Does Digital Trade Inhibit or Exacerbate Carbon Emissions?

--Evidence from China

Li Zhang[12]

[1]Digital Business Academy, Zhejiang Dongfang Polytechnic, Wenzhou, China
[2]Wenzhou Low Altitude Industry Economic Research Institute (Wenzhou New Think Tank) Wenzhou, China

*E-mail: 80006533@qq.com

Abstract. The reduction of carbon dioxide emissions is receiving increasingly more attention from the international community. Nevertheless, what are the primary factors that impact carbon dioxide emissions? How to curb carbon dioxide emissions without blocking economic development? Based on a panel data of China from 2000 to 2022, this article studies the relationships between Internet Penetration, Import and Export Trade and Carbon Dioxide emissions by using correlation analysis, unit root test, and least square regression via EViews. Results show significant same-direction Co-relation between Internet Penetration Rate, Import Trade value, Export Trade value and Carbon Emissions. The findings are as follows: Increase in both import and export trade volume are correlated with an increase in carbon emissions. In the global industrial division of labour, both consumers and producers of goods should be equally responsible for their carbon emissions. Although Internet development can suppress carbon emissions by optimizing the international supply chain to some extent, Internet Penetration development will mainly increase carbon emissions through promoting Cross-border E-commerce. Policies and measures are put forward accordingly, such as new energy substitution, carbon consumption tax, green certificate, electronic data transmission, and the use of low-altitude unmanned aerial vehicle for delivery to reduce manpower and save energy.

Keywords: Energy; Carbon Emission; Digital Trade; Cross-border Ecommerce; GMM

1 Introduction

The Climate warming has become one of the most serious problems facing global development in the century. In the fourth Climate Change Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) pointed out that the increase in greenhouse gases is the main cause of global warming, and anthropological carbon dioxide emissions are the main source of greenhouse gases. China holds the title of the "world factory", but is also the highest emitter of carbon in the world. In 2019,

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China was responsible for 31.2% of the global carbon dioxide emissions. The carbon emissions of the world rose from 20,625 million tonnes in 1990 to 34,344 million tonnes in 2019, with an average yearly increase of 2.3%. During these years, China's carbon dioxide emissions rose from 2,137 million tonnes in 1990 to 10,707 million tonnes in 2019, growing annually by an average of 13.8%. Nevertheless, China pledged at the United Nations General Assembly to peaking carbon dioxide emissions by 2030 and achieving carbon neutrality by 2060. It took Britain and France 59 years, 43 years in the US and Japan 37 years, while China promised only 30 years. Time is tight and the task is heavy.

As China's reform and opening up process progresses, international trade openness is increasing, and the participation in the global division of labour and cooperation is also deepening. With cheap labor and preferential foreign trade and foreign investment introduction policies, China has taken the initiative to undertake international industrial transfer and become the "world factory". Through export trade, China bears a large amount of carbon dioxide emissions for other countries, and particularly for developed countries. Developed countries meet domestic demand by importing "three high and low" products with high polluting, high emitting, high energy consuming and low in output, and then transfer the environmental costs.[1] Adekoya et al. (2023) reveal that energy efficiency is increased by endogenous technological innovation in Belt and Road Initiative (BRI) countries[2]. Moreover, China's technological innovation has a reducing spillover effect on the energy intensity of BRI countries, suggesting that China's energy-efficient technologies could be adopted or absorbed by other countries to reduce dependence on fossil fuels. Cheng et al. (2023) further explores the spatial spillover effect of green technology innovation, finding that innovations in one region can promote the growth of green technologies in adjacent regions[3]. This suggests that regional innovation capabilities and international technology spillovers are crucial drivers of green technological progress. This study also finds that import trade, OFDI, green finance, and regional innovation capability can promote regional green technology innovation. Wang et al. (2024) focused on the impact of tax incentives on green technology innovation in China[4]. The study concluded that tax incentives, particularly value-added tax preferences, had a positive impact on green technology innovation performance. This highlights the role of tax policies in promoting environmentally friendly innovations.

The existing literature has explored the impact of trade on carbon emissions, arguing the global trade brings high technology, which will help in improving energy use efficiency and in curbing carbon emission. However, the relationship between digital trade and carbon emission remains unexplored. Does digital trade inhibit or exacerbate carbon emissions? Base on a empirical study on China, this article find a surprising paradox: digital trade, in fact, increase carbon emissions. Relative recommendations are offered, in order to complete the trade theory and to shed light on the economy, energy and sustainable development.

2 Literature Review

Environmental and climate change become an important factor affecting human survival and development. Some researchers believed that Internet development significantly suppressed the region's carbon emissions intensity[5]. Some studies hold that trade exports are often based on domestic production and oriented by foreign demand, and high levels of CO2 emissions are caused by the use of fossil fuels in manufacturing processes[6]. Developed countries are shifting energy-intensive and polluting industries to developing countries.

2.1 Pollution Heaven Hypothesis

There are two negative and positive effects on carbon emissions, and domestic and foreign scholars have not drawn a unified conclusion. On the one hand, the expansion of trade scale accelerates the consumption of energy, and the high carbon emission industries will shift to the countries with relatively loose carbon emission requirements, thus transferring their own carbon emissions to other countries. The "pollution paradise hypothesis" believes that developed countries tend to relocate polluting industries to developing countries through overseas trade, thus aggravating the problem of environmental pollution in developing countries.

Guo et al. (2010) used the input-output model to calculate the effect of US-China trade on domestic and global carbon emissions in 2005[7]. The estimated results showed that the United States reduced the carbon dioxide emissions from China by 190.13 million tons, but increased the global carbon dioxide emissions by 515.25 million tons. By the import of products from the United States, China's emissions were reduced by 178.62 million tons and the global carbon dioxide emissions by 129.93 million tons. US-China trade has added to global carbon emissions by an additional 385.32 million tons. Wang, et al. (2011) used Logarithmic Mean Divisia Index (LMDI) to analyse factors on CO2 emission and find that China's production-based carbon emissions much exceed its consumption-based carbon emissions[8]. The majority of China's net exports come from industries with low carbon emissions intensity, while most of its net imports come from industries with high carbon emissions intensity, particularly those in the energy sector that are closely linked to carbon emissions. It is noteworthy that this output results in a carbon footprint that extends beyond China's borders. Araujo et al. (2020) found the total amount of carbon emissions in newly-joined EU countries rose because of the amplification of trade and alterations in their industrial setup[9]. Yang et al. (2022) employed the Logarithmic Mean Divisia Index method to analyse the factors that influence embodied carbon in China's export trade[10]. Their findings indicate that the growth of trade embodied carbon is directly correlated with the expansion of export scale. According to the research done by Xieet al. (2011), nearly one-third of the production enterprises set up by foreign investors in China are pollution-intensive enterprises, and nearly 25% of the capital flowing into China goes to pollution-intensive industries[11].

2.2 Pollution Halo Effect Hypothesis

International trade and foreign capital inflow are conducive to reducing the pollution emissions of host countries and improving the overall environmental quality of host countries. International trade and foreign capital inflows can offer sophisticated management expertise and production technology, at the same time make the host countries better understand the environmental preferences of foreign consumers and international or foreign environmental standards, and as a result make the host countries improve their production technology, improve their environmental standards, and reduce their domestic pollution emissions. This is the "pollution halo effect hypothesis". Ackerman et al. (2007) found that the U.S.-Japan trade led to an increase of 6.7 Mt CO2 emissions from Japanese industry and a reduction of 14.6 Mt CO2 from U.S. industry, resulting in a reduction of millions of tons of CO2 from a global perspective.[12]

2.3 Effect of Internet and Technology on CO2 Emission

Some researchers believe Internet development and technology advancement have a positive effect on CO2 reduction. Li et al. (2024) found the depth of digital trade clauses in RTAs significantly reduces the CO2 emissions of member countries[13]. Xuemeng Ding and Qiang Zhao (2022) employed the dynamic spatial Durbin model to examine panel data from 30 provinces in China between 2011 and 2018.[5] The findings indicate that internet development has a significant suppressive effect on carbon emission intensity in the region and a negative spatial spillover impact on the carbon emission levels in the surrounding areas. Wang et al. (2024) evaluate the reverse technology spillover effect of outward foreign direct investment (OFDI) on energy efficiency and carbon emissions, using the provincial and industry level panel data in China from 2004 to 2017.[14]The results indicate that reverse technology spillover of OFDI has an overall positive impact on total factor energy efficiency. However, this impact shows heterogeneity at both regional and industry levels. The results also finds that OFDI's reverse technology spillover not only directly affects carbon emissions but also indirectly affects them through energy efficiency, highlighting the potential for policy recommendations to improve energy efficiency and reduce carbon emissions. Ali et al. (2020) decomposed the factors that impact carbon emissions and concluded that technological advancements have played a significant role in reducing carbon emissions in the UK[15].

2.4 Summary and Comments

It is not difficult to summarize the following three points from the existing literature.

First of all, the transfer of carbon emissions can coexist with international trade; but it is the real concern of the international community, which is largely related to the development of environmental protection.

Secondly, it is generally believed that the transfer direction of carbon emission is opposite to the flow direction of commodities in international trade. If goods are exported from A to B, carbon emissions transferred B to A, in the opposite direction. A common situation is that developing countries, like China, India, and Brazil, export labour-intensive and resource-intensive commodities to developed regions and countries, including the United States of America, Europe, and Japan. Unfortunately, the carbon dioxide emitted during the manufacturing of these commodities is released within the exporting countries. In other words, the carbon emissions of these goods have shifted from the consumers of developed nations such as USA, Europe and Japan to the developing countries that produce their goods.

Last but not least, the foreign carbon emissions studies are much earlier than the related studies in China.

However, the preexisting literature has some limitations:

1. Trade openness and international trade volume have both positive and negative impact on carbon emissions, yet domestic and foreign scholars have not drawn a unified conclusion.

2. At present, the research on carbon transfer in international trade mainly focuses on the calculation stage, while research on the driving factors of carbon transfer in trade are rare.

3. Lack of research on import and export carbon emission statistics according to the industry classification. As we all know, the amount of carbon emissions caused by agriculture, light industry and heavy industry are from small to large. If a country's imports are mostly oil and gas, it may also cause a significant surge in the carbon emissions of the countries. What's more, if the imported oil and gas are used to produce electricity for factories produce commodities exporting to other countries, in fact, essentially, this country is a substitute for carbon emissions. Therefore, it is unfair to make this country take the responsibility, and simply increasing carbon tariffs to limit producers is not feasible or sustainable, for it may cause the lack of goods in other countries.

4. The identification of the transfer of carbon emissions means the adjustment of the relationship between relevant responsibilities and benefit distribution among countries, and there is a lack of research on this aspect. The rule, "Who produce, who let out Carbon Dioxide, so who take the responsibility"is well accepted worldwide. But from the perspective of "no consumption means no production", from the perspective of "who bears responsibility means who spends money", from the perspective of "the poor taking responsibility for the rich". This principle of liability is unfair and should be to redrawn.

3 Research Methodology

The reduction of carbon dioxide emissions is receiving increasingly more attention from the international community. Nevertheless, what are the primary factors that impact carbon dioxide emissions? How to reduce carbon dioxide emissions without affecting economic development? After the literature review and theoretical analysis, based on a panel data of China between 2000 and 2022, this article analyzes the relationship between Internet Penetration, Import and Export Trade, and CO2 emissions.

3.1 Research Hypothesis

There is controversy in the influence of international trade on CO2 emissions. Based on the literature review, for developing countries, international trade may exacerbate Carbon Dioxide emissions because developing countries mainly produce Labor-intensive and capital-intensive products with low added value. In order to make products for export, developing countries have to import Petroleum products or machines, and the production for export consumes more energy like coal, gas, or electricity, which further increase Carbon Dioxide emissions. Thus import Trade may exacerbate Carbon Dioxide emissions. Internet development may exacerbate Carbon Dioxide emissions since internet boosts international trade and transnational logistics through Cross-border E-commerce.

This paper proposes the following 4 hypotheses based on the existing literature analysis.

1. Internet development exacerbates Carbon Dioxide emissions.
2. Import Trade exacerbates Carbon Dioxide emissions.
3. Export Trade exacerbates Carbon Dioxide emissions.
4. International Trade exacerbates Carbon Dioxide emissions.

3.2 Research Approach

This work primarily employs literature review, theoretical analysis, correlation analysis, unit root testing, and least squares regression analysis. Eviews 11 is used to analyze data. Based on a panel data of China between 2000 and 2022, this article explores the relationship between Internet Penetration, Import and Export Trade and Carbon Dioxide emissions.

3.3 Variables and Data Source

This article uses China's Internet Penetration Rate to represent China's development of the Internet, and uses China's Import Trade Value and Export Trade Value to represent China's international trade volume, and use China's total CO2 emissions in kiloton to represent China's Carbon Dioxide emissions (Table 1). The Internet Penetration Rate denotes the proportion of Internet users in comparison to the overall population. China's Internet Penetration Rate, and China's total Carbon Dioxide emissions are collected from Worldbank Open Data. China's Import Trade Value and Export Trade Value (both in current US Dollars) are sourced from United Nations Comtrade database.

Table 1. Meaning of variables

Variable	Meaning
CO2E	China's total CO_2 Emissions (in Kilotons)
NETPENETRATION	China's Internet Penetration Rate in percentage

IMPORT	China's Import Trade Value (in Current US Dollars)
EXPORT	China's Export Trade Value (in Current US Dollars)
lnCO2E	$\ln CO2E = \ln(CO2E)$
lnINTERNET	$\ln INTERNET = \ln(NETPENETRATION)$
lnIMPORT	$\ln IMPORT = \ln(IMPORT)$
lnEXPORT	$\ln EXPORT = \ln(EXPORT)$
C_1, C_2, C_3	Intercept Terms
β_1, β_2, β_3	Correlation Coefficient
μ_1, μ_2, μ_3	Error Terms

4 Results and Discussion

Reform and opening up has promoted the rapid development of Chinese international trade economy. The total import and export volume has jumped from 474.30 billion US Dollars in 2000 to 5936.51 billion US Dollars in 2023, a 13-fold increase. Among them, the export volume increased from 249.20 billion US Dollars in 2000 to 3593.60 billion US Dollars in 2022; the import trade increased from 225.09 billion US Dollars in 2000 to 2556.76 billion US Dollars in 2023, an increase of 11 times (Figure 1). For many years, China has sustained a persistent trade surplus.

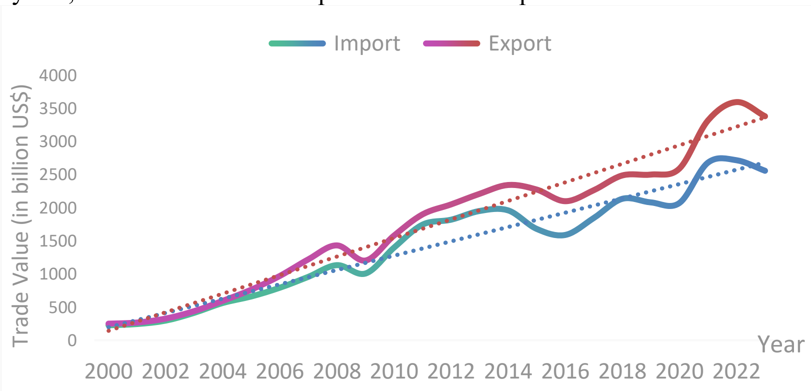

Fig. 1. China's Import Trade Value & Export Trade Value (in billion US Dollars)

4.1 Correlation Analysis

On the basis of panel data 2000-2022, this article analyzes the relationship between Internet Penetration, Import and Export Trade and Carbon Dioxide emissions by using correlation analysis. Meaning of Variables is showed in Table 1.

As shown in Table 2, the Results show obvious same-direction Correlation Relationships between Internet Penetration Rate, Import & Export Trade Volume and Carbon missions. The Correlation between China's Internet Penetration Rate and China's total CO_2 Emissions is 0.97, the Correlation between China's Import Trade Value and China's total CO_2 Emissions is 0.98, and the Correlation between China's Export Trade Value and China's total CO_2 Emissions is 0.97. The Correlation between China's Internet Penetration Rate and China's Import Trade Value is 0.97, and The Correlation between China's Internet Penetration Rate and China's Export Trade Value is 0.98. The Correlation between China's Import Trade Value and Export Trade Value is 0.99.

The findings are as follows: 1. Increase in both import and export trade volume are correlated with an increase in carbon emissions.2. In the global industrial division of labor, both consumers and producers of international goods should be equally responsible for their carbon emissions.3. Internet development is positively correlated with import and export trade scale. 4. Although Internet development can suppress carbon emissions by optimizing the international supply chain to some extent, Internet Penetration development will mainly increase carbon emissions. This phenomenon may be caused by the positive impact of the internet on international trade, i.e. the development of Cross-border E-commerce.

4.2 Unit Root Test

As these time series are different types, for instance, "CO2E"is in kilotons, "INTERNET" is in percentage, while IMPORT and EXPORT are in US Dollars, Ln is introduced in for the stationary of time series. Unit Root Tests were conducted to find whether exists a co-integration relationship between these variables. The unit root test results in Table 3 show that all variables — lnCO2E, lnIMPORT, lnEXPORT, and lnINTERNET — are stationary at their levels. In other words, they are integrated of order zero, or I(0). Since all series are already stationary, cointegration analysis does not apply here; cointegration is only relevant for non-stationary series that are integrated of order one (I(1)) or higher. Therefore, we do not need — and in fact should not — perform any cointegration test. Instead, we can directly use ordinary least squares (OLS) regression without worrying about spurious results. The validity of our OLS estimates is further supported by the residual stationarity tests reported later."

Table 2. Correlation analysis of China's Internet Penetration Rate, Import Volume, Export Volume (in current USD) & CO2 Emissions (in Kilotons)

	CO2E	IMPORT	EXPORT	INTERNET
CO2E	1.00			
IMPORT	0.98	1.00		
EXPORT	0.97	0.99	1.00	
INTERNET	0.97	0.97	0.98	1.00

Table 3. Group unit root test for lnCO2E, lnIMPORT, lnEXPORT, and lnINTERNET

Group unit root test: Summary
Series: LNCO2E, LNIMPORT, LNEXPORT, LNINTERNET
Date: 01/24/25 Time: 14:26
Sample: 2000 2022
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.83575	0.0000	4	85
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.82394	0.0000	4	85
ADF - Fisher Chi-square	37.7091	0.0000	4	85
PP - Fisher Chi-square	59.4236	0.0000	4	88

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

4.3 Least Square Regression Analysis

A common misunderstanding is that after running unit root tests, one must always check for cointegration. This is not correct. Cointegration is a concept defined only for non-stationary series that become stationary after differencing (i.e., I(1) series). If all variables are already stationary at levels (I(0)), as in our case, the notion of cointegration simply does not apply. Claiming "no cointegration" for I(0) variables is technically inaccurate because the precondition for cointegration—namely, non-stationarity—is absent. Hence, the proper procedure is to proceed directly with OLS regression. Our analysis follows this correct path, and the residual stationarity tests confirm that our OLS results are not spurious.

Since each group of time series is stable, in order to observe whether there exists a liner relationship between variables, regression scatter graphs are drawn with Eviews12. As can be seen from Figure 2, there is a linear correlation.

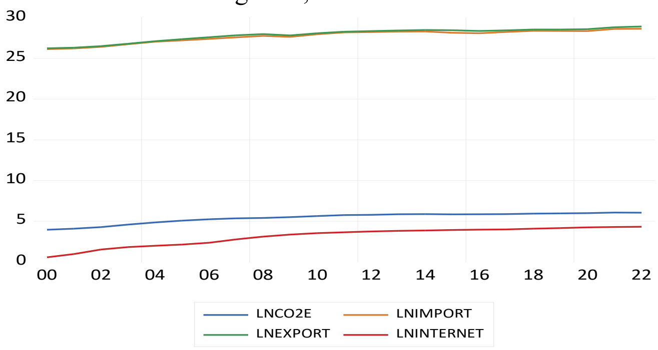

Fig. 2. Regression scatter graph of lnCO2E, lnIMPORT, lnEXPORT, and lnINTERNET

In order to see clearly what factor influence Chinese carbon emission, import and export are listed separately in two equations. Therefore, the following regression models are proposed:

$$lnCO2E = C_1 + \beta_1\, ln\text{IMPORT} + \beta_2\, ln\text{INTERNET} + \mu_1 \tag{1}$$

$$lnCO2E = C_1 + \beta_1\, ln\text{EXPORT} + \beta_2\, ln\text{INTERNET} + \mu_2 \tag{2}$$

The meaning of each variable is shown in Table 1. Based on China's data during the period of 2000-2022, Eviews12 was used to test, and the statistical results are shown in Table 4. As showed in Table 4， residuals of each regression were ADF tested.

The data was processed via Eviews 12, and the result shows that: after taking the natural logarithm of China's total CO2 Emissions, China's Internet penetration rate, China's Import Value and Export Value, the linear trends is similar (Fig .1). Moreover, it is speculated that there respectively exists a positive correlation between China's Internet penetration rate and China's total CO2 Emissions amount, between China's Import Value and China's total CO2 Emissions amount, and between China's Export Value and China's total CO2 Emissions amount.

Regression result is shown in Table 4. The R squared value of model (1) and (2) is 0.988 and 0.989 respectively, indicating a good fit for both model. This result signifies a sound model fit. In the significant test of regression coefficient, SIG. Value Of internet penetration to CO2 Emissions of model (1) and (2) is 0.046 and 0.049 respectively, less than 0.05. Residual ADF test for model (1) shows: T-statistic is-2.209, less than the statistic (-1.957) at 5% value, and P-value is 0.029, less than 0.05. Residual ADF test for model (2) shows: T-statistic is -2.060, less than the statistic (-1.957) at 5% value, and P-value is 0.040, less than 0.05. Therefore, there is no unit root in both residual series, which prove that the residual series for both model (1) and model (2) are stable. In conclusion, it can be judged that there is no col-linearity. The coefficient is positive. China's CO2 Emissions and internet penetration and are significantly correlated at the level of 0.05, while China's CO2 Emissions are significantly correlated with China's import and export at the level of 0.001 This initially confirms hypothesis (1) Internet development exacerbates Carbon Dioxide emissions. The regression equation is as follows:

$$lnCO2E = 0.587 * lnIMPORT + 0.176 * lnINTERNET - 11.412 \tag{3}$$

$$lnCO2E = 0.567 * lnEXPORT + 0.169 * lnINTERNET - 10.914 \tag{4}$$

However, all the variables cannot be put together in one equation. For one thing, besides the variables discussed in this article, other factors like population, GDP influence CO2 Emissions too, which has already been proved by other researchers. For another, the variables discussed in this article are correlated (see table2), which will cause multicollinearity. In summary, both variable omission and multicollinearity undermine a multiple linear regression equation's fitness and rightness.

Table 4. Regression Statistical Results of Model (1) and Model (2)

OLS Dependent Variable: lnCO2E		
Variable	**(1)**	**(2)**
lnIMPORT	0.587*** (T=4.797; P=0.0001)	
lnEXPORT		0.567*** (T=5.025; P=0.000)
lnINTERNET	0.176** (T=2.13; P=0.046)	0.169** (T=2.097219; P=0.049)
Constant	-11.412*** (T=-3.63; P=0.002)	-10.914*** (T=-3.765025; P=0.0012)
R-squared	0.988	0.989
Adjusted R-squared	0.987	0.988
F-statistic	852.084	896.893
Prob(F-statistic)	0.000***	0.000***
T-Statistic (Residual ADF Test)	-2.209	-2.060
Prob (Residual ADF Test)	0.029**	0.040**

Note: Asterisks***, ** and * denote statistically significant differences in the coefficients at the p < 1 per cent, p < 5 per cent and p < 10 per cent levels, respectively. In brackets, T denotes t-statistics, and P denotes Probability.

5 Conclusion and Suggestion

On basis of the existing theoretical analysis and empirical study, this paper finds out the factors of internet development, import and export, and international trade influence CO2 Emissions. Four hypotheses proved to be true and realistic.

1. Internet development exacerbates Carbon Dioxide emissions.
2. Import Trade exacerbates Carbon Dioxide emissions.
3. Export Trade exacerbates Carbon Dioxide emissions.
4. International Trade exacerbates Carbon Dioxide emissions.

5.1 Conclusion

Conclusion can be drawn in three aspects.

Firstly, although Internet development can suppress carbon emissions by optimizing the international supply chain to some extent, Internet Penetration development will mainly increase carbon emissions through promoting Cross-border E-commerce. With the spread of Covid-19, Cross-border E-commerce boost. People buy overseas product online, not only E-commerce platform, but also in social media and live shows. Facilitated consumption and impulse consumption boost international trade and increase multinational transport, both of which exacerbate Carbon Dioxide emissions

Secondly, the increase in both import and export trade volume are correlated with an increase in carbon emissions. In the first half year of 2022, China's imports of crude oil, natural gas, coal and other energy products amount to 1.48 trillion Yuan RMB in total, increased by 53.1%, accounting for 17.1% of the total imports value. A large proportion of the imported energy is used in the production of good for export. The principle, "Who produce, who let out Carbon Dioxide, so who take the responsibility" is unfair.

Thirdly, in the international industrial division of labor, both consumers and producers of international goods should be equally responsible for their carbon emissions. Therefore, not only Producers but also Consumers, not only developing countries but also developed countries should take the responsibility to reduce carbon emissions.

5.2 Suggestion

Internet development may relieve carbon emission intensity to some extent, but the rise of Internet Penetration Rate increase CO2 emission on the whole. This phenomenon is mainly due to the fast development of cross-border E-commerce, the prosperity in global logistics and people's facilitated goods consumption. Not only export increases Carbon emissions, but also import aggregates carbon emission of a country. The following suggestions are proposed:

1. Replace carbon import tax with carbon consumption tax. CO2 consumption tax makes a consumer realize how much CO2 emission maybe caused for what he or she bought and pay for that, so it will effectively cut unnecessary consumption. CO2 consumption tax cannot be levied for human basic needs like food and clothing.

2. Establish a global Green Certification System. It is imperative to implement a comprehensive international green product guideline, accreditation, and labelling scheme. Green certification refers to high-quality products that meet environmental protection requirements throughout the whole product life cycle, deemed safe in terms of its environmental impact and impact on human health, low-carbon, degradable, renewable or recyclable, consuming less resources and energy. Products with Green Certificates can enjoy low tax, or consumer duty-free. It is an effective means of promoting eco-friendly consumption practices, while simultaneously securing and enhancing people's standard of living. It is also an effective way to guide industrial green transformation and upgrading; it is also a practical need for countries to fulfil their international emission reduction commitments.

3. Cancel the patents related to Environmental protection. Patents provide incentives for people to invest in Research Development by endowing the right holder with exclusive rights. Nevertheless, rather than a commodity, from an economic point of view, the environment is public goods, or public resource that should not be used to make profit through patents. Excessive protection of patents will limit the promotion of new technologies, delay the adoption of new technologies, waste society resources, cause repeated research and development, and thus may cause even irreversible dam-

age to the environment. Therefore, environmental protection patents should be abolished. Developing countries cannot afford environmental products or equipment. Cancel the patents will help lower the prices for environmental products or equipment, so that poor countries can afford to apply high technology to reduce CO2 emission. It is advisable for all governments to purchase or subsidize the developers of environmental protection patents. The amount of government procurement or subsidy is determined with Research and Development costs and within the legal range of statutory compensation for patents. Developed countries should set an example by disclosing some environmental protection patents to the world every year, or at least transferring some patents at low prices, so that new technologies can be spread and applied quickly and widely. The World Environmental Protection Organization should also set up prizes and honorary titles to award environmental inventors.

4. Levy Foreign Investment Tax for polluting industry.

5. New energy substitution. Use solar energy, natural wind energy, water energy, for example, solar and wind alternate street lights.

6. Free electronic data transmission in trade and customs.

7. The use of low-altitude unmanned aerial vehicle for delivery to reduce manpower and save energy.

Above all, not only Producers but also Consumers, not only developing countries but also developed countries should take the responsibility to reduce carbon emissions. This study also shed light on the share of carbon emissions between trading partners and the division of emission reduction responsibilities, and has an important impact on the cooperation between countries to deal with global climate change.

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