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The Impact of FDI inflows on Technical-adjusted Emissions Embodied in International Trade

Empirical Analysis for 39 countries, 1999-2009

by

Rakel Jónsdóttir
ra3200jo-s@student.lu.se

Abstract

In an increasingly globalized world, international trade and foreign direct investment (FDI) provide countries with easier access to goods and services. However, this increased economic activity has consequences that threaten both the environment and human health. Therefore, it becomes important to estimate how FDI inflows influence emissions embodied in trade and whether it can promote sustainable trade patterns. The purpose of this study is to investigate the effect of FDI inflows on an indicator that measures the balance of carbon emissions embodied in trade by adjusting for technological differences (TBEET). This research is the first of its nature to apply the TBEET indicator developed by Jiborn et al. (2018) to econometric analysis. This study was conducted for 39 countries over ten years, 1999 to 2009. The main results suggest a small positive impact of increased FDI inflows on TBEET. Even though the results indicate a small impact, it suggests that FDI inflows are either going towards sectors that demand more energy or towards dirtier production technologies for both domestic consumption and exports – providing some support for the Pollution Haven Hypothesis. Therefore, the results did not support the expectations that increased FDI inflows will decrease TBEET as it indicates that it will result in more carbon-intensive exports than imports.

Keywords: FDI inflows, TBEET, emissions embodied in trade, Pollution Haven Hypothesis, Pollution Halo Hypothesis

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Abbreviations

2SLS - Two-stage-Least Square

BEET - Balance of emissions embodied in trade

BRICS - Brazil, Russia, India, China and, South Africa

CBA - Consumption-Based Accounting

CIA - Conditional Independence Assumption

CO_2 - Carbon Dioxide

EEE - Emissions Embodied in Exports

EEI - Emissions Embodied in Imports

EKC - Environmental Kuznets Curve

EPS - Environmental Policy Stringency

EU - European Union

FDI - Foreign Direct Investment

FE - Fixed Effect

GDP - Gross Domestic Product

OECD - Organization of Economic Cooperation and Development

OLS - Ordinary Least Square

PBA - Production Based Accounting

RoW – Rest of the World

TBEET - Technical-adjusted Balance of Emissions Embodied in Trade

TCBA – Technology-adjusted CBA

1 Introduction

Through international trade and foreign direct investment (FDI), globalization has created a link for countries to new markets that has increased both production and consumption. As a result, the world has been experiencing unprecedented growth rates. The role of FDI has significantly increased in the last two decades, and in 2007, FDI flows reached an all-time high, about 2 trillion USD. However, FDI flows have remained weak after the financial crisis in 2008 (Gestrin, 2016), and in 2020 private investments plunged due to the COVID-19 pandemic - reaching the lowest level since 2005 (OECD, 2021). All countries have utilized FDI at some point in their development process (Seker, Ertugrul & Cetin, 2015) as it brings various benefits for countries. It can serve as a source of external capital, increase development efforts and spur investments when the domestic savings are insufficient. Furthermore, FDI creates positive externalities from spillover effects of technology diffusion and new skills (Shahbaz, Nasreen, Abbas & Anis, 2015). Even though FDI can promote economic prosperity, it can escalate the impacts of climate change. In 2020, global carbon emissions were about 90 percent higher than in 1970 (EPA, 2020). Despite, energy efficiency improvements in the last decades, energy consumption continues to rise at a faster rate than the improvements (Kander, Malanima & Warde, 2013). Moreover, estimations imply that carbon emissions stay in the atmosphere for thousands of years (Malik & Lan, 2016). Therefore, this rapid increase is extremely alarming, and it is evident that the consequences have started to threaten both the environment and human health.

1.1 Research Problem

Countries can outsource their emissions through trade and investments (Zhang, Guan, Wang, Meng, Zheng, Zhu & Du, 2020). *Outsourcing* refers to the process of reducing territorial emissions by increasing emissions in another region through either trade or investments (Baumert, Kander, Jiborn, Kulionis & Nielsen, 2019; Peters, 2008). Such practice is not compatible with sustainable development, as it harms the global environment. To measure how much emissions are embodied in trade, various studies have calculated the difference between production-based accounting (PBA) and consumption-based accounting (CBA) to find the balance of emissions embodied in trade (BEET).

PBA accounts for all emissions generated within the country and is the easiest to measure. The PBA accounting principle serves as the basis for negotiations and commitments under the Kyoto Protocol (Nielsen, Baumert, Kander, Jiborn & Kulionis, 2020) and also the Paris agreement (Dietzenbacher, Cazcarro & Arto, 2020). In contrast, CBA assigns all emissions to the country where the final consumption occurs (Baumert et al., 2019). CBA relies on complex input-output tables for the world where several assumptions are made regarding product homogeneity within product groups. In the CBA approach, the PBA is adjusted by subtracting export-related emissions and adding import-related emissions. Another way to calculate BEET is to take emissions embodied in exports (EEE) and subtracting emissions embodied in imports (EEI). Through such evaluations, they find that the current trend in climate policy is that developed countries are outsourcing their emissions to less advanced regions in order to meet a proposed emission reduction target (Malik & Lan, 2016; Peters, Minx, Weber & Edenhofer, 2011).

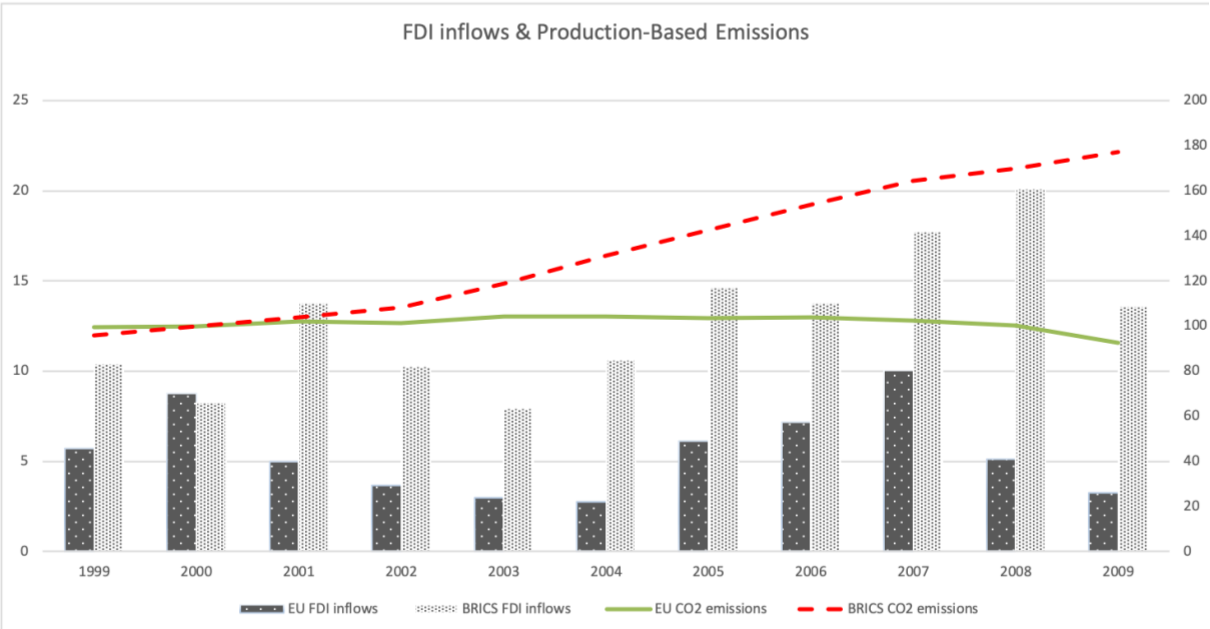

Figure 1.1: FDI inflows & Production Based Emissions in EU vs BRICS

(Source: The World Bank (2021) & OECD Green Growth Database (2020), Authors own calculations)

Figure 1.1 shows the trend of FDI inflows (measured as % of GDP) on the left axis, compared to the production-based emissions (an index in the year 2000 = 100), on the right axis, in the

EU and BRICS economies from 1999 - 2009. The simple assumption that developed countries (for example, the EU countries) are outsourcing their emissions to less developed countries (BRICS), is suggested in the figure. Production-based emissions are decreasing for EU countries while rising in the BRICS economies. The figure further shows that the BRICS economies have been a larger recipient of FDI, which could be associated with higher carbon emissions.

Nevertheless, reducing emissions in one place by increasing emissions elsewhere cannot be considered a way of solving issues related to climate change. The main weakness under the most common accounting method – BEET - is that it fails to consider differences in carbon-efficient technologies, as it only considers the differences between emissions generated in a country (PBA) and the emissions stemming from the final consumption (CBA). So, what according to BEET may seem as outsourcing of heavy production abroad to less developed countries, could instead be a consequence of these countries having on average more polluting technologies in each sector (Jakob, Steckel & Edenhofer, 2014). To remedy this, Jiborn, Kander, Kulionis, Nielsen & Moran (2018) propose an adjusted measure of BEET by accounting for technological differences - a technological-adjusted balance of emissions embodied in trade (TBEET) - that is decomposed into trade specialization and monetary trade balance. Trade specialization shows the difference between technology-adjusted carbon intensities of a country's exports and imports and the monetary trade balance shows the monetary value of imports and exports. A positive TBEET implies that a country has either; more energy-intensive exports than imports or a monetary trade surplus, and is often referred to in the literature as being an "insourcer" of emissions (Baumert et al., 2019). On the other hand, a negative TBEET indicates that a country has more energy-demanding imports than exports or shows a monetary trade deficit, thus getting labeled as an "outsourcer".

As FDI flows have proven to play a fundamental role in a country's development (Gestrin, 2016), the impact of FDI inflows on the environment is less clear. Arguably, the amount of FDI inflows that go directly towards greener technologies, which spurs renewable energy transitions, is only a small fraction of total FDI inflows. A myriad of studies investigating the relationship between the environment and FDI fail to take into account how much FDI flows actually are going towards cleaner technologies that will, in return, promote better environmental quality. Most papers include energy consumption or energy intensity in their analysis (Essandoh, Islam & Kakinaka, 2020; Mahmood, Furqan & Bagais, 2019; Pao & Tsai, 2011; Seker, Ertugrul & Cetin, 2015; Shahbaz et al., 2015) – as they account for the energy input that can be created for a given output. However, that type of approach would have been more applicable if they accounted for how much of the FDI flows are going towards technologies that improve energy efficiencies in the production process.

1.2 Aim and Research Question

The aim of this thesis is to contribute to the debate on whether developed countries lower their emissions by FDI in emerging economies and to investigate the role of FDI in promoting sustainable trade. BEET studies suggest that developed countries are outsourcing their heavy production and the related emissions to less developed countries, but BEET does not take into consideration the differences in production technologies, so this outsourcing could be an illusion. Thus, the idea of outsourcing might not be as simplistic as traditional BEET studies imply. The research question is:

What is the impact of FDI inflows on TBEET?

This study will apply the TBEET indicator, developed by Jiborn et al. (2018) and later utilized in a larger sample set by Baumert et al. (2019), in an econometric analysis of the role of FDI. To the best knowledge of this author, this has not been done before. The thesis will investigate the impact of FDI inflows on TBEET for 39 countries over ten years, from 1999 to 2009. It will also be evaluated whether there is any causal relationship between TBEET, FDI, and other control variables.

1.3 Scope and Limitations

The theoretical framework behind the mechanisms of increased FDI inflows will be observed, which will assist in answering the research question. Next, an overview of related literature will be discussed for better understanding the scope of this research. Three regression models will be performed to find a satisfactory estimate of the causal relationship between TBEET and FDI inflow. Along with a pooled Ordinary Least Square (OLS) model, two methods will be used. First, a fixed-effect (FE) model will be utilized to account for any omitted variables. Second, a two-stage least square (2SLS) regression will be performed to account for possible endogeneity issues. Performing separate regressions will give a better understanding of the causal relationship between variables that might exist.

This thesis will only conduct data until 2009 due to the availability of data for the TBEET indicator available in Baumert et al. (2019). Furthermore, this paper does not conduct any input-output analysis for a later time period of multi-regional input-output (MRIO) tables. It is both time-consuming and outside of the scope of this econometric study. Overall, this study will seek to add to the existing literature on the nexus between FDI inflows and emissions embodied in trade and provide some new insights for the indicator TBEET.

1.4 Outline of the Thesis

The remainder of this paper is organized as follows. In Section 2, a theoretical framework is presented along with proposing the hypotheses for this study. Section 3 provides a review of prior literature that is related to outsourcing, FDI, and trade. Following the literature review, Section 4, will give an overview of data sources and variables will be introduced. Section 5 will discuss methods that will be utilized in this study. Empirical results will be presented in Section 6. Lastly, Section 7 will be a conclusion and motivation for future research on this topic.

2 Theory

First, a theoretical perspective will be reviewed to gain a better understanding of the mechanism behind FDI flows that influence emissions embodied in trade. That will lay out fundamental perspectives before reviewing existing literature. Studies propose two opposite arguments on the nexus between FDI and the environment; they either find that FDI is detrimental for the environment, supporting the *Pollution Haven hypothesis*, or that FDI promotes a cleaner environment, supporting the *Pollution Halo hypothesis.*

2.1 Theoretical Approach

2.1.1 Pollution Haven Hypothesis

The *Pollution Haven hypothesis* suggests that a country with low environmental regulation will attract more FDI leading to increased CO_2 emissions (Essandoh, Islam & Kakinaka, 2020; Shahbaz et al., 2015; Shahbaz, Nasir & Roubaud, 2018). Empirical evidence shows that a large amount of FDI is being attracted to polluting industries (Mahmood, Furqan & Bagais, 2019). In theory, FDI increases economic activity, leading to increased consumption of resources, hence increasing the level of pollution (Pao & Tsai, 2011). In that regard, a positive TBEET is likely to exist in countries with an abundance of natural resources because of easier access to raw materials and increased ability to produce more products for domestic and international markets. Note, that a positive TBEET could also indicate a positive monetary trade balance.

The *Pollution Haven hypothesis* is connected to the idea of carbon leakage, the assumption that developed countries outsource their emissions to developing countries. As mentioned earlier, outsourcing results from foreign trade or investments that reduce territorial emissions within a country but increases emissions elsewhere (Baumert et al., 2019). This can be further classified into two different levels of leakage. The first type of leakage is often called **strong leakage**, which occurs when a country outsources its emissions to countries with less stringent environmental policies so that the emissions will be “leaked” to countries with lower environmental standards. On the other hand, **weak leakage** refers to all types of outsourcing (Peters, 2008). For example, in the natural development process, as countries become more developed and move up the knowledge ladder, they tend to focus more on advanced products, such as pharmaceuticals and services. Because heavy industries tend to be more carbon-intensive, service-based economies have shown the tendency to import such products while exporting less carbon-intensive goods. Therefore, as a country becomes more service-driven, structural outsourcing could occur when a country changes its composition of exports and imports. This is what TBEET can illuminate.

Additionally, comparative advantage is a powerful tool to understand countries' trade specialization. Comparative advantage is when an economy can produce a particular product at a lower cost than its trading partners. For example, a country with an abundance of coal reserves will have a comparative advantage in more carbon-intensive industries. Therefore, will specialize in industry that generates more emissions than a country with a comparative advantage in less carbon-intensive industries. As a result, energy-demanding exports will exceed the energy-demanding imports, indicating a positive TBEET.

However, Jiborn et al. (2018) point out that the carbon intensity of each country differs, so trade specialization does not tell the whole story of the outsourcing assumption. In their study from 2018, the authors explain that a country such as Sweden, a large steel producer, has a more carbon-efficient energy system than the world average. Hence, if Sweden trades with another country with carbon-inefficient energy system, Sweden will become a net carbon emission importer, suggesting a negative BEET. However, this is misleading in terms of actual outsourcing of heavy industries, and for that reason, TBEET uses the world average carbon intensity to avoid noise that comes from the differences in carbon intensity and to study structural outsourcing (Jiborn et al., 2018). In doing so, TBEET will identify any differences in trade structure that stems from the scale or composition effects. Nielsen and Kander (2020) further explore this and build upon the technology-adjusted CBA (TCBA) approach developed by Kander et al. (2015). The TCBA only adjusts for differences in carbon efficiency in the export sectors, but the TBEET adjusts for the differences in both import and export sectors. Nielsen and Kander (2020) introduce the concept of comparative carbon advantage. By calculating NEGA emissions (CBA – TCBA), the authors show that Sweden contributed to 590 tons of potential CO_2 savings by its carbon efficient exports by replacing less carbon efficient production abroad.

If the *Pollution Haven hypothesis* is correct, we would expect a positive impact on TBEET from FDI. Suppose we assume that heavier industries, such as the steel or cement industry, have larger technology differences between nations, in respect to CO_2 emissions. In that case, a positive impact on TBEET from FDI can indicate that FDI inflows go more towards dirtier production technologies. However, support for the *Pollution Haven hypothesis* could also indicate that sectors are more energy demanding, despite having efficient technology.

2.1.2 Pollution Halo Hypothesis

The *Pollution Halo hypothesis* suggests that through FDI, multinational enterprises will spread their cleaner technologies to host countries, reducing overall emissions and increasing environmental quality (Essandoh, Islam & Kakinaka, 2020; Shahbaz, Nasir & Roubaud, 2018). Even though prior studies suggest that countries export their dirtier industries to countries with less stringent environmental policies, there is no guarantee that FDI inflows will be directed towards setting up energy-demanding production like steel, pulp and chemicals. In some cases, FDI inflows might only proportionally impact export industries and instead contribute more to the domestic market in the host country, for instance set up steel and cement industries to contribute to domestic industrialization and infrastructure. In particular, part of the FDI inflows will likely go towards domestic investments, ultimately leading to a higher level of income (Graham, 1995). As purchasing power increases, so does consumption. Therefore, imports will grow, increasing the consumption-based emissions. Hence, according to the *Pollution Halo hypothesis* a negative TBEET is likely to exist in relation to FDI inflows.

2.1.3 Hypotheses

Most countries do not have a complete balance of their emissions embodied in trade even when technology differences are considered, so a positive or a negative TBEET is likely to exist. Baumert et al. (2019) decompose TBEET into two drivers; trade specialization and monetary trade balance, which can either counteract or reinforce each other. A negative TBEET suggests that imports are more carbon-intensive than exports, i.e. the composition of imports are more energy demanding than the exports, or that the country has a negative monetary trade balance, i.e. they are importing more value than they export. On the other hand, a positive TBEET results from either more carbon-intensive exports than imports or a monetary trade surplus.

Hence, the impact from FDI inflows on TBEET is ambiguous, as the TBEET could be affected by FDI in either direction. Either by promoting increased exports of heavy goods - positive TBEET - or promoting cleaner trade, higher purchasing power leading to more imports - negative TBEET. For that reason, this paper will investigate two contradictory hypotheses to see if support is found for the *Pollution Haven* or the *Pollution Halo* hypotheses.

1. *An increase in FDI inflows will cause a change in the trend of Technical-adjusted Balance of Emissions Embodied in Trade (TBEET)*
2. *An increase in FDI inflows causes a decrease in TBEET, i.e more carbon intensive imports than exports – negative TBEET*

2.2 Previous Research

2.2.1 Outsourcing

The first string of literature will explore carbon outsourcing, also referred to as carbon leakage. As mentioned earlier, international trade and FDI provide countries with a link to consumption and production which will increase economic activity. Due to the increased globalization, emissions embodied in both trade and investments continue to increase. However, the question remains about who should be held responsible for such emissions, is it the producer or consumer? Scholars investigating the balance of emissions embodied in trade (BEET) have emphasized the difference between production-based emissions and consumption-based emissions. In doing so, they often perform an environmental extended input-output analysis (Baumert et al., 2019; Chen, Ohshita, Lenzen, Wiedmann, Jiborn, Chen, Lester, Guan, Meng, Xu, Chen, Zheng, Xue, Alsaedi, Hayat, & Liu, 2018; Davis & Caldeira, 2010; Gasim, 2015; Kander, Jiborn, Moran & Wiedmann, 2015; Liu, Huang, Baetz & Zhang, 2018; Malik & Lan, 2016; Nielsen et al., 2020; Peters et al., 2011). To re-emphasize, the main difference between PBA and CBA is that PBA assigns all emissions to the territory where emissions are generated. In contrast, CBA assigns emissions to the final consumers of a good regardless of where in the supply chain the emissions generation took place.

Kander et al. (2015) recognize the drawbacks of both PBA and CBA in a study that proposed a new method for carbon accounting - technology-adjusted CBA (TCBA). While PBA give countries responsibility for their territorial emissions, it does not account for emissions that are outsourced to other countries. More so, PBA is unable to influence the level of consumption in a country. On this note, a recent study by Nielsen et al. (2020) analyzed the trends in carbon outsourcing from 2000 - 2014, pointing out that under the Kyoto Protocol, countries that were committed to the protocol significantly reduced their production-based emissions. However, global emissions increased from 2000 to 2014. This suggests that there may be carbon leakage in climate agreements that are not captured by PBA alone. CBA aims at capturing outsourcing problems. However, Kander et al. (2015) emphasize the pitfalls of CBA too, as it does not react to changes in the export sector's carbon efficiency and fails to take into account trade specialization through more carbon-efficient production, which will reduce emissions. Hence, CBA results could be exaggerated because it fails to consider that countries may have different technologies that affect the energy efficiency of their production. What seems to be outsourcing could be an illusion created by different technologies and energy systems among nations. Hence, TCBA uses the world average technology (therefore world average emissions) instead of domestic production carbon-intensities (Kander et al., 2015; Nielsen & Kander, 2020). However, a weakness of the TCBA approach is that it is not scale invariant as it treats emissions embodied in imports and exports differently (Domingos, Zafrilla & López, 2016). This implies for instance that the sum of TCBA for all EU countries individually will differ from TCBA for EU calculated directly as one entity. TBEET on the other hand is scale invariant because it calculates both imports and exports with world average technologies (Jiborn et al., 2018).

A common assumption in the literature is that more advanced economies reduce their domestic emissions at the expense of less developed countries. Such results are evident in multi-regional input-output analysis studies that have found that developed countries have been outsourcing their emissions to developing countries (Gasim, 2015; Malik & Lan, 2016; Peters et al., 2011). These results indicate that BEET is negative for developed countries, as PBA is smaller than CBA and positive for developing countries. Peters et al. (2011) ask whether developed countries outsource their emissions to developing countries by generating a trade-linked global database for CO_2 emissions in 113 countries from 1990 to 2008. Their results show that production-based emissions have increased global emissions by about 6 percent. They conclude by showing that in developing countries, consumption-based emissions have increased faster than the reduction in their domestic emissions. This indicates that as developed countries are outsourcing their emissions to developing countries, their increased consumption-based emissions are contributing to even higher global emissions. However, their approach fails to take into account the differences in carbon efficiency of production, which most likely causes an overestimation of their overall results. Therefore, this study would have been more applicable if they would have accounted for technological differences.

The milestone study conducted by Jiborn et al. (2018) proposed a new indicator - a technology-adjusted balance of emissions embodied in trade (TBEET) - that can be used to identify what effects; structural, composition, or technology effect, are at play in trade. Past research has shown that the traditional BEET is not a reliable indicator in exploring outsourcing trends. Mainly because BEET does not account for differences in production technologies and cannot separate the effects of structural and compositional effects from the effects of different technologies. Consequently, a negative BEET should not be categorized as *structural outsourcing* (Baumert et al., 2019; Jiborn et al., 2018; Kander et al., 2015; Nielsen et al., 2020). *Structural outsourcing* refers to the process when service-driven economies import heavy industry products instead of producing them themselves. To illustrate further, under the common BEET accounting, a country that specializes in heavy industry with efficient energy technologies and imports goods and services from countries that are less carbon-efficient, this country would be identified as an outsourcer of emissions (negative BEET) because the net effect of such trade would be negative (compared to a no-trade scenario). That would not be reasonable when accounting for the balance of emissions embodied in the trade, as this country would be contributing to a net decrease of global emissions (Baumert et al., 2019; Jiborn et al., 2018; Nielsen et al., 2020). Nielsen et al. (2020) further emphasized the drawbacks of BEET, by explaining that as a country transitions to more environmentally friendly energy sources, such as renewable energy, the country would decrease its production-based emissions resulting in a negative BEET and therefore would be classified as an outsourcer even though this country is contributing to lower global emissions.

Baumert et al. (2019) make a very valid argument that the disparities between countries' emissions embodied in the trade may arise because of differences in energy and production technologies, in a paper where they evaluate the claim that carbon emissions are systematically outsourced from developed to developing countries, from 1995 to 2009. By decomposing TBEET, developed by Jiborn et al. (2018), into its main drivers, trade specialization and monetary deficit, they find that emissions embodied in trade have only been 3.6 percent of global emissions. Hence, their results contradict the conventional BEET studies, as they show that TBEET is positive for the Nordic countries, advanced Asian countries, and aggregate EU-27. Moreover, the trend for emerging economies is less clear than traditional BEET studies suggest. This indicates that imbalances between PBA and CBA are more due to differences in carbon-efficient production technologies than outsourcing.

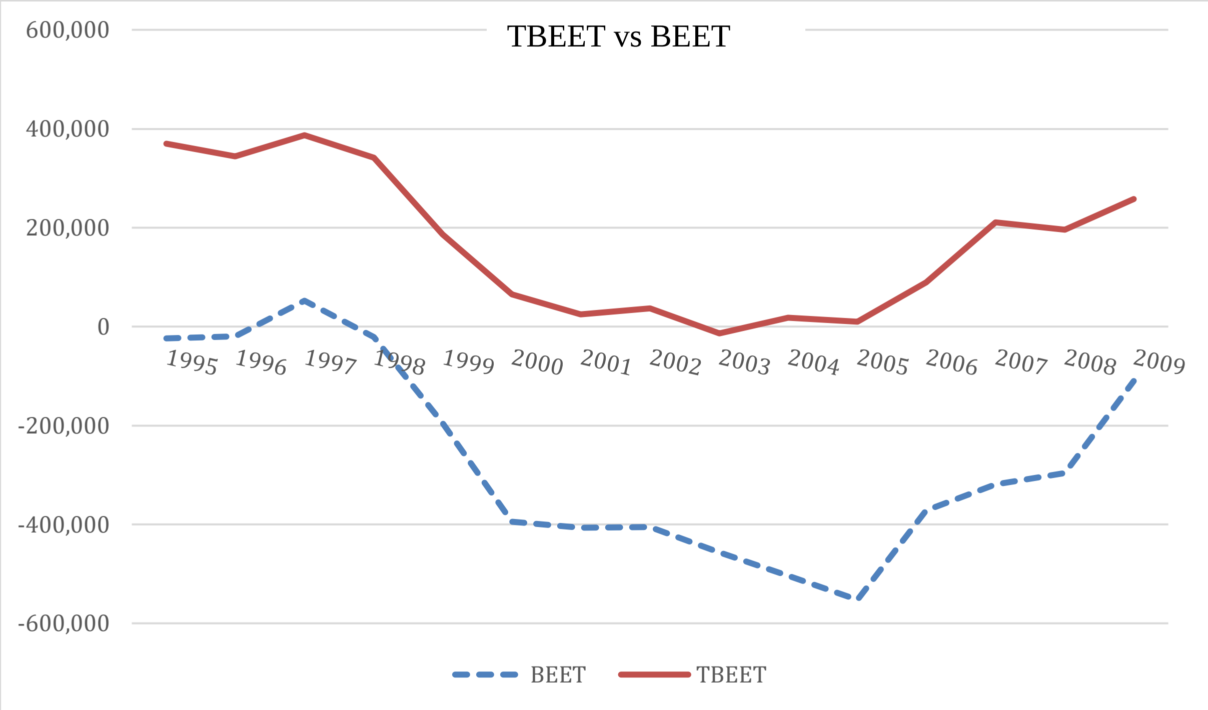

Figure 2.1: Sum of TBEET and BEET (Source: Baumert et al. (2019) dataset. Author's Construction)

Figure 2.1 shows the difference between BEET and TBEET measured in kiloton CO_2 for all 39 countries included in this study. The figure further illustrates that results from BEET studies might be overestimated as they do not account for difference in production technologies.

2.2.2 FDI and Emissions Nexus

The empirical research on the relationship between FDI and environmental degradation remains inconclusive. Several key findings from prior studies show that FDI inflows and the environment have a positive relationship, supporting the *Pollution Haven hypothesis*. A recent study conducted by Essandoh, Islam, and Kakinaka (2020) investigated the link between international trade, FDI, and carbon emission in 52 countries from 1991 to 2014. By studying the most crucial drivers of economic growth, FDI inflows, and trade, they find that developing countries have a positive relationship with carbon emissions, but developed countries have a negative relationship. In essence, a 1 percent increase in FDI causes a 0.25 percent increase in

CO_2 emissions for developing countries. Their results indicate that developed countries are achieving their emissions reduction targets at the expense of the developing countries, which further emphasizes the findings of BEET studies. These findings are also in line with the study conducted by Zhang et al. (2020), which proposes an investment-based accounting framework in order to trace carbon emissions that are embodied in the supply chains of multinational enterprises. The authors suggest that this framework can help in addressing carbon leakage that takes place through FDI.

The majority of studies investigate the co-integration of FDI, trade, economic growth, and energy consumption. Mahamood, Furqan, and Bagais (2019) show evidence that supports the *Pollution Haven hypothesis*, which indicates that FDI inflows are one of the factors causing environmental harm. Likewise, Pao and Tsai (2010) explored the relationship between FDI, real GDP, energy consumption, and emissions in BRIC economies from 1980 to 2007. They show that FDI increases emission levels, but their main findings suggest that FDI is inelastic, implying that change in FDI does not cause a large change in emissions levels. This is worth noting, as Seker, Ertugrul, and Cetin (2015) further add to Pao & Tsai's (2011) findings. They studied the impact of FDI on environment quality in Turkey and claim that while FDI increases the emissions, the effect is relatively small.

It is evident in the literature that FDI potentially harms the environment. However, financial development is found to improve environmental quality. Studies use financial development as a proxy for domestic credit to the private sector (Al-mulali, Tang & Ozturk, 2015; Omri , Daly, Rault, Chaibi, 2015; Shahbaz, Nasir & Roubaud, 2018). Therefore, FDI inflows might be essential for countries to become financially developed. Shahbaz, Nasir, and Roubaud (2018) conducted a study on the determinants of carbon emissions in France from 1955 – 2016 and found that FDI positively affects carbon emissions. Even though FDI harms the environment, the authors find that it lowers the emissions as the country becomes more financially developed. That trend is further emphasized in a paper by Al-Mulali, Tang and Ozturk (2015), where they find that financial development can reduce emissions in all countries irrespective of their income levels. This is significant because countries with lower financial development will need FDI, which might result in increased pollution. However, as less advanced countries become more developed, they will turn that trend around and improve environmental quality.

Through FDI, countries can achieve economic prosperity and also a cleaner environment. Studies showing that FDI inflows reduce carbon emissions in the receiving country support the *Pollution Halo hypothesis*, which implies that FDI inflows will transfer greener technologies and better energy systems to the host country (Essandoh, Islam & Kakinaka, 2020; Seker, Ertugrul & Cetin, 2015). A recent paper by Demena and Afesorgbor (2020) performs a meta-analysis study of the effect of FDI on emissions by using 65 studies. After accounting for heterogeneity, their results show that FDI significantly reduces emissions in the environment. A weakness of this study is that it includes papers that are homogenous and show similar results from the same authors, therefore giving a biased estimate of the effect of FDI on emissions.

Unlike most studies investigating the causal relationship of FDI inflow and emissions, Omri, Nguyen and, Rault (2014) examines causality between CO_2, FDI, and economic growth by using the Cobb Douglas production for 54 countries. Their results show that CO_2 emissions have a negative impact on FDI inflows, which means that countries will have a cleaner environment in the long run through FDI inflows. Additionally, various studies indicate that there exists bidirectional causality between CO_2 emission and FDI on one hand and between GDP growth and FDI on the other hand, which shows that FDI inflows reduce emissions However, in applying multivariate regression, Lee (2013) finds no effect of FDI on carbon emissions for the G20 countries.

As FDI inflows can improve environmental quality in the host country, the studies investigating such impacts fail to show how much of the FDI inflows are being contributed towards greener technologies. The quantity can matter a great deal to achieve financial development but the quality matters even more in promoting a cleaner environment. A recent paper conducted by Pan, Guo, Han, Wang, Song, and Liao (2020) investigated the role of FDI quality on energy efficiency in China from the years 2003 - 2016. Their results indicate that FDI quality plays a significant role in enhancing energy efficiency in China. The variable FDI quality measures the technology spillover effects of FDI on domestic firms coming from foreign technologies. This variable is influential as it enhances the common variable, FDI inflows, which is used in most studies and is able to identify how much is due to spillover effects of new technologies.

2.2.3 Trade and Emissions Nexus

The last string of literature focuses on the nexus between trade and emissions. Along with FDI, international trade is one of the driving forces for economic growth. Many scholars have devoted much of their attention to the relationship between trade and carbon emissions. There is a consensus in the literature on the linkages between international trade and climate change. However, trade liberalization and combating climate change have not always been parallel. The importance of having the two on the same path has created extensive efforts by the U.N Framework Convention of Climate Change (UNFCCC), the Kyoto Protocol, and most recently, the Paris Agreement in 2015. Even though there is a consensus in the literature that international trade and climate change are interdependent, there is much debate on the impact of trade on emissions. Prior literature suggests that trade can have three possible effects on CO_2 emissions (Tamiotti, 2009).

First, the **scale effect** implies that trade will increase emissions and escalate the impact of climate change. The scale effect is at play through both trade and FDI. With higher trade liberalization, economic activity will likely increase. As a result, a higher inflow of FDI will contribute to the increased industrial output of the domestic economy, increasing the overall pollution (Pao & Tsai, 2011; Shahbaz, Nasir & Roubaud, 2018). Aydin and Turan (2020) investigate the effect of financial openness, trade openness, and energy intensity on the environment in BRICS countries and find that trade openness only reduces emissions in China and India but increases carbon emissions in South Africa. However, Ertugrul, Cetin, Seker, and Dogan (2016) conduct a study in the top ten emitting developing countries and find that trade openness increases CO_2 emissions in the long run in Turkey, India, China, and Korea. A recent study conducted by Asongu and Odhiambo (2020) studied the impact of trade on CO_2 emissions in Sub-Saharan Africa from 2000-2019. They find that trade openness has a positive impact on CO_2 emissions and can promote a green economy. Furthermore, their findings suggest that the relationship between CO_2 emissions and trade lies on the Environmental Kuznets Curve (EKC). The EKC implies that in the early stage of development, pollution increases. At a certain level of income, the trend will reverse, and countries will emphasize protecting the environment - improving environmental quality (Mishra, 2020).

The second effect is the **technique effect**, which suggests that trade liberalization will increase innovation and technology that will further improve cleaner technologies, thus reducing pollution. Wang and Zhang (2021) study the effect of trade openness on decoupling carbon emissions from economic growth in 182 countries. They find that trade openness only decreases emissions in high-income and upper-middle-income countries but increases emissions in low-income countries, which indicates some outsourcing of emissions from the high and upper-middle income countries. Similar long-run results are found in a study of 23 upper-middle-income countries in Europe (Al-Mulali, Ozturk & Lean, 2015) and in nine newly industrialized countries (Hossain, 2011). Sebri and Ben-Salha (2014) investigate the dynamics between economic growth, renewable energy, CO_2 emissions, and trade in BRICS. Their findings imply that trade openness allows BRICS countries to benefit more from green technologies that will further improve the renewable energy sector and stimulate green growth. As most studies use similar trade measures (Aydin & Turan, 2020; Sebri & Ben-Salha, 2014; Hossain, 2011; Wang & Zhang, 2021), Njindan, Iyke, and Ho (2017) used a composite trade share to measure trade openness. The authors found that trade openness is related to lower levels of emissions in the long run, but the effect is smaller than studies that show similar results. However, the relationship lies on the EKC, and there is a point of openness where it starts to have adverse effects on emissions.

The last effect is the **composition effect** indicates that the impact depends on each country's trade policy. Therefore, the environmental impact of trade will depend on whether the primary sector is emission-intensive or not. This effect is connected to the *Pollution Haven hypothesis* and the idea of *structural outsourcing*. Wang and Zhang (2020) argue that the main reason why emissions decrease in high-income countries is that they have the means to outsource their production to other countries with less stringent environmental policies. Thus, if countries specialize in carbon intensive industries their emission will increase and vice versa if countries specialize in carbon-efficient industries their emission level will be lower. The TBEET indicator uses the world average carbon intensity, in that way it can capture the scale or composition effects of trade, by setting technology constant among the same sectors in different countries. Therefore, any differences between BEET and TBEET stems from the technique effect.

3 Data

3.1 Source Material

All data came from secondary sources and are quantitative. The majority of the data was collected from the World Development Indicators. Information was gathered on foreign direct investment (FDI) inflows, trade openness, GDP growth, total natural resources rents, inflation, and urban population change through this source. The environmental policy stringency index was collected from the OECD database. Numbers for total steel production for each country came from the steel yearbook report accessed through the World Steel Association. Lastly, information on the dependent variable, TBEET, was found through a database developed in a paper by Baumert et al. (2019).

3.1.1 Data Quality

World Bank: The World Development Indicators includes high-quality and relevant data about global development. It contains about 1,400 time-series indicators for 217 economies from the years 1960 - 2020. The main objective of this dataset is to provide material for researchers and policymakers with high-quality data for decision-making (World Bank, 2021).

OECD: The OECD database is one of the most reliable sources of data. Its main objectives are to "monitor trends, collect data, analyses, and forecasts economic development, and investigates evolving patterns in a broad range of public policy areas." (OECD, 2013; p.2). FIX HERE

World Steel Association: An up-to-date data source of steel production by country. The weakness of this data source is that it does not include all countries in the dataset. Therefore, there are few missing observations.

Baumert et al. (2019): The dataset from this paper includes PBA, CBA, trade balance, trade specialization, BEET, and TBEET for 40 countries and the-rest-of-the-world (RoW) for the period 1995 - 2009. This source builds upon Jiborn et al. (2018) calculations. As the indicator, TBEET, is relatively new and has never been used in another econometric study, to the author's best knowledge, the reliability of this source might be vague. Furthermore, it only accounts for CO_2 emissions but not all greenhouse gas emissions.

3.2 Variables

For the purpose of this research, an unbalanced panel dataset was created that consists of nine variables and 429 observations over a ten-year period, 1999 – 2009. The dataset from Baumert et al. (2019), includes 40 countries then the Rest-of-the-World (RoW). However, for the purpose of this study, 39 countries are included. Due to the availability of data for control variables, it was decided to exclude the country Taiwan from the dataset. The 39 countries that are included in the dataset, range from low-income countries to high-income countries. Table 3.1 presents all the countries included in the data and identifies their income level status and TBEET level in 2009. The classification of the income levels is derived from the definition published by the World Bank. In 2009, low-income countries were defined as those with an income per capita less than 935USD, middle-income countries 935 to 11,455 USD, and high-income economies with income per capita higher than 11,455 (Fantom & Serajuddin, 2016). Today, the threshold has increased, but as this paper includes data until 2009, the classification will include income level per capita in 2009 numbers. As seen in Table 3.1 there is not a direct link between a high-income country and a negative TBEET - indicating that the assumption of outsourcing is not as simple as suggested by BEET.

Table 3.1: TBEET and Income Level in 2009 for the Countries in the Dataset

(Source: Baumert et al. (2019) dataset & World Bank Indicators, Author's own construction)

Country Name	TBEET	Income Level
Australia	Negative TBEET	High Income Country
Austria	Positive TBEET	High Income Country
Belgium	Positive TBEET	High Income Country
Bulgaria	Positive TBEET	Middle Income Country
Brazil	Negative TBEET	Middle Income Country
Canada	Negative TBEET	High Income Country
China	Positive TBEET	Middle Income Country
Cyprus	Negative TBEET	High Income Country
Czech Republic	Positive TBEET	High Income Country
Estonia	Positive TBEET	High Income Country
Spain	Positive TBEET	High Income Country
Denmark	Positive TBEET	High Income Country
Finland	Positive TBEET	High Income Country
France	Negative TBEET	High Income Country
Germany	Positive TBEET	High Income Country
Greece	Negative TBEET	High Income Country
Hungary	Negative TBEET	Middle Income Country
Indonesia	Negative TBEET	Middle Income Country
India	Negative TBEET	Middle Income Country
Italy	Negative TBEET	High Income Country
Ireland	Positive TBEET	High Income Country
Japan	Positive TBEET	High Income Country
Korea, Rep.	Positive TBEET	High Income Country
Latvia	Negative TBEET	Middle Income Country
Lithuania	Negative TBEET	Middle Income Country
Luxembourg	Positive TBEET	High Income Country
Malta	Positive TBEET	High Income Country
Mexico	Negative TBEET	Middle Income Country
Netherlands	Positive TBEET	High Income Country
Poland	Negative TBEET	Middle Income Country
Portugal	Negative TBEET	High Income Country
Romania	Negative TBEET	Middle Income Country
Russia	Positive TBEET	Middle Income Country
Slovenia	Negative TBEET	High Income Country
Slovak Republic	Positive TBEET	High Income Country
Sweden	Positive TBEET	High Income Country
Turkey	Negative TBEET	Middle Income Country
United Kingdom	Negative TBEET	High Income Country
United States	Negative TBEET	High Income Country

It should be noted that a positive TBEET indicates that a country's energy-demanding exports are greater than its imports and/or that it has a monetary trade surplus.

3.2.1 The Dependent Variable – TBEET

The dependent variable in this study is a technical-adjusted balance of emissions embodied in trade (*tbeet*) and is presented in percentages. The TBEET indicator developed by Jiborn et al. (2018) uses data from the World Input-Output Database for 41 countries divided into 35 sectors. Through this data source, the authors performed Leontief's input-output analysis to find the traditional BEET (Note: $BEET_i = EEE_i - EEI_i$). The authors' central argument is that BEET is not a reliable indicator in analyzing emission outsourcing. Therefore, they adjust for technology differences by canceling out all effects unrelated to the differences in the energy system and production technologies by isolating trade specialization and monetary trade balance. The main idea behind TBEET is to "standardize the relative carbon intensities for similar or identical products on the import and the export side by using the average carbon intensity on the world market for each sector" (Jiborn et al., 2018, p.30). Thus, the carbon intensities in trade will be based on the world average for each sector. The intensities for the sector are then divided by the carbon intensity of the global economy.

Baumert et al. (2019) further developed this approach to 40 countries and the RoW. They show that technology-adjusted emissions embodied in exports and imports are calculated as:

$$\text{(i) } TEEE_i = \sum_{j \neq i}^{n} e_{ij}^{WA} \text{ and } TEEI_i = \sum_{j \neq i}^{n} e_{ji}^{WA}$$

Therefore,

$$\text{(ii) } TBEET_i = TEEE_i - TEEI_i$$

Where e_{ij} represents the emissions embodied in trade from country i to j. The denotation e_{ij}^{WA} is the total emissions that would have been generated if identical products had been produced with world average technology (Baumert et al., 2019). Likewise, they illustrate how TBEET is decomposed by isolating the impact of trade specialization and monetary trade balance. In doing so, they illustrate how only the composition and scale effect of trade will have an impact on the balance of emissions embodied in imports and exports. Compared to a no-trade scenario, a country that displays a monetary trade surplus or has relatively more carbon-intensive exports than imports will have a positive TBEET. On the other hand, negative TBEET indicates that a country has a monetary trade deficit or more energy-intensive imports than exports.

3.2.2 Control Variables

The main variable of interest is foreign direct investment inflows (*FDI)* and is expressed as a percentage of GDP. Along with FDI inflows, there are five other regressors in the baseline model. The regressors *lngdp* is the natural log of the total real GDP per capita in constant 2010 USD. This variable was included in the baseline model because the assumption in the literature is that more advanced economies, richer countries, have a cleaner environment due to easier access to greener technologies. Thus, the expected sign of *lngdp* is negative - as a country becomes richer TBEET will decrease. Next, the regressor *lntrade,* measures trade openness and is a ratio of the difference between exports and imports to GDP. Even though trade is measured in the TBEET indicator, a variable for trade openness is considered an appropriate variable to investigate if higher trade openness will cause higher emissions embodied in trade. The expected sign of trade openness is positive – a more open country will have a higher TBEET. The natural logs will be taken of GDP per capita and trade openness due to non-linearity and the assumption that it lies on the EKC, as suggested by prior literature (Al-Mulali, Ozturk & Solarin, 2016; Aydin & Turan, 2020; Ertugrul et al., 2016).

The third variable is *lnsteel* which stands for the natural log of total steel production and is expressed in million metric tons. This regressor is included in the model to investigate if one individual heavy industry product (carbon-intensive) impacts the dependent variable (*tbeet*). The expected sign of *lnsteel* is positive, since a country that produces a lot of steel can also be expected to be a large exporter of steel, which is a product group that tends to weigh heavy in TBEET. The fourth regressor is an index that measures the stringency of environmental policy, *EPS.* Zhang (2020) argues that the main reason why trade openness decreases in high-income countries is that they have the means to outsource their production to other countries with less stringent environmental policies. Hence, the expected sign of *EPS* is negative - countries with stricter environmental policies are expected to have lower TBEET. The last regressor in the baseline model is *natural,* which indicates the total natural resources rents (oil reserves, natural gas, mineral rents, etc.) in a country, and will be treated as a dummy variable. Getting a 1 if the percentage of natural resources in a country is 5% or higher of the country's GDP and 0 if lower than 5%. The reason behind including a variable that shows if a part of a country's GDP comes from natural resources is based on the comparative advantage. A country abundant in coal reserves is likely to have a comparative advantage in coal production (lower opportunity cost) and then specialize in that industry. Therefore, it is expected that if a country has high natural resource rents, it will have a positive TBEET. Definitions of each variable are found in Table 3.2.

3.2.3 Instrumental Variables

Additionally, two instrumental variables will be utilized for the last regression in this study. Due to a possible reverse causality, the last regression that will be performed is a two-stage-least square (2SLS) regression. For that reason, this paper will apply the variables *inflation* and *urban* to the regression analysis. The instrument *inflation* measures the percent change in annual consumer prices, and the instrument *urban* refers to how many percentages of people are living in urban areas out of the total population. The main rationale behind including variables that measures inflation and urban population is that these two variables were utilized as instrumental variables in a study conducted by Omri et al. (2015). Their study accounted for simultaneity bias between carbon emissions and financial development by applying four instruments, energy consumption, FDI, urbanization, and inflation, to a generalized method of moments (GMM). However, for this paper, a 2SLS model will be used to solve the endogeneity problem.

The nature of an instrument is that it only captures the effects of treatment for those countries that receive FDI, and it has to fulfill three requirements. First, there must be a strong first case, meaning that the instrument needs to be correlated with the variable whose effect is sought after, in this case, *fdi*. Second, the independence assumption should hold, meaning that instruments need to be as good as random. Third, the exclusive restriction assumption needs to be applied. Exclusive restriction implies that the instrument can only affect the outcome variable through the main variable of interest (Angrist & Pischke, 2009). However, this is an identifying assumption and cannot be tested. Additionally, the monotonicity assumption assumes that the countries that are affected (the countries that experience a change in their TBEET level) should be affected by the instrument in the same way. However, this is unlikely to be true as we cannot be sure that the estimate is the weighted average of the country's causal effect (Instrumental Variables, 2020).

The instrument that measures the percentage of urban population is considered to meet all three requirements. First, it has a clear effect on FDI inflows; higher urbanization increases FDI flow (Sahu, 2013). Next, it is anticipated that *urban* is uncorrelated with all unobserved determinants of *tbeet*, so it should be as good as random. Lastly, the most significant obstacle in choosing a valid instrument is to ensure that the exclusion restrictions are validated. That the instrument ($\mathcal{Z}_i$) only affects *tbeet* (Y_i) through its effects on *fdi* (D_i). This assumption cannot be tested (Instrumental Variables, 2020), but it is hoped for that *urban* is not correlated with the outcome variable, *tbeet.* Therefore, a proxy for urbanization is considered to be an appropriate instrument for this study. Although, some studies suggest that as urbanization increases, trade is likely to be affected as well (Thia, 2016). The second instrument for this study is *inflation.* It fulfills the assumption of independence and has a relatively strong first stage. However, the problem with this instrument is the correlation to the outcome variable. As inflation increases, the price will go up, impacting the trade structure as exports become less competitive. The limitation of both instruments is recognized.

Table 3.2: Definitions of Variables

Variable	Definition
tbeet	Normalized Technical-adjusted balance of emissions embodied in trade - % (kt CO_2 TBEET/kt CO_2 PBA)
fdi	Foreign Direct Investment inflows (% of GDP)
lngdp	Natural log of real GDP per capita - % (constant 2010 USD)
lntrade	Natural log of trade openness (X+M/GDP)
lnsteel	Natural log of total steel production (million metric tons)
eps	Environmental Policy Stringency Index (0 to 5, 0 = not stringent 5 = totally stringent)
natural	Natural resources rents (if more than 5% = 1, if less than 5% = 0)
inflation	Inflation – annual % change in consumer prices
urban	The percentage of people residing in urban areas out of total population

3.3 Descriptive Statistics and Data Limitations

The descriptive statistics are presented in Table 3.3 below and shows the total observations, mean, standard deviation, and the minimum and maximum value for each variable. There are total of 429 observations for the dependent variable and 426 for the variable of interest. As seen in Table 3.3 there are few missing observations, mainly for the variable *steel and eps*. After analyzing the data, it was decided to drop all the missing variables since there are not a significant amount of missing observations (or less than 10 percent). Nonetheless, due to missing observations a pairwise correlation matrix was made which shows the correlation between all of the available data for each pair of variables (Consult Appendix for the correlation matrix).

The standard deviation is considerably high for the main variable of interest, ranging from -58.32 % to 499 %. In analyzing the data to see what might be a reason for a high standard deviation for *fdi*, it is evident that the country Malta appears to be a large outlier in the dataset as FDI inflows range from -11% to 499%. The standard deviation is also considerably high for the variable *gdp* and *steel.* This will not be a concern because this research employs fixed effects model that only focuses on within-variation.

Table 3.2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
tbeet	429	.031	.171	-.484	1.142
fdi	426	9.91	36.721	-58.323	449.083
gdp	429	27606.778	20525.773	810.217	111968.35
trade	429	87.321	55.207	18.349	343.562
steel	370	28030.978	62221.341	150	577070
eps	332	1.701	.872	.417	4.075
natural	418	.096	.295	0	1
urban	429	70.912	14.332	27.453	97.603
inflation	429	4.777	7.936	-4.478	85.746

Because this study employs a fixed-effect model for panel data, the internal validity is compromised at the expense of external validity. Therefore, the main data limitation is the low within variance in the outcome variable and four other control variables (See Appendix for full table). Another concern is the validity of instruments for the 2SLS regression. As discussed above, this limitation is recognized and will be noted in the result section.

4 Methods

Most of the studies analyzing the relationship between FDI and environmental degradation are quantitative (e.g., Ertugrul et al., 2016; Essandoh, Islam & Kakinaka, 2020; Omri et al., 2015; Omri, Nguyen & Rault, 2014; Shahbaz et al., 2015; Shahbaz, Nasir & Roubaud, 2018). Quantitative research will enable a larger sample set to examine the relationship between variables (Creswell, 2009). Therefore, this study will be of the same nature.

In estimating the impact of FDI on the environment, prior literature has investigated a co-integration between variables, the dynamic relationship between FDI and the dependent variable, and if there is a causal relationship. In doing so, they have employed either dynamic OLS or fixed-effect models to investigate the relationship between variables and Granger causality tests to account for endogeneity problems (Al-Mulali, Ozturk & Lean, 2015; Al-mulali, Tang & Ozturk, 2015; Essandoh, Islam & Kakinaka, 2020; Lee, 2013; Mahmood, Furqan & Bagais, 2019; Omri, Nguyen & Rault, 2014; Pao & Tsai, 2011; Seker, Ertugrul & Cetin, 2015). Hence, this study employs three models; a pooled ordinary least-square (OLS) model to account for heterogeneity, a fixed-effect model to investigate the causal relationship between the dependent variable and other control variables. Lastly, a two-stage-least square model which will account the endogeneity problem.

4.1 Fixed Effects

A fixed-effect model is useful in dealing with the threat of omitted variable bias and to control for the average differences across groups, countries, or individuals for any observable or unobservable factors. One fundamental assumption in the fixed-effect model is that the unobserved *Ai* is time-invariant in a linear model (Angrist & Pischke, 2009), therefore,

Equation 1.1 $$E(Y_0|A_i, X_{it}, t) = \alpha_i + \lambda_t + A'_i\gamma + X_{it}\delta$$

Also, as the causal effect of treatment (D_{it}) is constant, Equation 1.2 can be derived as:

$$\textit{Equation 1.2} \qquad E(Y_0|A_i, X_{it}, t, D_{it}) = \alpha + \lambda_t + \rho D_{it} + A'_i\gamma + X_{it}\delta$$

Where ρ is the effect that is sought after and D_{it} is the treatment status. The denotation i stands for different individuals/countries/groups and t the time period. Given that this study utilizes panel data with repeated observations for 39 countries, the fixed-effect equation is as follows:

$$\textit{Equation 1.3} \qquad Y_{it} = \alpha_i + \lambda_t + \rho D_{it} + X_{it}\delta + \varepsilon_{it}$$

where $\alpha_i = \alpha + A'_i\gamma$

The causal effect will be estimated by treating α_i, the fixed effect, as a parameter to evaluate. λ denotes the year effect, which is also treated as a parameter that will be estimated. The ρ is the causal effect of interest, and D_{it} is the treatment status. "The unobserved individual effects are coefficients on dummies for each individual while the year effects are coefficients on time dummies" (Angrist & Pischke, 2009, p.166).

The question of whether the unobserved time-invariant coefficient, α_i, should be treated as a random variable or as parameters to be estimated can be answered with a Hausman test (Consult Appendix). For α_i to be treated as a random effect, it has to be uncorrelated with other covariates. However, under fixed effects the Conditional Independence Assumption (CIA) can be relaxed because it controls for unobserved time-invariant factors. Therefore, it allows correlation between the error term that is time-invariant (η_i) and other covariates (X_{it}) as long as the strict exogeneity assumption holds (Wooldridge, 2010). The strict exogeneity assumption with unobserved effect assumes that the time-variant part of the error term (ε_{it}) is uncorrelated with explanatory variables (X_{it}) (Martinez, 2020). Thus, the strict exogeneity of the disturbance should be zero:

$$\textit{Equation 1.4} \qquad E(\varepsilon_{it}|X_{it}) = 0$$

However, there are some limitations in using fixed effects. First, fixed effects are highly susceptible to measurement errors, that can be more problematic in fixed-effect models than in any other econometric model (Collischon & Eberl, 2020). Fixed effects estimators only capture the groups, countries, or individuals that change their treatment status (D_{it}) over the period, so it captures the effect of countries that change their level of FDI inflows. The problem with measurement error is that it will always cause inefficiency, and it is exaggerated in variables with low within variance. In this study, the within variance for the variables *tbeet, trade, steel, eps,* and *natural* are all smaller than the between variance, which can be problematic (See Appendix A for a more detailed table). On the other hand, measurement error will also cause attenuation bias if the error term is correlated with any control variable, then the mean will not be zero, thus not random.

Second, the strict exogeneity assumption is often violated. Unobservable shocks might happen, which will affect both the outcome variable, *tbeet*, and the variable of interest, *fdi*. In this study, this is likely the case, as most countries in the dataset were affected by the financial crisis in 2008, which caused a significant decrease in FDI inflows and, to a lesser extent, emissions embodied in trade. Hence, what might look like an effect of *fdi* on *tbeet* could be the impact of the shock.

Third, there could be some unobserved time-varying heterogeneity. Thus, it might be difficult to know what biases are eliminated from the model. Unobserved time-varying heterogeneity is likely to lead to an upward bias, resulting in smaller estimates than seen in the pooled OLS model. Finally, fixed effects are vulnerable to reverse causality. Endogeneity problem can be more severe under fixed effect model than OLS model (Collischon & Eberl, 2020). Overall, the fixed effects method is a powerful method in accounting for omitted variables bias and problematic variations. However, as it only accounts for unobservable factors that do not change over time, there could be some time-variant factors that are unobserved but influence the estimates. Therefore, the external validity is often reduced in fixed-effects models as it only captures the countries that change their treatment status.

4.1.1 Model Specification

The baseline model in this study is a pooled OLS and can be written as:

$$(1)\ tbeet = \beta_0 + \beta_1 fdi + \beta_2 lngdp + \beta_3 lntrade + \beta_4 lnsteel + \beta_5 eps + \beta_6 natural + \mu$$

Under the pooled OLS model, the CIA is often violated, which assumes that any observed characteristics are mean independent of treatment, leading to inefficiency and bias. Linear regression does not account for heterogeneity which will lead to bias because the residuals are likely to be serially correlated over time. As mentioned above, fixed-effects relax the CIA because it captures the time-invariant covariates and therefore gets rid of any unobserved heterogeneity. Moreover, it deals with the threat of omitted variable bias. For that reason, a fixed-effect method is considered an appropriate method for this study. Additionally, the Hausman test is rejected (See Appendix A), suggesting that a fixed-effect model is more relevant than a random effect model.

The fixed-effect model for this paper can be written as:

$$(2)\ tbeet_{it} = \alpha_i + \beta_1 fdi_{it} + \beta_2 lngdp_{it} + \beta_3 lntrade_{it} + \beta_4 lnsteel_{it} + \beta_5 eps_{it} + \beta_6 natural_{it} + \varepsilon_{it}$$

$$(2a)\ \mu = \varepsilon_{it} + \eta_i$$

Where α_i is the country's intercept that captures the heterogeneity across every individual, i , and t is the time period. The error term (μ) in the fixed effect model is divided into two parts (2a), one that includes an unobserved factor that does not vary over time (η_i) and the other that is observable and varies over time (ε_{it}). The mean of the error term is zero because the fixed-effects account for the intercept differences, but under the OLS model, every individual is treated the same. Furthermore, the fixed effect coefficient (α_i) captures all the across group activity, which will leave the within-group activity that we are looking for to answer the research question:

What is the impact of FDI inflows on TBEET?

4.1.2 Alternative Model

As discussed above, one of the weaknesses of a fixed-effect model is reverse causality. Past studies suggest that there exists a reverse causality between FDI and emissions. Therefore, an endogeneity problem is likely to be present between FDI and TBEET as well. For example, increased FDI inflows can cause an increase in the trend of TBEET, but the opposite could also be true; a higher level of TBEET can cause increased FDI inflows. To remedy this, a

2SLS regression will be performed. In order to run the 2SLS model, another regression (3a) will be made to estimate the endogenous regressor (*fdi)*. Two instruments, *inflation* and *urban,* are correlated with the independent variable but not the dependent variable. Hence, the endogenous regressor will be estimated with the following equation:

$$(3a)\ fdi = \gamma_1 urban + \gamma_2 inflation$$

The regressor shown in 3a will be put in the adjusted econometric model which is as follows:

$$(3)\ \ tbeet = \beta_0 + \beta_1 fdi + \beta_2 lngdp + \beta_3 lntrade + \beta_4 lnsteel + \beta_5 eps + \beta_6 natural + \mu$$

Nevertheless, for a 2SLS regression to account for reverse causality and give unbiased estimates, the instruments need to be valid. The limitation to a 2SLS analysis lies in finding a valid instrument. A valid instrument needs to have a strong first case, and the assumption of independence and monotonicity needs to hold. Lastly, the exclusion restriction needs to hold, but this assumption cannot be tested. Therefore, when finding an instrument, it has to be argued how that instrument will only affect the outcome variable through the variable of interest. Moreover, instrumental variables often have high internal validity but low external validity (Instrumental Variables, 2020). Therefore, weak instruments will give a vague picture of the estimates.

5 Empirical Analysis

For this study, three different regressions are performed to analyze the relationship between the indicator TBEET and FDI inflows. The following section indicates results for all three models. The first model (1) is pooled OLS and will investigate any evidence of multicollinearity or heteroscedasticity. The second model (2) and the preferred model in this study is the fixed effects model, presented with clustered standard errors. Lastly, an adjusted econometric model - the 2SLS model (3) - is performed to control for reverse causality. The main results from the preferred model support the first hypothesis, that *increased FDI inflows cause increases of TBEET*. However, the second hypothesis: *increased FDI inflows cause a decrease in TBEET,* is rejected. So, the *Pollution Haven hypothesis* receives more support than the *Pollution Halo hypothesis*.

5.1 Results

In performing a linear regression (Model 1), it is evident that there is no multicollinearity (VIF test = 1.31). However, there is evidence of heteroscedasticity in the data - see Appendix for a scatterplot of the residuals. The results of all three models are given in Table 5.1. Comparing the three models it is noticeable that Model 1 and 3 have higher R-squared than Model 2. This indicates that fewer observations can be explained by Model 2, which was anticipated as fixed-effects are only interested in within estimations.

Table 5.1: Results for all Three Models

	(1) OLS	(2) Clustered FE	(3) 2SLS
fdi	.002**	.001*	.003
	(.001)	(0.068)	(.004)
lngdp	.014**	-.052	.017***
	(.006)	(.05)	(.006)
lntrade	.129***	.071	.134***
	(.015)	(.043)	(.037)
lnsteel	.026***	.015	.03***
	(.005)	(.014)	(.006)
eps	-.002	-0.00008	-.001***
	(.001)	(0.00038)	(0)
natural	.003	-.017	.025*
	(.018)	(.015)	(.015)
_cons	-.879***	.107	-.938***
	(.111)	(.473)	(.203)
Observations	317	317	317
R-squared	.3	.051	.343

*Robust standard errors are in parentheses *** p<.01, ** p<.05, * p<.1*

5.1.1 Preferred Model

Even though Model 1 indicates a statistical significance at a 5 % level for the main variable of interest, the coefficient is likely biased because of possible omitted variables and heteroscedasticity. Therefore, the preferred econometric model in this study is the fixed effect model with clustered standard errors. The standard errors are clustered to account for heteroscedasticity. The results of Model 2 suggest a significant positive relationship between the dependent variable and the main variable of interest. The results indicate that at a 10 % level of significance, a 1 percent increase in FDI inflows is related to an 0.001 percentage point increase in TBEET. All the other variables are insignificant at every level of significance as shown in Table 5.2. Notwithstanding the lack of significance, the variable *lnGDP* and *EPS* illustrate a negative relationship with *tbeet*, as expected. Moreover, the variables *lntrade* and *lnsteel* indicate a positive relationship as predicted. Interestingly, the variable *natural* indicates a negative relationship with the outcome variable.

Table 5.2: Results from the Preferred Model

	(2) Clustered FE
fdi	.001*
	(0)
lngdp	-.052
	(.05)
lntrade	.071
	(.043)
lnsteel	.015
	(.014)
eps	-0.00008
	(0.00038)
natural	-.017
	(.015)
_cons	.107
	(.473)
Observations	317
R-squared	.051

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

5.1.2 Adjusted Econometric Model

One of the drawbacks of the fixed-effect model is that it cannot account for reverse causality. As discussed in the section above, there is a possible endogeneity problem. For that reason, this study proposes an adjusted econometric model (Model 3) that will consider the reverse causality. In estimating the possible relationship between TBEET and other control variables with a 2SLS regression model, the validity of instruments needs to be considered. The instruments used to estimate the endogenous regressor are *inflation* and *urban*, and their validity is measured using an F-test and Sargan-Hansen test. The null hypothesis under the Sargan-Hansen test is that the instruments do not affect *fdi*. Hence, the aim is to fail to reject the null hypothesis because the purpose of an instrument is to affect the main variable of interest (*fdi)*.

The F-test for the first instrument, *inflation*, is 2.34, which indicates a weak instrument (rule of thumb F>10). Moreover, the null hypothesis is rejected under the Sargan-Hansen test. However, the F-test for the instrument *urban* is 20.95, implying a strong instrument (F>10). Nevertheless, the Sargan-Hansen test is rejected because it is below 0.1. Even though the two instrumental variables are not individually strong, together their F-test is 18.98. The results are robust, but it is evident that *fdi* is not significant. However, the more detailed table of results - Table 5.3 - shows that from the years 2005 to 2008, the results are significant at 5 % and 1 % level of significance. From the year 2005 to 2008, the FDI inflows propose a negative relationship with TBEET. For example, in 2007, a 1% increase in FDI inflows was associated with a 0.08 percentage point decrease in TBEET.

Table 5.3: Detailed Results from 2SLS Regression

	(3) 2SLS
fdi	.003
	(.004)
lngdp	.017***
	(.006)
lntrade	.134***
	(.037)
lnsteel	.03***
	(.006)
eps	-.001***
	(0)
natural	.025*
	(.015)
1999b.year	
2000.year	-.026
	(.024)
2001.year	-.022
	(.025)
2002.year	-.014
	(.027)
2003.year	-.026
	(.026)
2004.year	-.039
	(.026)
2005.year	-.058**
	(.024)
2006.year	-.066***
	(.024)
2007.year	-.08***
	(.026)
2008.year	-.088***
	(.027)
2009.year	-.037
	(.026)
_cons	-.938***
	(.203)
Observations	317
R-squared	.343

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

All the other variables are significant. The variables *lngdp, lntrade, lnsteel,* and *eps* are significant at a 1 % level, while the variable *natural* shows significance at a 10 % level. The variable *lngdp* suggests that a 1 percent increase in GDP will increase TBEET by 0.017 percentage points. If trade openness is 1 percent higher, the TBEET will increase by 0.134 percentage points. Furthermore, a 1 percent increase in steel production will increase TBEET by 0.03 percentage points. The variable *natural* also has a positive relationship with *tbeet*, and shows that if a country's natural resources rents are more than 5 %, the TBEET will increase by 0.025 percentage points. Despite weak results, they suggest that countries that are equipped with resources, such as iron ore, coal, and oil, will have a positive TBEET. This is interesting because regardless of the country's income level, it will export most of those heavy products. On the other hand, the EPS index proposes a negative relationship with the dependent variable and suggests that as a country increases its stringency with environmental policy, the TBEET will decrease by 0.001 percentage points.

5.2 Discussion

In this study, it was hypothesized that increased FDI inflows would cause a change in the trend of TBEET. More so, an increased influx of FDI will lead to a decrease (negative) in TBEET. Note that a negative TBEET indicates either a monetary trade deficit or more energy-demanding imports than exports, i.e., PBA < CBA.

Theoretically, the impact of FDI inflows on emissions is ambiguous. Various studies have shown that the *Pollution Haven* effect is at play through higher FDI inflows that increase environmental degradation (Mahmood, Furqan & Bagais, 2019; Shahbaz et al., 2015). At the same time, other studies suggest that increased FDI inflows are related to the *Pollution Halo* effect, which implies that trade flows and FDI will stimulate technological diffusion and improve environmental quality (Essandoh, Islam & Kakinaka, 2020; Shahbaz, Nasir & Roubaud, 2018). Similarly, the studies investigating the FDI and emission nexus use fixed effects with either a time-series or panel data. This panel data study is of the same nature. However, prior studies perform a Granger causality test to investigate reverse causality (Al-mulali, Tang & Ozturk, 2015; Seker, Ertugrul & Cetin, 2015; Shahbaz, Nasir & Roubaud, 2018). Instead, this study applies a 2SLS regression model to account for endogeneity problems. The results from this study show that the impact varies depending on the regression method.

Results from Model 1 do not give correct estimates of the impact of FDI inflow on TBEET because of possible omitted variable bias and heteroscedasticity. The main results (Model 2) support the first hypothesis that FDI inflows cause a change in the trend of TBEET. However, unexpectedly the second hypothesis is not supported, as the results indicate that an increase in FDI inflows causes an increase in TBEET. The results are robust and significant at a 10 % level of significance. Nevertheless, the impact is relatively small, or a 1 percentage increase in FDI inflow causes a 0.001 percentage point increase in TBEET. This indicates that the increased inflow of FDI, in the 39 countries included in this study is directed towards building up heavy industries for domestic consumption and exports. Therefore, the energy-demanding exports exceed the energy-demanding-imports. Furthermore, the positive relationship between FDI inflows and TBEET suggests a pollution haven effect. Even after considering differences in production technologies and energy systems, there is an upward trend in the emissions embodied in trade. This upward sloping trend could indicate that trade's structural and composition effects outweigh the technique effect. However, this has to be interpreted with caution as more research is needed to confirm this effect.

Even though the indicator TBEET has never been applied to an econometric study before, the results concur with other researchers studying the impact of FDI on carbon emissions. For example, Seker, Ertugrul, and Cetin (2015) and Pao and Tsai (2010) both show that FDI has a small positive effect on carbon emissions which is also evident in the preferred model. The most likely explanation of the small impact is the low within-variance in the outcome variable, *tbeet*, because fixed-effect only estimates the within variance.

On the other hand, the results for the main variable of interest in Model 3 are insignificant at every level. Nonetheless, the detailed results imply a negative relationship between FDI inflows and TBEET in four years (2005 - 2008). These results suggest that FDI inflows will lead to lower levels of TBEET - negative TBEET - which indicates more energy-intensive imports than exports. However, the two instruments that are used in estimating Model 3, *inflation* and *urban*, possibly violate the exclusive restriction assumption, which implies that instruments can only affect the outcome variable through its effect on the main variable of interest. Thus, both *inflation* and *urban* are likely correlated with the outcome variable - *tbeet.*

Despite the possible violation of the exclusive restriction assumption, the F-test implies that they are strong instruments together. Omri et al. (2015) employed four instruments: FDI, urbanization, inflation, and energy consumption in studying the effect of higher financial development on carbon emissions. In their paper, they argue that all instruments fulfill the exclusive restriction. This study attempts to employ two of the same instruments, inflation, and urbanization, to capture the effect they have on TBEET through FDI inflows. As this paper and the paper conducted by Omri et al. (2015) have different outcome variables (CO_2 vs. TBEET), the instruments are likely to be highly correlated with the outcome variable in this study, particularly monetary trade balances. For that reason, the instruments do not fulfill the exclusive restriction assumption. Therefore, Model 3 gives biased estimates as weak instruments will deflate the standard errors and increase the t-statistics (Instrumental Variables, 2020). Thus, the preferred model is considered to give the best estimates of the causal relationship between FDI inflows and TBEET.

5.2.1 Limitations

Although this study has been carefully prepared and presented significant results, there are several limitations. Firstly, this research's preferred model employs fixed effects that only capture the differences within the country. Therefore, the internal validity is compromised at the expense of external validity. Furthermore, as fixed effects are vulnerable to measurement error and there is a low variance for five out of seven variables, the fixed effects are likely to underestimate the causal effect. Nevertheless, it was considered a more appropriate method than both OLS and the 2SLS model. Secondly, one of the main drawbacks of the 2SLS model is the lack of strong instruments. In that case, linear regression (Model 1) will inform more about the relationship between the variables if instruments are weak (Instrumental Variables, 2020). Therefore, for future research, it would be of interest to find stronger instruments to get valid estimates.

There are certain drawbacks in using the TBEET indicator to measure the magnitude of emissions embodied in trade. Mainly because TBEET and other BEET studies only account for CO_2 emissions but not all greenhouse gases. While CO_2 accounts for most greenhouse gases, it is certainly not the only one that affects environmental quality. Thus, TBEET gives an idea of a possible trend but does not tell the whole story. Moreover, this study only includes data up until 2009 and does not conduct any input-output analysis for more recent years. Hence, the above analysis does not enable any generalization of the estimates as the findings promote different results for different regression methods.

6 Conclusion

Over the last few decades, international trade, together with FDI flows has generated tremendous growth in economic activity worldwide. Likewise, energy consumption and emissions have risen to the point that the threats of climate change cannot be ignored. There is still a lot that can be done, and as countries embark on modern economic growth, they can turn the race around. One way of improving environmental quality is by the diffusion of new technology, which can be channeled through FDI inflows. FDI flows can induce the implementation of energy-efficient technologies that will assist countries in improving their energy mix.

This paper sought to answer the question of what the impact of increased FDI inflows has on technical-adjusted emissions embodied in trade. Moreover, to see whether FDI inflows promote more carbon-intensive imports or exports. The TBEET indicator is an adequate variable to capture the effect of FDI inflows on emissions embodied in trade because it cancels out the effects stemming from differences in production technologies and energy systems. The main findings suggest that the impact of FDI inflows is positive, therefore, the results contradict the second hypothesis - which implies that FDI inflows will cause a decrease in TBEET.

Furthermore, the aim of this study is to contribute to the debate on whether developed countries lower their own emissions by FDI in emerging economies. Moreover, to shed light on the role of FDI inflows in promoting more sustainable trade. There are three possible effects of trade on CO_2 emissions; structural -, composition - and technique effect. While the first two are embedded in the TBEET indicator, the last effect is canceled out. Hence, the estimate will tell how much FDI inflows impact the structural and compositional effects of trade - how much FDI is influencing trade specialization. Assuming that heavier industries have larger technology differences among countries, considering the CO_2 emissions, the positive impact of FDI inflows on TBEET, indicates that the FDI inflows contribute more to building up heavy industries for domestic consumption and exports than being directed towards lighter industries or improving production technologies. The results also suggest that the main sectors are more energy demanding and as a result, FDI inflows contribute more to carbon-intensive exports than carbon-intensive imports. These findings are significant and provide a clear indication of the trend in TBEET. From 1999 to 2009, the FDI inflows in the 39 countries for this study were not allocated towards more energy-efficient production technologies that could then improve environmental quality. Instead, FDI inflows were going towards more carbon-intensive industries. Moreover, the results may suggest that FDI influx contributed more to trade's structural and composition effect than technique effect. However, the findings should be evaluated with caution because different regression models promote different results.

6.1 Future Research

To the author's knowledge, this is the first study to investigate the impact of FDI inflows on TBEET. Therefore, more research on this topic is necessary before making any generalizations. Nevertheless, it is evident that during the time period in this research, FDI inflows did not contribute to lower emissions embodied in trade. Hence, several questions remain to be resolved; in particular, to what extent does FDI inflow contribute to the technique effect? A question of this nature can give a better understanding of how FDI inflows can contribute to improvements in energy systems and production technologies, in essence, more sustainable trade. As discussed above, the TBEET isolates the impacts of structural and composition effects. Therefore, by investigating the impact of FDI inflows on BEET on the one hand and FDI inflows and TBEET on the other hand, then taking the difference between the two coefficients will give a causal estimate of FDI inflows on the technique effect in trade. Moreover, it will give a better picture of what is stemming from technological differences than from outsourcing.

Another question of interest for future research could be what impact FDI inflows have on TBEET in low - to middle-income countries. Due to data availability, this paper investigates the impact for 39 countries ranging from middle- to high-income countries. However, FDI inflows might play a more critical role in the development process for less developed countries and consequently have a more considerable impact on environmental quality than in countries that are already well equipped with energy-efficient production technologies. Moreover, the assumption in the literature that developed countries are outsourcing their emissions to developing countries will undermine any climate policy. So outsourcing needs to be studied and monitored. However, as discussed in this paper, such implications are not as simplistic when adjusted for technological differences. Therefore, future research could investigate the impact of FDI inflows on TBEET in low - to middle-income countries because they tend to utilize FDI flows to a larger extent and the urgency for more energy-efficient technologies is greater in less advanced economies.

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Appendix A

Table A.1: Pairwise Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) tbeet	1.000						
(2) fdi	-0.034	1.000					
(3) lngdp	0.290*	0.059	1.000				
(4) lntrade	0.308*	0.316*	0.237*	1.000			
(5) lnsteel	-0.015	-0.167*	-0.114*	-0.580*	1.000		
(6) eps	-0.011	0.013	0.107*	0.059	-0.035	1.000	
(7) natural	-0.049	-0.091*	-0.325*	-0.183*	0.187*	0.059	1.000

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A.2: Within and Between Variance

Variable	Mean	Std. Dev.	Min	Max	Observations
tbeet					
overall	0.0309389	0.171202	-0.4837757	1.141725	N = 429
between		0.1576027	-0.3025406	0.5876751	n = 39
within		0.0710765	-0.4497621	0.5849886	T = 11
fdi					
overall	9.910103	36.72073	-58.32288	449.0828	N = 426
between		22.17543	0.2322822	137.3431	n = 39
within		29.41447	-138.5683	321.6498	T- bar = 10.9231
gdp					
overall	27606.78	20525.77	810.2173	111968.3	N = 429
between		20636.65	1003.723	99929.89	n = 39
within		2320.809	15193.33	39645.24	T = 11
trade					
overall	87.3209	55.20656	18.34896	343.5618	N = 429
between		54.67217	24.81717	287.916	n = 39
within		11.33821	38.62186	142.9668	T = 11
steel					
overall	28030.98	62221.34	150	577070	N = 370
between		55758.06	281.6667	311969.9	n = 35
within		27387.97	-159678.9	293131.1	T = 10.5714
eps					
overall	1.701423	0.872195	0.4166667	4.075	N = 332
between		0.6793606	0.4602273	2.790151	n = 31
within		0.548302	0.201802	3.678696	T-bar = 10.7097
natural					
overall	0.0956938	0.2945233	0	1	N = 418
between		0.2446181	0	1	n = 38
within		0.1683477	-0.3588517	1.004785	T = 11

The between variance shows how much countries in the dataset are different from each other, while within variance shows how much people are different from themselves over time. If the standard deviation of between variance is higher than the within variance it indicates that countries differ more from each other than within themselves. That is the case for the variable *tbeet, trade, steel, eps and natural.*

Table A.3: Hausman Specification Test

	Coef.
Chi-square test value	33.342
P-value	0.0000

Ho: The random effects is preferred model

This test is performed to see whether random effect model should be utilized over a fixed effect model. As shown in table A.3 above it is evident that the null hypothesis is rejected (P-value< 0.1) Thus, the preferred model is Fixed effect model

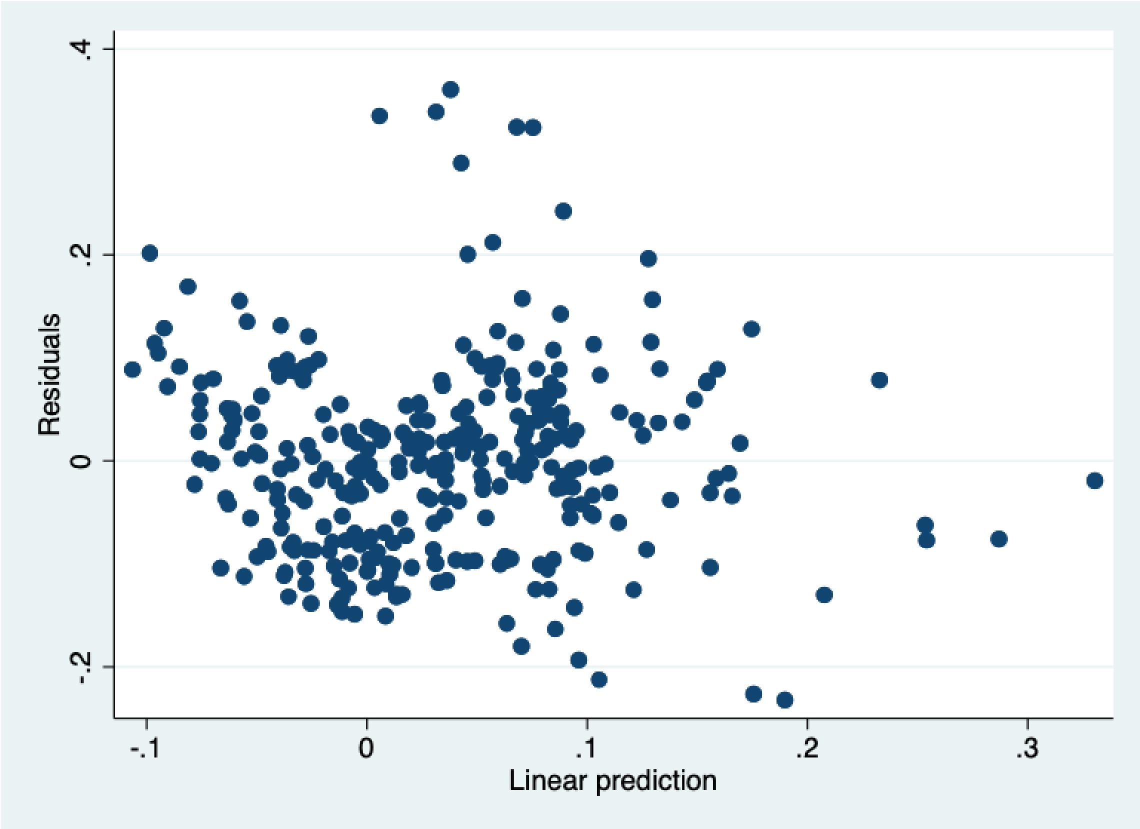

Figure A.1: Scatterplot for Residuals

The Breauch Pagan test and the residual plot suggests that there is evidence of heteroscedasticity in Model 1.

Appendix B – Sensitivity Robust Check

This Appendix presents results from a sensitivity robust check. As discussed in Section 3.3, there is a large outlier in the dataset. Investigating this further it appears that the country Malta has a large standard deviation. Therefore, a sensitivity robust check will exclude Malta from the data to see if this certain outlier has an effect on the overall results.

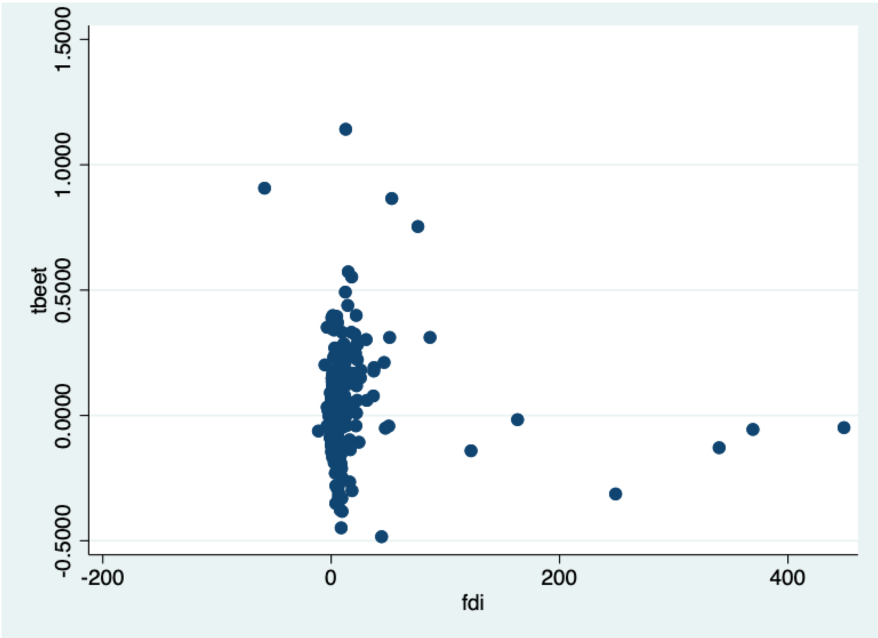

Figure B.2: Scatterplot for FDI and TBEET

Scatterplot for the variables *fdi* and *tbeet*. As seen in the plot, there are serious outliers in the data.

Table B.4: Linear Regression

tbeet	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.98	.048	0	.003	**
lngdp	.021	.007	2.89	.004	.007	.035	***
lntrade	.137	.015	8.86	0	.107	.168	***
lnsteel	.027	.005	5.65	0	.017	.036	***
eps	-.017	.009	-2.01	.046	-.034	0	**
natural	-.007	.018	-0.36	.718	-.042	.029	
Constant	-.963	.12	-8.02	0	-1.199	-.727	***

Mean dependent var	0.034	SD dependent var	0.114
R-squared	0.304	Number of obs	317.000
F-test	22.618	Prob > F	0.000
Akaike crit. (AIC)	-576.622	Bayesian crit. (BIC)	-550.310

**** p<.01, ** p<.05, * p<.1*

Results in Table B.4 show a statistical significance at 5 percent level for the main variable of interest. Indicating that a 1% increase in FDI inflows increases TBEET by 0.001 percentage points. However, after excluding Malta (the outlier) – seen in Table B.5 - from the dataset the results become significant at 1 percent level and indicate that a 1% increase in FDI inflows increase TBEET by 0.002 percentage points. All other variables are significant except *natural*.

Table B.5: Sensitivity Robust Check - Linear Regression Excluding the Outlier

tbeet	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.002	.001	1.76	.079	0	.003	*
lngdp	.014	.005	2.58	.01	.003	.024	**
lntrade	.129	.015	8.84	0	.1	.158	***
lnsteel	.026	.005	4.84	0	.015	.036	***
eps	-.002	.001	-3.86	0	-.003	-.001	***
natural	.003	.012	0.24	.808	-.021	.027	
Constant	-.879	.108	-8.16	0	-1.091	-.667	***

Mean dependent var	0.034	SD dependent var	0.114
R-squared	0.300	Number of obs	317.000
F-test	28.600	Prob > F	0.000
Akaike crit. (AIC)	-574.458	Bayesian crit. (BIC)	-548.146

*** *p*<.01, ** *p*<.05, * *p*<.1