement for carbon emissions. The quantity of carbon emissions produced per unit of economic production (GDP) is represented by the metric CO_2e/GDP, which is used to evaluate an economy's carbon intensity. The study intends to investigate how CBAM influences the operational frameworks of multinational corporations operating in China, including product pricing and export policies. As one of the indicators for the Sustainable Development Goals of the United Nations, this variable has economic relevance.

Research Model

As a result, the empirical model used in this study uses CO2e/GDP as the dependent variable and considers as independent variables things like industrial employment, fixed investment, government tax income, finance investment, and export trade. The research model is cited in papers by Hasanov et al. (2018) and Liddle (2018). Equation (1) is a representation of the model.

$$\frac{CO_2e}{gdp_\tau} = \lambda_1 Export\ growth_\tau + \lambda_2 Metal\ output_\tau + \lambda_3 Metal\ dividend_\tau$$
$$+\lambda_4 Electronic\ output_\tau + \lambda_5\ Eemploy_\tau + \lambda_6 Fixed\ invest_\tau$$
$$+\lambda_7 Land\ tax_\tau + \lambda_8 Dine\ out_\tau + \varepsilon_\tau$$

There are 8 control variables in above equation. Functionality, design, price, packaging, and after-sales service are just a few examples of the export commodities, and the independent variable is the yearly change rate of the export value (export growth). In addition to meeting client requests and adhering to international standards, they must also demonstrate innovation and quality control.

China is no different from other nations in its concentration on export growth and economic expansion. As a result, our analysis predicts that there would be a sizable positive association between CO_2e/GD and the yearly growth rate of export commerce.

Table 1. Variable Description

Variable	**Explanation**
Fixed investment	Gross Fixed Investment
Dine out	Indices of Consumer Price -Food Away from Home
Metal output	Industrial Production Index-Fabricated Metal Products Manufacturing
Electronic output	Industrial Production Index-Other Electronic parts

	and Components Manufacturing Not Elsewhere Manufacturing
CO_2e/GDP	The Carbon Emissions per unit of GDP
Land tax	Total of Land Value-Added Tax
Metal dividend	Yield of Steel & Iron

4. Analysis

Data for the analysis was gathered from official data releases by China's National Bureau of Statistics, China Electricity Council, National Energy Administration, China Customs, and WIND Information, an industry data source. Official statistics and commercial data were used in the latest investigation for Carbon Brief, which reveals two variables were responsible for the increase. First, the second quarter of 2022 is being used as a baseline since emissions at that time were still being restrained as a result of the Covid lockdowns that had shut down most of the nation and Shanghai. Second, China's extensive hydroelectric fleet has seen its output fall as a result of the current drought. It's possible that China's emissions would have steadied by now even without these one-time variables.

The slow pace of China's economic recovery following the removal of Covid limits has raised concerns about the possibility of more stimulus policies with a high carbon footprint. Along with accelerating expenditures in coal-based steel production, China is also maintaining a rise in coal power development that began last summer. A large portion of this will be finished during the "15th five-year plan" era (2026-2030), during which China has committed to lowering its coal use.

On the other hand, low-carbon energy investment is still increasing at an astounding rate. If low-carbon capacity expansion proceeds as predicted, it will be adequate to satisfy projected increases in energy demand and may even put China on track to reach its emissions peak within the next two years. Overall, the most recent quarterly research reveals that emissions strongly recovered from their 2022 Covid shutdown lows and increased only a little bit over their record-breaking 2021 levels. Significant increases in transportation and coal-fired electricity were the primary causes of the emissions resurgence.

Weather-related variables are to blame for the rise in coal-fired electricity. The generation of coal-fired electricity would continue to be below its peak without this weather variance. If they are kept up, low-carbon energy additions can now fully meet the anticipated increase in power demand. Expectations of government assistance for carbon-intensive sectors have grown as a result of China's slow economic recovery from the "zero-Covid" era. For the first time, the usage of electric cars is significantly slowing the increase of the demand for petrol. New coal-fired power plants and steel mills are still being pushed. Emissions surpass records set in 2021. just in the second quarter of 2023, China's CO2 emissions rose an anticipated 10% year over year, regaining around 1% of the record levels of 2021.

Two explanations explain the rise: the contrast with the sharp decline in the second quarter of 2022 brought on by Covid-19 lockdowns in Shanghai and other cities around the nation, and the continued decline in hydropower output brought on by droughts. Low-carbon energy investment is continuing to expand at an astounding rate, which helps to reduce the growth in emissions. The capacity anticipated to be added this year would be adequate to meet the whole anticipated expansion in energy consumption, bringing an emission peak within reach. Emissions would have stabilised long before the short-term fluctuations in hydropower output and the subsequent rise in oil consumption after the "zero-Covid" phase. Specifically, irregular rather than structural reasons are to blame for the increase in emissions.

After the Covid-19 limits were lifted, oil consumption increased, although not as much as was anticipated. The economic recovery has been slow in other areas, which has increased expectations for a government stimulus that uses a lot of carbon. Two coal power plants are approved each week, with construction beginning in the first part of the year, continuing the coal power plant building frenzy that began in the summer of 2022. Additionally, investments in coal-based steel capacity are increasing quickly. As a result, a significant amount of coal-fired power plants and coal-based steel production facilities will be finished after 2025, when China has promised to start lowering its coal use.

A tax on carbon emissions is a crucial step in encouraging companies to develop cutting-edge "green" emission reduction technology. Therefore, the originality of this study resides in the incorporation of the government's cost-benefit evaluation factors, such as tax revenue and financial indicators, while developing policies to reduce carbon emissions. Table 2 shows the million tonnes of CO2 in China's quarterly emissions from cement and fossil fuels. The National Bureau of Statistics, China Customs, and WIND Information data on changes in inventories are used to estimate emissions, which are then adjusted for the IPCC default emissions factors and annual emissions factors per tonne of cement production until 2019. In Statistical Communiqués and National Bureau of Statistics yearly yearbooks, monthly statistics for fuel use are scaled to annual data. The increasing uptake of electric cars (EVs) is beginning to significantly affect the need for fuel.

In the first half of 2023, 28% of all cars sold were electric vehicles, including plug-in hybrids, up from 22% in 2022 and 4% in 2020. As a consequence, from 4.5% a year ago to 7.5% by the end of June 2023, the percentage of EVs sold over the previous ten years as a proxy for the mix of automobiles on the road

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has grown. This indicates that the deployment of EVs probably reduced the rise in petrol consumption by about three percentage points. This demonstrates the reason Sinopec, a major oil and gas company in China, recently stated that the switch to EVs will result in a peak in China's petrol demand in 2023. With projected life cycle emissions per km driven that are around 40% lower than for gasoline-fuelled automobiles, EV adoption is already helping to cut CO2 in China, on average; the difference will grow as power production is decarbonized.

Table 2. Descriptive Statistics

Variable	Min	Max	Mean	S.D.
CO_2e /GDP	0.334	0.406	0.372	0.033
Export growth	0.84	22.71	7.75	7.446
Metal output	88.31	100.94	102.294	5.566
Eemploy	553	603	605	26
Fixed invest	302	469	382	40
Land tax	306	338	307	0.762
Metal dividend	1.36	7.01	3.73	1.862
Dine out	80.33	109.46	102.390	6.098
Electronic output	82.97	191.55	104.139	35.67

There is a strong positive correlation between the amount of real fixed investment in the construction sector (Fixed invest), the production of electronic products and related components (Electronic output), and the number of people employed in the sector (Eemploy). This is consistent with China's present pattern of industrial development. China generally entails switching from fossil fuels to renewable energy in order to reach the goal of net-zero carbon emissions. This can lessen reliance on traditional energy sources that are susceptible to price volatility and geopolitical conflicts, improving supply chain resilience. By incorporating renewable energy into its fixed investment strategy, the construction sector in China should concentrate on improving energy security and lowering the risks of supply chain interruption. The correlation coefficient of the CPI for eating out is favourably connected with the two earlier variables in terms of daily life. This suggests that there are factors at play in China's dominance in the semiconductor and electronics sectors, factors that cost employees the opportunity to have happy family meals. In order to comply with the worldwide Sustainable Development Goals (SDGs), the government should actively work towards good health and social welfare for employees dignified labour and economic growth and reduced domestic and international inequality.

On the other side, there is a large inverse relationship between land value tax collection and fixed investment creation (fixed invest). This suggests that China's existing tax system is not very accommodating or helpful to the growth of the electronic industry capable of producing net-zero carbon emissions. The government should aggressively change the legislation and foster a climate that is conducive to investment.

Table 3: Correlation Matrix

Variable	Co2e/GDP	Fixed invest	Metal output	Eemploy	Dine out	Electronic output	Yield	Land tax	Export
Co2e/GDP	1.000								
Fixed invest	−0.884***	1.000							
Metal output	−0.54	0.538**	1.000						
Eemploy	−0.768***	0.740***	0.401	1.000					
Dine out	−0.622***	0.802***	0.57*	0.867***	1.000				
Electronic output	−0.751***	0.83***	0.678**	0.629**	0.588*	1.000			
Metal dividend	0.682**	−0.612**	−0.536**	−0.58*	−0.612*	−0.541*	1.000		
Land tax	0.639***	−0.882***	−0.656**	−0.513	−0.50	−0.715***	0.659**	1.000	
Export growth	−0.400*	0.59**	0.22	0.46*	0.311	0.51*	−0.57*	−0.344	1.000

5. Regression Analysis

China continues to be a large manufacturer of high-tech industrial components from an export standpoint. The prominence of China's industrial and technological sectors in the global trade market remains unaffected by the breakdown of globalisation. However, the industry, nation of origin, and kind of exported goods are only a few of the variables that affect export trade growth. Companies that prioritise sustainability are more likely to achieve reduced carbon emissions sooner given that businesses associated to electronic components place a high priority on sustainable operations. Utilising renewable energy and cutting waste, for instance, can reduce a business's negative effects on the environment and carbon footprint. Additionally, as more customers become aware of sustainability and are prepared to pay a premium for sustainably produced commodities, businesses' products and services have a competitive edge in the global market. Table 3 shows that the correlations between the variables can sufficiently account for the variability of the dependent variable, carbon dioxide emissions per capita of GDP, with an Adj R-squared value of 0.999. The selected variables in this analytical model have a very significant impact on carbon dioxide emissions per capita of GDP, as indicated by regression P-values that are close to 0. The empirical findings indicate that employment in the manufacturing of power machinery and equipment, the index of electronic component output, and the CPI dining-out index are all strongly adversely connected with China's carbon emissions (Co2e/GDP). As opposed to this, China's carbon emissions (Co2e/GDP) show a highly significant positive correlation with the index of metal product production (Metal output), fixed investment in construction (Fixed invest), land value-added tax (Land tax), and yield of the steel industry (Metal dividend), as well as a significant positive correlation with the rate of growth in export trade (Export growth).

Column1	Column2
Variable	Coefficient
Export Growth	0.386**
Metal output	0.635***
Eemploy	−0.001***
Fixed invest	0.11***
Land tax	0.148***
Metal dividend	3.0072***
Dine out	−1.09***
Electronic output	−0.7726***
Adj R-square	0.994
F-statistic	2034.54
Prob(F-statistic)	0.0004

6. Conclusion

It is crucial that the European Union and China have open and transparent conversations to reduce the tensions brought on by the CBAM plan. The CBAM's potential effects on trade dynamics and economic interests may be addressed by cooperation between the two parties, who can then look for areas of agreement to guarantee that the climate goals are realised without compromising economic growth. The CBAM's novel method of accounting for emissions intensity and carbon pricing demonstrates a developing comprehension of the complexities of climate policy. The CBAM's pilot phase and future implementation will offer concrete information on its real effects on global commerce and emissions reduction in the upcoming years. Finding a balance between environmental responsibility and economic development will continue to be important as the EU and China both develop their climate agendas. The EU and China can overcome the obstacles presented by the CBAM and establish a road towards collaborative and sustainable climate action through careful thought, teamwork, and the adoption of the policy suggestions described in this paper.

Few studies have examined how to cope with its effects from the standpoint of the carbon market, but the implementation of the European Union (EU) Carbon Border Adjustment Mechanism (CBAM) would alter the cost effectiveness of Chinese exporters. to look at China's plans for allocating allowances to reduce the effects of the EU CBAM from the viewpoint of the carbon market. For or the purpose of cost efficiency assessment and carbon allowance allocation, this paper uses the steel and cement industries in each province of China as examples. It concludes that the EU CBAM has a negative impact and that the CBAM must be incorporated into the top-level system design of allowance allocation to achieve an allowance allocation scheme that maintains the cost efficiency level of each industry. Importantly, aligning allowance allocation strategies with the broader goals of sustainable climate action and economic resilience ensures that industries remain competitive while contributing to long-term decarbonization efforts. By integrating CBAM considerations into policy design, China can better navigate global climate regulations, support industrial adaptation, and safeguard economic stability during the low-carbon transition. Second, a higher and more consistent price for carbon in China may effectively offset the effects of the EU CBAM and guarantee that the cost-effectiveness of each industry does not change dramatically. Thirdly, the effect of the EU CBAM on the cost effectiveness of each industry would diminish dramatically after the Chinese carbon price hits 60 RMB/ton. Fourth, when the volume of items shipped to the EU surpasses a specific threshold, efforts to restrict exports are ineffective in reducing the effects of the EU CBAM. The research presented in this article offers China and other developing nations practical policy insights that will help them actively address the issues raised by the EU CBAM.

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