ORIGINAL PAPER

# Is there a waterbed effect generated by carbon reduction policies? A parallel EU-27 – China

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**Abstract:**
This study explores the phenomenon known as the waterbed effect in the context of carbon emission reduction policies, focusing on a comparison between the EU-27 and China. This is an economic metaphor used to describe the migration of phenomena from one place to another following the implementation of restrictive policies, especially between regions with differing regulatory standards. Global trade dynamics play a crucial role, with trade relationships between the EU-27 and China influencing carbon emissions. Despite EU-27 efforts, the trade deficit with China has widened, leading to a disproportionate increase in emissions. Analysed data indicate the existence of a waterbed effect concerning carbon emissions between the two regions, potentiated by the redistribution of emissions due to disparities in environmental regulations and production outsourcing. Thus, the study reveals a correlation between trade imbalances and carbon emissions, with China's emissions surpassing those of the EU-27 in recent years. Efforts to curb emissions within the EU-27 are undermined by the waterbed effect, exacerbating global climate challenges. Moreover, the waterbed effect evolves into a "move the goalposts" phenomenon, emphasizing the need for comprehensive and collaborative climate policies.
This analysis contributes to a deeper understanding of the complex dynamics between climate policy and the global distribution of carbon emissions, with notable implications for the development and future implementation of environmental policies worldwide. Addressing climate change requires a multifaceted approach, with EU-27 climate policies playing a crucial role. To effectively mitigate climate change, EU-27 policies must advocate for international agreements, contribute to global conservation efforts, and implement domestic policies with minimal economic impact. Additionally, recognizing the interconnectedness of global emissions and trade dynamics is essential to developing sustainable solutions. Ultimately, a collective effort is needed to combat climate change, emphasizing the importance of comprehensive and equitable climate policies on a global scale.

**Keywords:** waterbed effect, $CO_2$ emission, environmental policies, trade balance, greenhouse gas.
**JEL Classifications:** Q51, Q56, Q58, F18, H27

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## Introduction

Climate change is a complicated and tender subject (Olimid et al. 2022). The term "carbon footprint" denotes the comprehensive quantity of diverse emissions of greenhouse gases (GHG), predominantly encompassing carbon dioxide, discharged as a consequence of the decisions and activities undertaken by an individual, entity, or nation/state. Typically, the carbon footprint is quantified in units of carbon dioxide ($CO_2$) or its equivalent ($CO_2e$ or million metric tonnes of carbon dioxide equivalent - MMTCDE). Even though the focus is usually on $CO_2$, there are other gases that contribute to this greenhouse effect such as methane ($CH_4$), nitrous oxide ($N_2O$) and Fluorinated gases (hydrofluorocarbons - HFCs, perfluorocarbons - PFCs, sulphur hexafluoride – $SF_6$, and nitrogen trifluoride – $NF_3$). For example, one ton of methane ($CH_4$) is equivalent to 25 tons of $CO_2$ (Stein, 2024). The bulk of these greenhouse gases, emanate from practices such as deforestation, the combustion of fossil fuels, and the manufacture and utilisation of various commodities and amenities.

In grasping the significance of the carbon footprint, one can analogize it to the imprint left by traversing through wet cement. This imprint ensnares and preserves one's impact, enduring for an extensive duration. Although often imperceptible, each decision made contributes either to the augmentation or mitigation of one's carbon footprint. Evidently, the carbon footprint serves as an indelible testament to human activity on the planet, hence elucidating the imperative nature of endeavours aimed at its reduction.

Worldwide, more and more measures have been adopted to reduce carbon emissions. But it is an approach that has several speeds. The European Union, along with many other countries, have committed to carbon neutrality by 2050, but China says it will do so before 2060 (United Nations, 2020; Wu et al., 2022). Given the different approaches of the EU-27 countries and China (a two-speed strategy), this study aims to identify whether there is a real effect, at the global level, of the efforts made by EU-27 member states regarding the drastic reduction of carbon emissions with the aim of slowing down climate change.

## The evolving trend of carbon emissions: EU-27 vs China

The latest climate assessment by The Intergovernmental Panel on Climate Change (IPCC) asserts that humanity must drastically reduce greenhouse gas emissions. To limit global warming to 1.5 degrees Celsius, global greenhouse gas emissions must decrease by 60% by 2035 compared to 2019 levels (IPCC, 2023). Achieving this requires a collective effort from all countries, particularly those that are highly industrialized, but major polluters such as China and India did not undertake to do so until a few decades later (Chandrasekhar, 2022; Myllyvirta, 2023).

To tackle climate change, the European Parliament adopted the European Climate Law, which raises the EU's target of reducing net greenhouse gas emissions at least 55% by 2030 (from the current 40%) and makes carbon neutrality by 2050 legally binding.

In Europe, climate protection is increasingly integrated into political initiatives such as industrial policies, equity in society, and recovery efforts following the pandemic (European Commission, 2020). The Climate Law is part of the European Green Deal, the EU's roadmap towards climate neutrality. To reach its climate goal, the European Union has come up with an ambitious package of legislation known as "Fit for 55". It comprises several interlinked revised laws and new proposed laws on climate and energy (European Council, 2022; Olimid & Olimid, 2022). Contrarily, China currently lacks very ambitious targets in this regard. The latest five-year plan of China does not

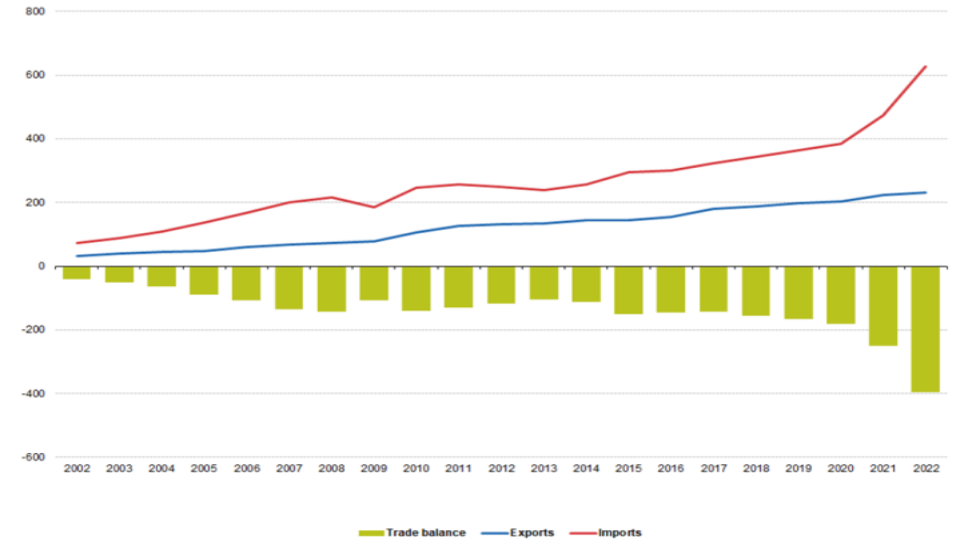
demonstrate any intensifications in efforts towards climate protection; instead, it mirrors the level of commitment seen in the previous five-year plan (Dröge, 2021).

International trade relations have become a central element in the global economy. However, they can result in adverse environmental consequences, as production geared towards exports may lead to unsustainable utilization of freshwater resources, pollution, loss of biodiversity, and deforestation. Trade channels economic incentives to producers across countries and, combined with weak or inadequate regulatory frameworks, can lead to negative environmental outcomes. Insufficiently regulated markets are particularly susceptible to generating adverse environmental impacts through trade activities (FAO, 2022).

The expansion of global trade and the increasing integration of global value chains raise inquiries regarding the interplay between trade and the environment. The economic growth spurred by the expansion of trade can directly affect the environment by augmenting pollution or depleting natural resources. Moreover, trade liberalisation might engender a concentration in pollution-intensive activities in certain nations if there are disparities in environmental policy stringency among countries, a phenomenon known as the pollution haven hypothesis (OECD, 2019). Savona and Ciarli (2019) highlighted that global trade patterns and alterations in emission intensities lend support to the pollution paradise hypothesis, suggesting that the intensity of environmental pollution has shifted from developed to emerging nations.

International trade exerts significant influence on greenhouse gas (GHG) emissions and climate change. Trade relations between China and the European Union play a critical role in global GHG reduction efforts. However, trade between China and the EU-27 results in incredibly unequal $CO_2$ emissions (Yang, L., Yan, Y., & Priewe, J., 2011).

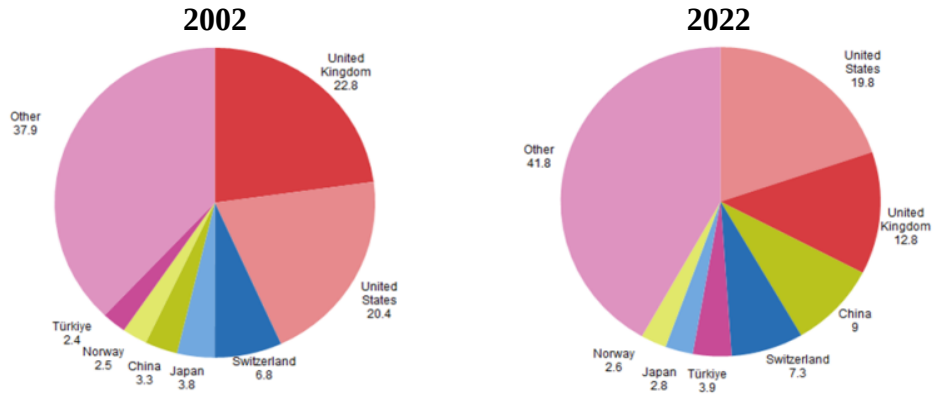
**Figure 1 – EU-27 trade in goods with China: 2002 – 2022 (€ billion)**




Based on an analysis of the total value of trade in goods (in other words, the sum of exports and imports: trade balance), it can be observed (Figure 1) that EU-27 ran

a sizeable trade deficit with China throughout the period from 2002 to 2022. Between 2002 and 2022, it grew from €41 billion to €396 billion. In total trade, China overtook the United States in 2020 and became the EU's largest trade partner in goods (Eurostat, 2023). Exports from China to the EU are approximately two to three times greater than exports in the opposite direction. Statistical data for 2022 reveals a year-on-year increase of over 30% in Chinese exports to the EU, whereas EU exports to China saw a more modest growth of only 3% (EPIC, 2023).

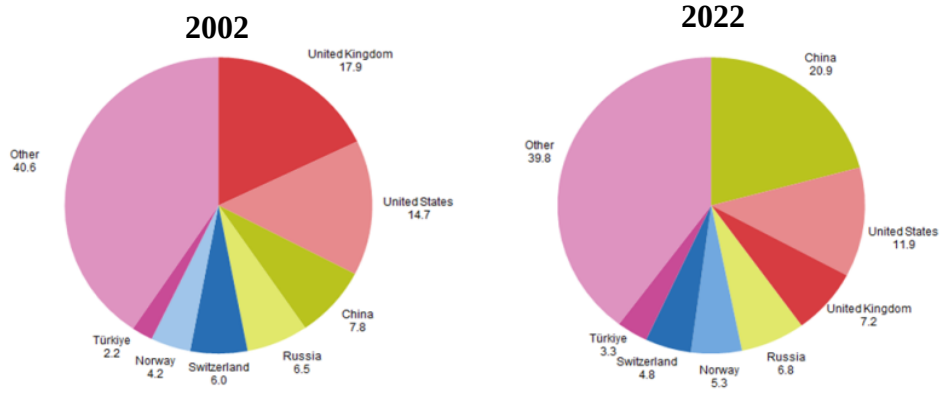
**Figure 2 – EU-27 exports of goods, 2002 and 2022 (%)**




Note: the figure shows the top seven partners with the highest value of exports in 2022
*Source:* Eurostat (online data code: DS-018995)

eurostat

**Figure 3 – EU-27 imports of goods, 2002 and 2022 (%)**




Note: the figure shows the top seven partners with the highest value of exports in 2022
*Source:* Eurostat (online data code: DS-018995)

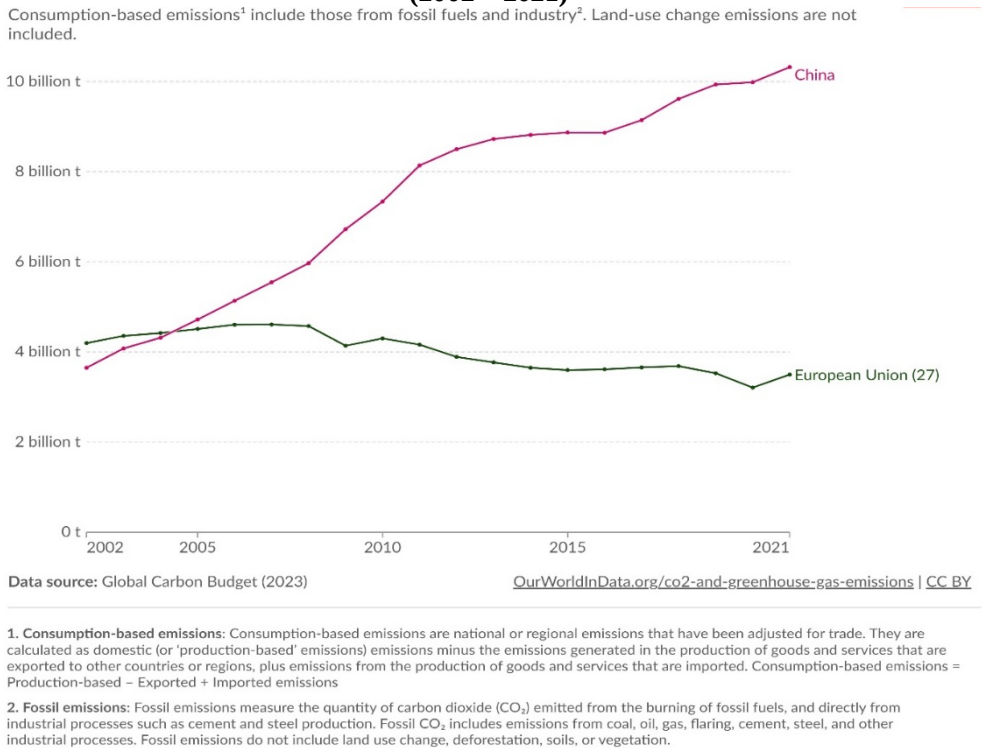
eurostat

The very unbalanced trade balance of the EU-27 – China relationship and its evolution can also be observed from the comparative analysis of Figure 2 (EU-27 exports of goods, 2002 and 2022) with Figure 3 (EU imports of goods, 2002 and 2022).

To put this unbalanced trade balance in context, we followed for the similar period (2002–2021; for the year 2022 there is no information yet), the parallel evolution of the amount of CO2 emissions, both for the EU-27 and for China (Figure 4) (Ritchie et al., 2023).

The trade deficit of the EU-27 with China, characterised by a substantial flow of goods and services from China to the EU-27, often entails the import of products with a high carbon footprint, such as industrial and manufactured goods. The production of these goods in China may involve intensive use of coal-based energy and other polluting practices, thereby contributing to the increase in global carbon emissions.

**Figure 4 – Evolution of consumption-based $CO_2$ emissions: EU-27 – China (2002 – 2021)**




1. **Consumption-based emissions**: Consumption-based emissions are national or regional emissions that have been adjusted for trade. They are calculated as domestic (or 'production-based' emissions) emissions minus the emissions generated in the production of goods and services that are exported to other countries or regions, plus emissions from the production of goods and services that are imported. Consumption-based emissions = Production-based – Exported + Imported emissions

2. **Fossil emissions**: Fossil emissions measure the quantity of carbon dioxide ($CO_2$) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil $CO_2$ includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

It can be observed that in the first half of 2004, there was an inflection point where the inversion of the major polluter characteristic occurred. The decreasing trend of the EU-27 countries is in opposition to the increasing trend of China's carbon emissions. This phenomenon can also be explained by the trade gap's sharply increasing trend, as shown in Figure 1.

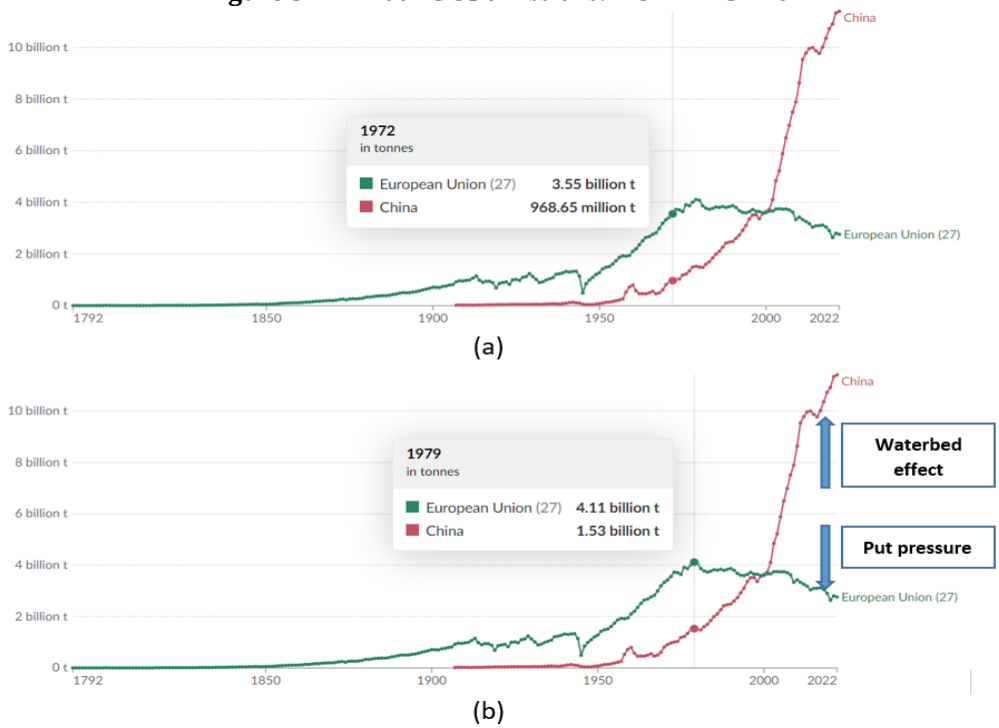
This comportment is similar to that of a waterbed mattress that contains a certain amount of water. By putting pressure on the mattress in one place, the displaced water will always cause the mattress to rise somewhere else because water does not compress. In economic literature, this behaviour is called the "waterbed effect" (Appunn, 2019).

The waterbed effect occurs as a consequence of the pollution haven hypothesis, which posits that when industrialised nations aim to establish manufacturing facilities or

offices overseas, they typically seek the most cost-effective options in terms of resources and labour, even if it entails adopting environmentally unsound practices. Countries offering inexpensive resources and labour often have less rigorous environmental regulations, whereas those with stringent environmental standards become comparatively costlier for companies due to compliance costs. Consequently, firms opting to invest physically in foreign countries tend to gravitate towards those with the lowest environmental standards or weakest enforcement mechanisms (Levinson & Taylor, 2008). The waterbed effect appears even more clearly if we extend the analysis period of the evolution of carbon emissions.

The starting point is the United Nations Conference on the Human Environment (also known as the Stockholm Conference). This was an international conference convened under the auspices of the United Nations, held in Stockholm, Sweden, from June 5 to 16, 1972. It was the UN's first major conference on international environmental issues, and marked a turning point in the development of international environmental politics (European Parliament, n.d.). The correspondent of 1972 in the amount of carbon emissions can be seen in Figure 5 (a). But, due to inertia, the waterbed effect only began to manifest itself at the 1979 World Climate Conference in Geneva (Figure 5 – b). This is one of the first major international meetings on climate change. It was essentially one of the first scientific conferences, attended by scientists from a wide range of disciplines. This led to the establishment of the World Climate Programme (WCP).

**Figure 5 – Annual $CO_2$ emissions: EU-27 – China**



After 1979, the EU-27 countries began to put strong pressure on action to reduce the amount of carbon emissions, while China's carbon emissions exploded. The waterbed effect in the carbon market is obvious (Fankhauser et al., 2010; Bohringer, 2014).

Given that the EU-27 and China are two of the largest economies and carbon emitters in the world, their commercial relationship and trade balance have a significant impact on global carbon emissions and the environment. Therefore, it is crucial that policies and actions undertaken by both entities address these challenges and promote sustainable economic development and a transition to clean and renewable energy sources.

## Conclusions

The waterbed effect refers to the phenomenon where further abatement efforts in one area lead to increased emissions in another area, resulting in constant $CO_2$ emissions. The stated desire of mankind is to reduce carbon emissions worldwide. Unfortunately, the world is not built like a multitude of balloons in which the air quality of each area depends exclusively on the efforts made; the world is a single balloon in which everyone pours out noxes. The effort must be everyone's.

In the case of the relation between EU-27 and China, the reduction of emissions in the EU-27 may be offset by the increase in emissions from China, in an attempt to meet European demand. This transfer of emissions can partially or even completely negate the progress made in the EU-27, highlighting the need for a coordinated and global approach to combating climate change. In this context, the trade deficit of the EU-27 with China represents a significant factor contributing to this effect.

Right now, even though European reduction efforts are permanent and evident, cumulative (worldwide) emissions are increasing rather than decreasing. In these conditions, due to the growing trade imbalance of the EU-27 countries in relation to China (Jian et al., 2022), the waterbed effect quickly turns into a "move the goalposts" effect (Mitu, 2024). This effect bears similarity to "problem externalization" in the sense that it involves the transfer of difficulty or a problem to other parties or domains, to no longer be directly addressed or dealt with by those responsible.

The trade deficit of the EU-27 with China is just one of the numerous factors contributing to the rise in global carbon emissions and environmental degradation. Addressing these issues requires a deep understanding of the interconnections between international trade, carbon emissions, and environmental sustainability, as well as the strong commitment of the international community to adopting sustainable and responsible solutions.

For this to happen, Bohringer (2014) suggests that EU-27 climate policy needs to fulfil three essential criteria: (i) advocating for international accords on climate protection; (ii) making its own contribution to worldwide climate conservation efforts, and (iii) executing domestic climate policies with minimal costs. To these we can add that the EU-27 must really engage as a player who understands that outsourcing environmental problems is not a viable solution. In vain we will clean only the European yard because the polluted air circulates globally.

**Authors' Contributions:**
The authors contributed equally to this work.

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