Politecnico di Torino

Master's Degree Program in Management
Engineering with a Specialization in Finance

Academic Year 2023/2024

November 2024 Graduation Session

International Trade and Sustainability of Italian Companies

THESIS SUPERVISOR:

Prof.ssa Anna D'ambrosio

CANDIDATE:

Luca Terzolo

I am a part of all that I have met;
Yet all experience is an arch wherethrough
Gleams that untravelled world whose margin fades
For ever and for ever when I move.

Alfred Tennyson

Abstract

This research paper presents an analytical exploration of Italy's green trade from 2008 to 2019, particularly emphasizing the import and export dynamics of green goods. The analysis is underpinned by a robust classification system that utilizes the North American Industry Classification System (NAICS) for green goods and services, and the Harmonized System (HS) codes for environmental goods. These classifications enable a precise delineation of green trade activities, ensuring that the data reflects true green trade flows.

Employing the Intrastat data system, this study methodically tracks the trends in trade balances, focusing exclusively on quantifying the changes without inferring the impact of policy shifts. This approach allows for a clear assessment of trade patterns based solely on market behaviors and industry developments. The paper assumes a steady growth in environmental awareness and technology adoption, which influences the trade dynamics of green goods.

Through this detailed analysis, the study provides insights into the structural dynamics of Italy's green trade, highlighting the reliance on imported technologies and the burgeoning export of domestically produced green goods. It illustrates the critical role of international trade in shaping Italy's environmental and economic landscape, suggesting a pivotal position for Italy in the global green trade network.

This work adds to the discourse on sustainable economic development by mapping out the trajectory of green trade in Italy, and underscores the importance of refined classification systems in understanding trade impacts on environmental sustainability.

Contents

List of Tables

List of Figures

1 Introduction

This thesis presents an in-depth analysis of the relationship between Italy's exports and imports and their sustainability implications, emphasizing the temporal dynamics and variations over time. The study delves into how the interplay between exporting and importing environmentally beneficial goods shapes Italy's ecological footprint and assesses the underlying trends that influence these trade activities over a series of years.

Employing a comprehensive dataset that captures detailed trade transactions across multiple years, this research applies sophisticated econometric techniques to explore the sustainability dimensions of Italy's trade. The focus is squarely on quantifying and understanding the environmental impacts associated with the export and import of green goods, aiming to uncover patterns and shifts in trade behaviors as they relate to environmental outcomes.

The methodology section outlines the analytical frameworks used to dissect the trade data, including the statistical models that parse the relationships between trade volumes and environmental attributes. By examining these relationships over time, the thesis aims to provide a nuanced understanding of the evolving nature of trade and sustainability.

This investigation goes beyond mere static analysis to explore the dynamics of trade flows, revealing how external economic conditions, shifts in market demand for green products, and technological advancements in production processes impact Italy's trade-sustainability nexus. The longitudinal perspective adopted here allows for a deeper exploration of how these factors collectively influence the sustainability trajectory of Italy's trade activities.

The results from this detailed analysis are intended to shed light on the complex mechanisms through which trade impacts environmental sustainability. By charting the variations and trends over time, the research provides a granular insight into the evolving nature of Italy's trade engagements, highlighting the environmental stakes associated with its global trade interactions.

In summary, this thesis enhances our understanding of the intricate linkages between trade and environmental sustainability, focusing on the temporal and substantive nuances that define Italy's role in the global green trade arena. Through this rigorous analytical exploration, the study contributes a sophisticated perspective to the ongoing discourse on sustainable development in the context of international trade.

2 Literature Review

The literature on the relationship between international trade and environmental quality presents a complex and multifaceted field of study, with considerable attention given to the interplay between trade liberalization, economic development, and environmental regulations. Scholars have debated the extent to which trade openness influences environmental outcomes, with findings supporting both the degradation and improvement of environmental quality depending on factors such as regulatory frameworks, production processes, and the specific nature of the traded goods. Key theoretical models, such as the Environmental Kuznets Curve (EKC), offer insight into the dynamic relationship between economic growth and environmental degradation, suggesting that environmental impacts may initially worsen but improve as income levels increase.

The pollution haven hypothesis further complicates this discourse, positing that stringent environmental regulations in developed countries may shift pollution-intensive industries to developing nations. Italy's role in green trade, particularly in balancing green imports and exports, exemplifies the challenges and opportunities associated with integrating environmental sustainability into global trade practices. Policymakers must carefully design regulations and strategies that harness the potential of green trade to foster both economic growth and environmental protection, while accounting for the complexities and diverse economic contexts of trading nations.

2.1 International trade and environmental quality: a survey (Jayadevappa & Chhatre 2000)

The relationship between international trade and environmental quality has been extensively explored in the literature, particularly concerning the interactions between economic development, trade policies, and environmental regulations. The existing body of research indicates that these linkages are complex and multifaceted, reflecting the intricate dynamics between trade liberalization and environmental outcomes. Jayadevappa & Chhatre (2000) emphasize that international trade has incorporated environmental concerns since the 1970s, with varying effects depending on the specific environmental issues and the trade dynamics involved. This complexity is further illustrated by theoretical models such as the Heckscher-Ohlin model, which, when extended to include environmental externalities, suggests that trade can either exacerbate or alleviate environmental degradation depending on factors such as production processes, regulatory frameworks, and the comparative advantages of trading nations (Pethig 1976, Siebert 1992).

Empirical studies offer a nuanced picture, with evidence both supporting and challenging the notion that trade liberalization leads to environmental degradation. For instance, Lucas et al. (1992) and Hettige et al. (1992) find that trade openness can result in increased pollution, particularly in developing countries where environmental regulations may be less stringent. Conversely, other studies, such as those by Grossman & Krueger (1995*b*), argue that trade openness can lead to improved environmental quality through the adoption of cleaner technologies and better environmental practices, driven by the income and growth effects associated with increased trade.

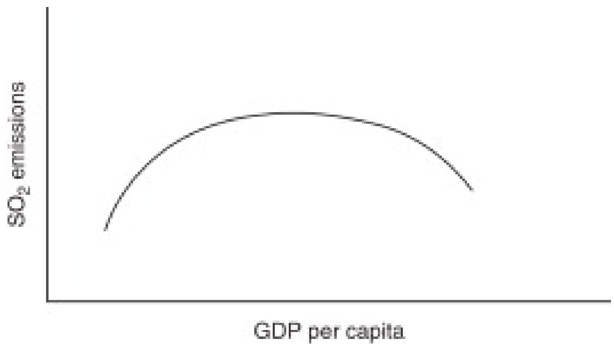

Figure 1: Environmental Kuznets Curve (EKC)

The Environmental Kuznets Curve (EKC) hypothesis offers another perspective on the relationship between trade, economic growth, and environmental quality. The Environmental Kuznets Curve. (EKC) posits an inverted U-shaped relationship between environmental degradation and income levels, where environmental degradation initially increases with economic growth but begins to decline as income reaches a certain threshold. While this hypothesis has been empirically validated in some contexts, its applicability remains contested, with several studies highlighting its limitations. For instance, Stern et al. (1996) and De Bruyn et al. (1998) critique the EKC for oversimplifying the complex dynamics between trade, economic growth, and environmental outcomes, noting that the relationship may not hold universally across different environmental indicators or countries at varying stages of development.

In the context of Italy, understanding the EKC is particularly relevant as the country continues to develop its green trade sector. Italy's green trade involves the exchange of goods and services that have minimal environmental impact or contribute to environmental sustainability. The relationship between green imports and exports in Italy presents a unique case, where the interplay of these trade flows could either support or undermine the country's environmental objectives. Importing green technologies, for example, may help reduce domestic pollution by enabling cleaner production processes, while exporting green products could contribute to global environmental goals by providing sustainable alternatives to traditional goods. However, this balance is delicate, and policy interventions are required to ensure that the environmental benefits of green trade are fully realized without unintended negative consequences.

Policy implications arising from this body of literature suggest that there is a need for policies that harmonize trade and environmental objectives. Harmonization of environmental standards across countries, as discussed by Beghin et al. (1994), could mitigate the negative environmental impacts associated with trade liberalization. In the case of Italy, aligning its green trade policies with international environmental standards could enhance the competitiveness of its green products while ensuring that trade contributes positively to global sustainability goals. However, such harmonization efforts must consider the diverse economic and environmental contexts of different countries to avoid imposing uniform standards that may be inefficient or counterproductive in specific settings.

Further research is needed to explore the specific dynamics of Italy's green trade sector, particularly concerning the direct and indirect environmental impacts of green imports and exports. Studies should focus on various factors such as carbon footprints, resource utilization, and long-term sustainability, providing a more comprehensive understanding of how green trade flows influence Italy's overall environmental quality. Additionally, the role of government policies in shaping these trade flows and their environmental outcomes warrants closer examination, as highlighted by Copeland (1994), who underscore the importance of judicious policy design in managing the trade-offs between economic and environmental goals.

The literature suggests that while trade can contribute to economic development and environmental improvement, the outcomes are heavily contingent on the regulatory context and the specific nature of the trade flows. For Italy, the development of a robust green trade strategy that leverages both imports and exports to enhance environmental quality will be crucial for achieving sustainable growth. The interactions between trade policies, environmental regulations, and economic development present both challenges and opportunities, and understanding these interactions is key to formulating effective strategies for promoting green trade in Italy.

2.2 Pollution havens and the trade in toxic chemicals: Evidence from U.S. trade flows (Tang 2015)

The interaction between international trade and environmental regulation has been a subject of significant scholarly attention, particularly in the context of the pollution haven hypothesis (PHH). This hypothesis posits that firms in countries with stringent environmental regulations may relocate production to countries with laxer regulations, leading to a shift in pollution-intensive industries from developed to developing nations. This phenomenon is especially pertinent in the global trade of toxic chemicals, where the cost of compliance with environmental regulations can be substantial.

Jaffe et al. (1995) provide an early comprehensive overview of the impact of environmental regulation on the competitiveness of U.S. manufacturing, highlighting the potential for regulatory costs to influence the location of production. Subsequent studies have sought to empirically test the Pollution haven hypothesis. (PHH), particularly in the context of hazardous and toxic substances. The study by Tang (2015) stands out in this regard, as it examines U.S. trade flows in toxic chemicals listed in the Toxics Release Inventory (TRI). Using a difference-in-differences approach, Tang finds that after chemicals are listed under Toxics Release Inventory. (TRI), there is a significant increase in imports from poorer countries, suggesting the emergence of pollution havens as a result of stringent U.S. environmental regulations.

The theoretical underpinnings of the pollution haven hypothesis are closely related to the Environmental Kuznets Curve (EKC) hypothesis. The EKC suggests that environmental degradation initially increases with economic growth but eventually decreases as income reaches a certain threshold, reflecting increased demand for environmental quality (Grossman & Krueger 1993). This relationship implies that wealthier countries, having passed the peak of the EKC, may impose stricter environmental regulations, which could in turn drive pollution-intensive industries to relocate to countries that are still on the upward slope of the EKC. However, as Stern (2004) notes, the applicability of the EKC is not uniform across all pollutants or regions, and its relevance to toxic chemical trade is particularly complex.

Empirical evidence on the existence and magnitude of pollution havens is mixed. Brunnermeier & Levinson (2004) and Levinson & Taylor (2008) find support for the PHH, showing that environmental regulations can lead to a relocation of pollution-intensive production to countries with lower regulatory standards. However, other studies suggest that the relationship between environmental regulation and trade is more nuanced. For example, the Porter hypothesis, articulated by Porter & Van der Linde (1995), argues that stringent environmental regulations can induce innovation, leading to more efficient production processes that offset the costs of compliance. Costantini & Crespi (2008) and Costantini & Mazzanti (2012*a*) provide empirical support for this hypothesis, showing that environmental policies can lead to an increase in green exports from countries that adopt stricter regulations, as firms innovate to maintain competitiveness.

The mixed results in the literature may be attributed to several factors, including differences in the levels of aggregation used in empirical analyses and the types of pollutants or industries studied. For instance, studies that analyze trade flows at the industry level may find different results compared to those that focus on specific commodities or individual firms (Becker & Henderson 2000, Ederington & Minier 2003). Additionally, the impact of environmental regulation on trade may vary depending on the type of regulation, the economic structure of the country, and the specific pollutants or industries under consideration. For example, Hibiki & Managi (2010) examine the Japanese Pollutant Release and Transfer Register (PRTR) program and find that while the program does not appear to penalize companies for the risk of toxic chemical releases, it does increase their investment in pollution abatement.

In the context of U.S. trade in toxic chemicals, the findings of Tang (2015) provide important insights into how environmental regulation can influence trade patterns. Tang's analysis shows that the listing of chemicals under TRI is associated with a significant shift toward imports from poorer countries, suggesting that U.S. firms may be offshoring production to avoid the costs associated with compliance. This finding is consistent with the weak form of the pollution haven hypothesis, which posits that an increase in regulatory stringency will lead to a marginal relocation of pollution-intensive industrial activity.

Moreover, Tang's study also reveals that exports of listed chemicals tend to decrease following their inclusion in the TRI, indicating that domestic production may be declining as firms move production offshore. This finding suggests that the impact of environmental regulation on trade is not limited to imports; it also affects the competitiveness of domestic industries in international markets. The decline in exports could be seen as evidence of the strong form of the pollution haven hypothesis, where a disproportionate share of pollution-intensive production is relocated to countries with lower regulatory standards.

The implications of these findings for environmental policy are significant. While the TRI and similar regulatory programs are designed to reduce domestic pollution, they may inadvertently contribute to global environmental degradation if they lead to the offshoring of pollution-intensive production. This raises important questions about the effectiveness of unilateral environmental regulations in a globalized economy. As Copeland & Taylor (2004*a*) argue, international coordination on environmental standards may be necessary to prevent the displacement of pollution across borders, a phenomenon often referred to as "leakage."

In addition to the policy implications, the literature also highlights the need for more nuanced empirical research that accounts for the heterogeneity of industries, pollutants, and regulatory environments. Future studies could benefit from more detailed data on firm-level production and emissions, which would allow for a more precise estimation of the impact of environmental regulation on trade. Moreover, research could explore the dynamic effects of regulation over time, considering how firms adapt to regulatory changes and whether these adaptations lead to sustained improvements in environmental performance or simply result in the relocation of pollution.

In conclusion, the relationship between environmental regulation and trade in toxic chemicals is complex and influenced by a range of factors, including the stringency of regulations, the economic structure of countries, and the specific characteristics of the pollutants or industries involved. While there is evidence supporting the pollution haven hypothesis, particularly in the context of U.S. trade in toxic chemicals, the overall impact of environmental regulation on trade remains an area of ongoing research. The findings of Tang (2015) underscore the importance of considering the global dimensions of environmental regulation and the potential for regulatory measures to have unintended consequences. As the world becomes increasingly interconnected, the challenge for policymakers will be to design regulations that protect the environment without simply shifting the burden of pollution to other countries.

2.3 Dynamic technique and scale effects of economic growth on the environment (Mohapatra et al. 2016)

The correlation between green imports and green exports within the context of Italy's green trade can be framed through the lens of broader environmental economic theories. At the core of this relationship are sustainable products, which are characterized by low environmental impact throughout their lifecycle, including the stages of production, use, and disposal (Dasgupta et al. 2002). Italy's role in this domain is influenced by its robust manufacturing and agricultural sectors, where the development of sustainable products, ranging from organic foods to eco-friendly textiles and renewable energy technologies, has become increasingly prominent (Etsy & Porter 2005).

In examining the economic implications of sustainable trade, concepts such as scale, technique, and composition effects are often discussed (Copeland & Taylor 1994, 2004*b*). Scale effects involve the increase in production volumes, which, if not managed sustainably, could result in greater environmental degradation. Technique effects refer to the adoption of cleaner production technologies and practices that reduce the environmental footprint (Andreoni & Levinson 1998). Composition effects focus on shifts in economic structures, such as transitioning from traditional, polluting industries to more sustainable, eco-friendly sectors (Grossman & Krueger 1995*a*).

Italy's efforts to balance green exports with the sustainability of imports present notable challenges. The core issue lies in ensuring that the environmental benefits derived from green exports are not undermined by the importation of goods with high environmental costs (Beckerman 1992). This is particularly critical in a globalized economy where trade dynamics are influenced by international market demands, environmental regulations, and global trade policies (Antweiler et al. 2001). Italian exporters often face challenges due to varying environmental standards in foreign markets, while imports may not always align with Italy's stringent sustainability criteria (Tang 2011).

Dynamic effects play a crucial role in the environmental impact of economic activities, including trade. Over time, changes in technology adoption and consumer preferences can significantly alter the environmental outcomes of trade practices (Kolstad & Krautkraemer 1993). As Italy continues to invest in green technologies and renewable energy, the composition of its imports and exports may shift, potentially reducing the environmental impact of its trade balance (Cole & Elliott 2003).

However, research in this area faces significant challenges, particularly related to data limitations and the complexity of modeling dynamic environmental impacts (Lantz & Feng 2006). Comprehensive and accurate datasets on the environmental effects of trade are often unavailable, complicating empirical analysis (Day & Grafton 2003). Moreover, international trade agreements can restrict the implementation of stringent environmental regulations, further complicating efforts to promote sustainable trade (Oladosu & Rose 2007).

In summary, while Italy is well-positioned to enhance its role in the global market for sustainable products, the country must carefully manage the relationship between green imports and exports to ensure that economic growth supports rather than undermines environmental sustainability. Further research is essential to understanding the long-term effects of green trade and developing policies that encourage the growth of sustainable industries with minimal environmental impacts (Lopez 1994, Mohapatra et al. 2016).

2.4 Green Innovation and Green Imports: Links between Environmental Policies, Innovation, and Production (Brunel 2019)

The relationship between green imports and exports within the context of Italian green trades is a burgeoning field of study, revealing significant insights into the interplay of environmental policies, innovation, and economic production. The empirical investigation into this subject focuses on the renewable energy sector, particularly within Organization for Economic Co-operation and Development. (OECD) countries, as examined by Brunel (2019) and the wider body of research on environmental economics.

Green innovation, driven by stringent environmental policies, often results in the adoption and adaptation of foreign technologies rather than the development of novel domestic innovations. Brunel (2019) highlights that while policies such as subsidies and mandates for renewable energy usage boost the adoption of green technologies, domestic innovation remains limited except in specific nations like Germany, Japan and the United States. This observation aligns with earlier studies indicating that the diffusion of environmental technologies often transcends national borders, with significant innovation occurring in technologically advanced countries and subsequently being exported to other nations (Jaffe & Palmer 1997, Popp 2002).

The Italian green trade sector, particularly in the context of imports and exports, reflects these global trends. Italy, like many other countries, imports a considerable amount of its renewable energy technology, which is then integrated into domestic energy systems. The importation of these technologies is driven by the global competitive advantage of leading innovator countries, which develop and patent new technologies more rapidly due to robust policy frameworks and substantial R&D investments (Dechezlepretre et al. 2013, Verdolini & Bosetti 2017). Consequently, while Italy benefits from the environmental advantages of these technologies, the economic stimulus through domestic innovation and production is less pronounced.

Empirical evidence underscores the notion that environmental policies have heterogeneous effects on domestic innovation and production. For instance, the introduction of renewable energy policies in OECD countries generally leads to a significant rise in the adoption of foreign technologies with minimal domestic inventions (Brunel 2019). However, when examining specific renewable energies, such as wind and solar, there is a discernible increase in domestic production activities in countries with strong innovation outputs. This nuanced understanding is crucial for Italy, as it underscores the potential for targeted policies to foster both the adoption of advanced technologies and stimulate local production capacities.

Further research by Peters et al. (2012) and Dechezlepretre & Glachant (2014) explores the cross-border effects of environmental regulations, showing that stringent domestic policies often lead to increased innovation abroad, which then feeds back into the domestic economy through imports. This dynamic is particularly relevant for Italy, where the renewable energy sector's growth is intertwined with the international trade of green technologies.

The dual role of imports and exports in stimulating the green economy cannot be understated. Imports of advanced green technologies enable Italy to achieve its environmental targets more efficiently, leveraging the innovations developed in countries with a comparative advantage in technology creation. Conversely, as domestic capabilities improve, there is potential for Italy to export homegrown innovations, particularly in niche markets where it may develop specific expertise or competitive advantages.

In conclusion, the literature on green trades, environmental policies, and innovation presents a complex picture of international interdependencies and domestic potentials. For Italy, the strategic importation of cutting-edge technologies combined with policies that nurture local innovation and production can create a balanced approach to achieving both environmental and economic goals. This approach necessitates continuous evaluation and adaptation of policies to ensure that Italy not only adopts the best available technologies but also progressively builds its capacity to innovate and produce within the renewable energy sector.

2.5 Impacts of Environmental Policies on Global Green Trade Kang & Lee (2021)

The literature on Italian green trades, particularly focusing on the relationship between green imports and exports, reveals the complexity and challenges inherent in defining and promoting sustainable products. A significant challenge in this research is the classification of industries and products as "green," which profoundly impacts the analysis of trade patterns and the effectiveness of environmental policies.

The classification of green products is central to the study of green trade. This classification process typically involves matching codes from various systems, such as the U.S. Bureau of Labor Statistics (BLS) and the Standard International Trade Classification

(SITC). Green industries are categorized based on their contributions to renewable energy, energy efficiency, pollution reduction, and other environmentally friendly practices United States (2012). However, the classification process is not without challenges. The study notes the potential for bias, particularly due to the broad and sometimes overlapping categories used in defining green products. For instance, the study classified industries based on Standard International Trade Classification. (SITC) Rev.2 codes, resulting in 106 green industries out of 788, focusing on sectors like chemicals, machinery, and manufactured goods (Kang & Lee (2021)). The inherent difficulty in this classification suggests that the definition of what constitutes a green product can be somewhat subjective and variable, leading to challenges in comparative analysis and policy formulation Pearce & Turner (1990).

One of the major problems in researching green trade is the heterogeneity of environmental policies across countries, particularly between developed and developing nations. Developed countries, with their advanced technologies and stringent environmental regulations, tend to dominate the green trade landscape (Costantini & Crespi (2008)). These nations impose environmental taxes and promote energy-efficient technologies, which enhances their green export capabilities (Pollin (2019)). Conversely, developing countries often struggle with insufficient financial resources and technological capabilities, making it challenging for them to align with global green trade standards (Harris et al. (2002)). This disparity creates a complex dynamic in global green trade, where the benefits of environmental policies in one country may not translate into global environmental improvements due to the varying levels of policy enforcement and technological adoption in other countries (Costantini & Mazzanti (2012*b*)).

Another critical issue is the impact of environmental policies on trade. The study uses environmental taxes and energy intensity as indicators of these policies. The findings indicate that while environmental taxes generally have a positive impact on green exports among high-income countries, the effect of energy intensity is more variable (Tsurumi et al. (2015)). High energy intensity, which indicates less efficient energy use, negatively impacts green exports from developing to developed countries. However, within trade among developing countries, higher energy intensity can sometimes correlate with increased green exports, possibly due to lower environmental standards and the need to meet domestic demand through imports (Jug & Mirza (2005)).

The study also emphasizes the role of global value chains (GVCs) in green trade, highlighting that countries with advanced eco-friendly technologies are better positioned to benefit from green exports (Kang & Lee (2021).) However, the internationalization of production processes means that countries with lower technological capabilities are often relegated to the import side of the trade equation, thereby limiting their participation in green trade (Kuik et al. (2019)).

In summary, the literature underscores the importance of a robust classification system for green products and highlights the challenges posed by varying levels of environmental regulation and technological capability across countries. These factors significantly influence the dynamics of green trade and must be carefully considered in any policy aimed at promoting sustainable trade practices. The research underscores the need for international cooperation and support for developing countries to enhance their participation in global green trade, ensuring that environmental benefits are realized on a global scale (Costantini et al. (2017)).

2.6 The impact of green trade and green growth on natural resources (Huang & Zhao 2022)

The study of green trade and green growth in the context of Italy is crucial for understanding the environmental and economic impacts on natural resources. Green trade refers to the incorporation of environmentally sustainable practices in trade, while green growth focuses on economic growth that is both inclusive and environmentally sustainable. Italy's green trade involves both imports and exports of goods and services that adhere to environmental standards, aiming to reduce the carbon footprint and promote sustainability. The relationship between green import and export plays a significant role in determining the effectiveness of these green strategies (Balsalobre-Lorente et al. 2021).

In the context of Italy, green trade practices have shown potential in mitigating the adverse effects of traditional energy resources such as coal, oil, and gas. By focusing on renewable energy sources and eco-friendly technologies, Italy can reduce its dependence on fossil fuels, thereby decreasing greenhouse gas emissions and promoting environmental sustainability (Zafar et al. 2020). The empirical evidence from studies conducted in various countries, including China, suggests that green trade policies can significantly reduce the use of natural resources that contribute to environmental degradation (Huang & Zhao 2022).

Green growth, on the other hand, is a broader concept that encompasses economic policies aimed at fostering sustainable development. This includes investments in renewable energy, energy efficiency, and sustainable transportation systems. In Italy, green growth strategies are essential for transitioning towards a low-carbon economy. The implementation of green growth policies can lead to significant improvements in environmental quality and public health, as well as economic benefits through the creation of green jobs and industries (Pao & Tsai 2011).

One of the primary challenges in promoting green trade and green growth in Italy is the need for substantial investment in infrastructure and technology. This includes upgrading existing facilities to meet environmental standards and developing new technologies that are both efficient and sustainable. Moreover, policy interventions are necessary to incentivize businesses and consumers to adopt green practices. This can be achieved through subsidies, tax incentives, and regulatory frameworks that support the development and adoption of green technologies (Adefarati & Bansal 2019).

The literature also highlights the importance of international cooperation in promoting green trade. Italy, being a part of the European Union, benefits from regional policies and agreements that aim to reduce carbon emissions and promote sustainability. Collaborative efforts at the international level can help in addressing global environmental challenges and fostering a more sustainable global trade system (Shahbaz et al. 2016).

Furthermore, the relationship between green import and export in Italy is influenced by various factors, including market demand, technological advancements, and regulatory policies. For instance, the demand for green products and services is increasing globally, driven by consumer awareness and regulatory requirements. This creates opportunities for Italian businesses to expand their green exports, thereby contributing to economic growth and environmental sustainability (Sandberg & et al. 2019).

In conclusion, the study of green trade and green growth in Italy provides valuable insights into the effectiveness of these strategies in promoting sustainable development. The transition to a green economy requires a multifaceted approach, involving investments in technology and infrastructure, policy interventions, and international cooperation. By focusing on both green import and export, Italy can enhance its economic resilience and environmental sustainability, contributing to global efforts to mitigate climate change and promote sustainable development (Zafar et al. 2020).

3 Methodology

The section methodically discusses the procedures and data utilized to examine trade dynamics and sustainability within the European Union, focusing particularly on Italy's engagement. It begins by detailing the dataset sourced from the Data collection system for compiling statistics on international trade in goods between the European Union Member States. (Intrastat) system, which records the economic transactions between Italy and other European Union. (EU) member states. The narrative outlines how the Intrastat system was developed to continue effective data collection in a landscape without traditional customs borders, thus supporting robust statistical analysis of intra-EU trade.

The discussion then shifts to the sustainability measures used in the analysis. Two distinct methodologies are highlighted: the employment-focused Green Goods and Services (GGS) list based on the North American Industry Classification System (NAICS) and the product-oriented list of environmental goods from the Organisation for Economic Co-operation and Development (OECD), categorized by Harmonized System (HS) codes. These tools are employed to evaluate the environmental impacts of trade and the green employment within the industries.

The section concludes with an in-depth look at the data elaboration process, where advanced statistical tools, particularly Stata software, are used to manage, organize, and analyze the complex datasets. Emphasis is placed on the application of rigorous regression models and data validation techniques to ensure the findings' accuracy and reliability, providing a detailed understanding of Italy's role in promoting sustainable trade practices within the EU's single market.

Overall, this part of the text carefully articulates the methodological approaches, data sources, and analytical techniques necessary to dissect the complexities of sustainable trade, underscoring the economic and environmental dimensions of international commerce.

3.1 Data

The section on data delves into the dataset derived from the Intrastat system, which captures the economic transactions between Italy and other EU member states. It outlines the evolution of Intrastat, developed to facilitate efficient data collection in a European Single Market without traditional customs controls, thus supporting detailed statistical analysis of intra-EU trade.

The narrative further explores the mechanisms of data collection, emphasizing direct reporting from companies involved in intra-community trade to the Italian National Institute of Statistics (ISTAT). This reporting is rigorously processed to ensure the accuracy and completeness of data, which is structured to include key variables such as product classifications, transaction values, and firm identifiers. Each variable is explained, highlighting its importance and use in the study to provide insights into Italy's trade dynamics within the EU.

Overall, this section articulates the data sources and collection methods employed, setting a solid foundation for examining Italy's economic interactions within the European single market.

3.1.1 Dataset Source and Provenance

The dataset described in the document (Di Pietro 2005), and used in this study, pertains to the **Intrastat data collection system**, which is central to monitoring the flow of goods between Italy and other member states of the European Union (EU). Established after the creation of the European Single Market in 1993, the Intrastat system was introduced to address the need for continued data collection on trade in a context where customs borders between EU member states had been removed. Prior to this, trade data was gathered through customs procedures, but the removal of these formalities necessitated the creation of a new method to accurately capture information about cross-border transactions. Intrastat thus emerged as a mechanism to collect trade data while avoiding the complexities and delays associated with traditional customs processes.

The dataset is created through direct reporting by companies involved in the intra-community acquisition and supply of goods within the EU. Firms engaged in such trade are required by law to submit periodic reports to national statistical authorities, in this case, the Italian National Institute of Statistics (ISTAT). The Intrastat system mandates businesses to provide detailed information about their transactions, including both imports and exports. This reporting occurs at different intervals, depending on the volume of trade. Larger operators, who account for the majority of trade activity, are required to submit monthly declarations, whereas smaller operators may submit reports on a quarterly or annual basis.

The data itself is sourced from the declarations made by businesses, which include essential details about the goods traded, their value, and their volume. These declarations are submitted electronically to the customs authorities, which then forward the information to Italian National Institute of Statistics. (ISTAT) for further statistical processing. The dataset thus captures key data points such as the type of goods being traded, the monetary value of the transactions (converted into Euros), and the physical quantities involved, typically measured in units such as kilograms. Additionally, the dataset records the origin or destination country within the EU and specifies whether the transaction represents a purchase or a sale. In this way, the dataset provides a comprehensive record of Italy's intra-EU trade, facilitating a nuanced understanding of the country's economic exchanges within the single market.

The creation and use of the dataset are governed by a robust legal framework established by the EU. Central to this framework is Regulation (EC) No 638/2004 of the European Parliament and Council (Parliament & Council 2004), which outlines the rules for collecting and reporting data on intra-EU trade in goods. According to this regulation, all companies that exceed specific thresholds in terms of trade volume are required to report their transactions. The data collected must meet specific criteria concerning accuracy, timeliness, and completeness. In Italy, these EU regulations are complemented by national laws that ensure compliance and further streamline the reporting process. Both the Italian Customs Agency and ISTAT play critical roles in enforcing these legal requirements and ensuring the data collected is both reliable and timely.

The dataset is structured around several key dimensions, which include the classification of goods, transaction details, and reporting frequency. Goods are categorized using internationally recognized systems such as the *CombinedNomenclature.*(CN8), the *HarmonizedSystem.*(HS), and the *Standard International Trade Classification* (SITC). This standardized classification ensures consistency across national borders and facilitates the comparison of trade data across different countries. Additionally, the dataset records the value of goods traded, expressed in *Euros*, and the physical quantities, which are often measured in units like *kilograms*. The dataset also captures other important variables such as the type of transportation used, the partner country involved, and whether the goods are being imported or exported.

The Intrastat dataset is collected on a monthly basis, although aggregate statistics may also be reported on a quarterly or annual basis depending on the requirements of different stakeholders. The dataset distinguishes between two major types of trade: general and special. The **general trade system** includes all goods entering or leaving a country, irrespective of whether they are in free circulation or temporarily stored in customs warehouses. The special trade system, on the other hand, focuses only on goods that have cleared customs and are available for consumption or use in the domestic market. However, the Intrastat dataset operates under a separate framework from these customs-based systems, reflecting the unique nature of intra-EU trade where goods are no longer subject to traditional border controls.

In terms of data confidentiality, the dataset adheres to strict protocols designed to protect sensitive commercial information. The legal provisions governing data confidentiality ensure that individual company data remains secure while aggregate statistics are made available to the public. ISTAT implements various quality control measures, including data validation and error correction processes, to guarantee the accuracy of the dataset. These measures are integral to maintaining the integrity of the data and ensuring it meets the needs of policymakers, businesses, and other users.

The data **processing workflow** for the Intrastat system includes several key stages: initial data collection from company declarations, processing and validation to check for consistency with legal and methodological standards, correction of any errors identified during validation, and the aggregation of data for reporting purposes. The final dataset is then made available for analysis by national and EU authorities, as well as by researchers and other stakeholders.

The Intrastat dataset is a critical tool for monitoring trade between Italy and other EU countries (ISTAT 2023). It provides detailed insights into the flow of goods, both in terms of value and quantity, and offers a comprehensive picture of Italy's trade dynamics within the single market. The dataset is built on a foundation of direct reporting by companies engaged in cross-border trade and is governed by a stringent legal framework that ensures its reliability and usefulness. As such, it serves not only as a vital source of data for national economic analysis but also contributes to broader EU-wide statistics, supporting policy decisions and economic planning at various levels. The continued development and refinement of this dataset are essential for maintaining a clear and accurate understanding of Italy's role in the European and global economy.

3.1.2 Sampling process

The Intrastat data collection system serves as the primary method for monitoring Italy's trade with other EU countries. The system relies on direct reporting from businesses engaged in intra-EU trade, who are required by law to submit periodic declarations to the Italian National Institute of Statistics (ISTAT). These declarations detail the goods traded, their value, and their volume.

The **sampling process** for the Intrastat dataset is not random, but rather is based on specific legal thresholds that determine whether a business is required to report its transactions on a monthly, quarterly, or annual basis. Companies with higher volumes of trade are subject to more frequent reporting, while smaller operators may only be required to submit data on a quarterly or annual basis. The declarations include detailed information about the goods being traded, categorized according to international nomenclatures, the value of the transactions (in *Euros*), the quantities traded, and the origin or destination country. This structure ensures comprehensive coverage of intra-EU trade, particularly focusing on businesses responsible for the majority of trade flows.

Data elaboration within the Intrastat system involves several stages. Once declarations are submitted by businesses, they are transmitted to the customs authorities, which then pass the data to ISTAT for processing. ISTAT applies strict validation procedures to ensure the data's accuracy, including checks for consistency with the legal and methodological standards set by both EU and national regulations. Any errors or inconsistencies are corrected during this phase, and adjustments are made to account for late or missing declarations. Once validated, the data are aggregated into broader statistical categories and made available for analysis.

In addition to ensuring data quality, the Intrastat system adheres to confidentiality standards, protecting individual business information while releasing aggregate data for public use. The data produced is vital for both national and EU-level economic analysis, supporting a wide range of policymaking and commercial decision-making processes.

3.1.3 Dataset structure

The current dataset analyzed in this paper is extensive and well-structured, consisting of a total of **2,762,687 observations**. Each observation represents a specific **transaction**, incorporating various dimensions of international trade, industry classification, and firm-level data. This dataset serves as the foundation for analyzing trade flows and sustainability trends, covering transactions across the period from 2008 to 2019. The data includes detailed product classifications (such as $NC8$ and $ATECO$ codes) alongside firm identifiers, country data, and monetary values, providing a comprehensive overview of the international trade activities involved.

The structure of the dataset encompasses several key columns, each of which plays an important role in the analysis. Below is a detailed explanation of each variable, including how it should be interpreted and its relevance to the study:

id: This column serves as a unique identifier for each observation (transaction) in the dataset. It was introduced specifically to facilitate database operations such as merging and sorting, ensuring that each transaction is uniquely identifiable.

year: This column indicates the year in which the transaction was recorded. The dataset covers the period from 2008 to 2019, enabling a temporal analysis of trade trends over time.

NC8: The $NC8$ is the $Combined\ Nomenclature$ used by the European Union for the classification of goods in trade statistics. It consists of 8 *digits*, where the first 6 digits represent the $Harmonized\ System$ (HS) code, used globally for trade classification, and the last 2 digits provide further specificity within the EU. For example, the $6 - digit$

HS *code* might represent a general category such as "vehicles," while the $8 - digit$ $NC8$ *code* further specifies the type of vehicle. This hierarchical structure allows for classification with increasing levels of detail.

firmid: This column assigns a unique code to each firm involved in the transaction. For privacy and security reasons, company names have been anonymized and replaced with this $firmid$, ensuring that firm-level analysis can be conducted without compromising confidentiality.

manufacturing: A *dummy variable* that indicates whether the firm responsible for the transaction is classified as a manufacturing company. The value is 1 for manufacturing firms and 0 otherwise.

paese (country): Initially recorded in Italian, this column represents the country involved in the transaction. It was later translated into English for clarity. The countries are identified by a $3 - digit$ *code*, following the *Geonomenclature* classification developed by ISTAT and Eurostat. This classification is standardized across international datasets, and a full list of country codes is provided in Table 30.

developed: This column categorizes countries into *developed* or *non* $-$ *developed* based on international classifications. The value is 1 for developed countries, 0 for non-developed countries, and 2 for undefined countries, following the criteria established by ISTAT and other international organizations.

province: This column represents the $Italian\ province$ where the transaction occurred. For import transactions, it indicates the province of the importing company, while for exports, it refers to the location of the exporting (producing) company.

movement: A *dummy variable* that specifies whether the transaction is an *import* or an *export*. The value 8 represents an import, while 9 represents an export. This allows for a clear distinction between incoming and outgoing trade flows.

import value / export value: These columns capture the monetary value of the transaction. Depending on whether the transaction is an import or an export, one of these columns will contain a non-null value, representing the amount associated with the trade.

ateco2007impr: This column represents the $ATECO$ 2007 classification of the firm responsible for the transaction, at the $6-digit\ level$. ATECO is the Italian classification system for economic activities, based on $NACE\ Rev.$ 2, the European standard. In this context, the $6 - digit\ ATECO\ code$ identifies the economic activity of the firm involved.

ateco2007_impr_5d: A derived variable from $ateco2007impr$, this column reduces the level of detail to 5 $digits$. It provides a broader classification of the firm's economic activity while still retaining a significant degree of specificity.

ateco2007_impr_4d: Similar to the above, this variable represents the firm's economic activity at the $4 - digit\ level$. It offers a higher-level view of the industry sector and will be crucial in later analysis.

ateco2007_impr_3d: This column further generalizes the classification to 3 $digits$, offering an even broader industry categorization. It simplifies the analysis by grouping firms into more general sectors.

ateco2007: This variable identifies the $ATECO\ code$ for the product involved in the transaction, using $5 - digit\ precision$. It provides detailed information about the product's economic activity and is key for product-specific analysis.

ateco2007_4d: A derived variable that generalizes the product classification from 5 $digits$ to 4 $digits$, capturing broader product categories while maintaining essential distinctions.

ateco2007_3d: This column, derived from $ateco2007$, further reduces the product classification to 3 $digits$, representing higher-level product categories. It provides a generalized view for sector-wide analysis.

This dataset, with its wide range of variables, provides a comprehensive foundation for analyzing international trade patterns, industry classifications, and sustainability metrics. The following sections will provide detailed interpretations for each column, explaining their significance and how they are used in the context of this study. An extract of the $final\ dataset$, which includes the results of all the modifications and merging processes, is attached for reference (Table 1).

Table 1: Dataset tradesample

id	year	NC8	firmid	man.[1]	paese	dev.[2]	prov.[3]	mov.[4]	imp.[5]	exp.[6]	impr[7,8]	impr_5d[8]	impr_4d[8]	impr_3d[8]	ateco[8]	ateco_4d[8]	ateco_3d[8]
69280	2008	95051088	1822	1	1	1	LU	9		8559	222909	22290	2229	222	32999	3299	329
69281	2008	84189992	2444	1	1	1	VI	8	44621		289300	28930	2893	289	28250	2825	282
69282	2008	84179000	2444	1	1	1	FI	8	2985		289300	28930	2893	289	28211	2821	282
69283	2008	59113288	2444	1	1	1	VI	8	57880		289300	28930	2893	289	13962	1396	139
69284	2008	96062200	3121	1	1	1	CN	8	51		141310	14131	1413	141	32992	3299	329
69285	2008	96081096	4390	1	1	1	VB	8	1221		256100	25610	2561	256	32993	3299	329
69286	2008	87168000	2444	1	1	1	VI	8	30003		289300	28930	2893	289	30990	3099	309
69287	2008	32073000	2185	1	1	1	AR	9		2990	244000	24400	2440	244	20300	2030	203
69288	2008	52103900	4583	1	1	1	PO	9		22	132000	13200	1320	132	13200	1320	132
69289	2008	51113032	4670	1	1	1	PO	9		677954	132000	13200	1320	132	13200	1320	132
69290	2008	55151992	4653	1	1	1	PO	9		12137	132000	13200	1320	132	13200	1320	132
69291	2008	76169992	4037	1	1	1	VA	9		164846	245300	24530	2453	245	25993	2599	259
69292	2008	84779008	4235	1	1	1	VA	9		5245	289600	28960	2896	289	28960	2896	289
69293	2008	52081300	3929	1	1	1	VA	9		996	132000	13200	1320	132	13200	1320	132
69294	2008	62104000	1135	1	1	1	PS	9		4713	141000	14100	1410	141	14192	1419	141
69295	2008	8093010	1648	1	1	1	FG	9		27559	110210	11021	1102	110	1240	1240	124
69296	2008	94013008	2473	1	1	1	PS	9		2369	310930	31093	3109	310	31011	3101	310
69297	2008	74112112	820	1	1	1	AN	8	808566		256200	25620	2562	256	24440	2444	244
69298	2008	40169300	934	1	1	1	LI	9		372958	222909	22290	2229	222	22190	2219	221
69299	2008	39269096	4810	1	1	1	SI	9		621	274000	27400	2740	274	22290	2229	222
69300	2008	2032219	3718	1	1	1	VR	8	179739		101300	10130	1013	101	10110	1011	101
69301	2008	32081090	3629	1	1	1	TV	9		1414	203000	20300	2030	203	20300	2030	203

Table 1 – Continued from previous page

id	**year**	**NC8**	**firmid**	**man.**[1]	**paese**	**dev.**[2]	**prov.**[3]	**mov.**[4]	**imp.**[5]	**exp.**[6]	**impr**[7][8]	**impr_5d**[8]	**impr_4d**[8]	**impr_3d**[8]	**ateco**[8]	**ateco_4d**[8]	**ateco_3d**[8]
69302	2008	73182896	4450	1	1	1	CO	9		13812	259400	25940	2594	259	25940	2594	259
69303	2008	72222040	872	1	1	1	MO	8	4662		259999	25999	2599	259	24310	2431	243
69304	2008	85423192	1409	1	1	1	BZ	8	53994		282209	28220	2822	282	26110	2611	261
69305	2008	39076080	3743	1	1	1	LC	9		25494	172100	17210	1721	172	20160	2016	201
69306	2008	85471088	629	1	1	1	CN	8	3981		282990	28299	2829	282	23430	2343	234

[1] Manufacturing
[2] Developed
[3] Province
[4] Movement
[5] Import value
[6] Export Value
[7] Company
[8] Ateco 2007

3.2 Measures of sustainability employed in the study

In this study, two distinct methodologies for classifying and measuring sustainability are employed, each rooted in different classification systems. The first method relies on the Green Goods and Services (GGS) list, which is based on the North American Industrial Classification System (NAICS). This system, closely aligned with the European ATECO codes, is implemented by the U.S. Bureau of Labor Statistics (BLS) to track employment in green activities (paragraph 3.2.1). Data collection through this approach involves surveying businesses to determine the share of revenue or employment attributed to green goods and services. For the purposes of this study, the classification uses the 4-digit North American Industry Classification System. (NAICS) codes, which strike a balance between granularity and generalization, allowing for meaningful sectoral distinctions while maintaining analytical clarity. This method is particularly focused on measuring employment within industries involved in green production.

The second classification system employed is the OECD list of environmental goods, which utilizes the Harmonized System (HS) codes, extending to the NC8 level in Europe (paragraph 3.2.2). This product-based classification system is used primarily in trade and tariff analyses and is designed to identify goods that contribute to environmental protection. The OECD list groups products into environmental sectors, such as pollution management and resource conservation, and links them to specific HS codes. Unlike the NAICS-based Green Goods and Services. (GGS) list, which centers on industry employment, the OECD approach provides a detailed examination of goods traded in international markets, offering a product-level perspective on sustainability.

By employing these two distinct systems one industry based and the other product-based—the study integrates complementary measures of sustainability, offering a broader and more nuanced understanding of the green economy.

3.2.1 Employment in Green Goods and Services

The classification of Green Goods and Services (GGS) (Table 29), divided by sectors, is established through a comprehensive data collection process conducted by the **U.S. Bureau of Labor Statistics** (U.S. Bureau of Labor Statistics. (BLS)). This process is implemented under the Quarterly Census of Employment and Wages (QCEW) program, which encompasses nearly all civilian wage and salary employment in the United States. The foundation of this classification lies in the GGS survey, which targets approximately **120,000 business** and government establishments across **325 industries** identified by the North American Industrial Classification System **(NAICS)** as potentially producing green goods or providing green services.

The GGS survey is instrumental in gathering information on the extent to which these establishments are involved in green production. Specifically, participating establishments are asked to report whether they produce green goods or services, as defined by the BLS. For establishments that engage in such production, the survey requires the specification of the percentage of revenue or employment that can be attributed to green activities. The reporting of revenue is prioritized, as this metric is often easier for businesses to provide and less burdensome than quantifying employment related to specific green goods or services. In cases where establishments do not generate revenue, such as non-profit organizations or government entities, the percentage of employment dedicated to green goods or services is reported instead.

The percentage of revenue or employment associated with green production is then multiplied by the total employment at the establishment to estimate the number of GGS jobs. This method ensures that only the portion of employment directly tied to the production of green goods and services is included in the GGS classification, allowing for a precise calculation of GGS jobs across various sectors. By collecting and analyzing this data, the BLS is able to provide a detailed breakdown of green employment, including the proportion of green jobs in different sectors, such as manufacturing, construction, and trade.

The data collection process is highly structured. The establishments surveyed are drawn from a sample divided into three panels, with each panel containing approximately 40,000 units. Two of the panels overlap with the previous year's sample to facilitate the measurement of changes in GGS employment over time, while the third panel introduces new establishments to capture emerging trends. This sampling method ensures that GGS employment can be estimated both at the national level and within individual states and industry sectors.

Once the data is collected, the employment figures are estimated using a Horvitz-

Thompson estimator[1]. This estimator takes into account the 12-month average employment from the Quarterly Census of Employment and Wages. (QCEW) program, the percentage of revenue or employment associated with green production, and the sampling weight of each establishment. The estimator allows for robust GGS employment estimates that reflect the contribution of green jobs relative to the overall employment in a given sector.

In terms of sectoral classification, the GGS classification is refined by determining the share of total employment in each sector dedicated to green goods and services production. For instance, the construction sector saw significant increases in green jobs due to activities related to energy-efficient building projects and the construction of renewable energy plants. Manufacturing, similarly, contributed through the production of green products such as pollution control equipment, hybrid vehicles, and renewable energy technologies.

The classification of GGS employment by sector thus provides a comprehensive picture of the contribution of various industries to the green economy. By leveraging detailed establishment-level data on green production and applying rigorous estimation methodologies, the BLS is able to offer insights into the role of different sectors in advancing environmental sustainability through green goods and services. This classification forms a crucial component of understanding the evolving nature of green employment in the U.S. economy.

However, despite the value of the GGS data, the collection of this data ended in **2013** due to financial constraints imposed by the federal government. On March 1, 2013, President Obama ordered across-the-board spending cuts as part of the Balanced Budget and Emergency Deficit Control Act, also known as sequestration. This led to a significant reduction in the Bureau of Labor Statistics' budget, which required cuts of over $30 million, amounting to approximately 5% of the 2013 budget appropriation. To manage these budgetary reductions while preserving its core programs, the BLS decided to eliminate two programs, including all products related to "measuring green jobs." This elimination included the GGS data on employment by industry and

[1]A statistical technique used to estimate total or mean characteristics of a population from a sample where elements are selected with varying probabilities. It compensates for unequal selection probabilities by weighting each sampled unit by the inverse of its probability of selection.

occupation for businesses that produce green goods and services, as well as data on wages and green career information. As a result, the release of 2011 data marked the final scheduled publication of GGS employment estimates. These budgetary cuts forced the termination of the program despite its contribution to understanding green employment trends and the green economy.

3.2.1.1 GGS 4 digits .

Starting from the **Green Goods and Services (GGS) dataset** provided in Table 3, which presents private sector GGS employment by detailed industry with annual averages, we have created a refined dataset. The original data categorizes industries using the **North American Industry Classification System** (NAICS), where codes can vary in length from 2 to 8 digits. The 8-digit NAICS codes provide a highly specific level of detail, distinguishing between subcategories within industries. However, for the purpose of generating a more streamlined dataset that maintains significant sectoral distinctions while avoiding excessive granularity, we have opted to use only the 4-digit NAICS codes. These **4-digit** codes represent broader industry groupings, offering a middle ground between overly detailed and excessively general classifications. This approach allows for a clearer analysis of GGS employment trends across major sectors while retaining enough specificity to make meaningful distinctions between industries. The newly constructed dataset, summarized below, reflects GGS employment data aggregated at the 4-digit NAICS level, providing a comprehensive yet accessible perspective on green employment by sector (Table 2).

Table 2: Green Goods and Services (GGS) 4 digits precision

Industry	NAICS[1]	NAICS 4d[4]	GGS Employment[2]		GGS Percent[3]		GGS change
			2010	2011	2010	2011	
Oilseed and grain farming	1111	1111	3934	4775	9,3	10,6	841
Vegetable and melon farming	1112	1112	10045	10701	10,7	11,3	656
Fruit and tree nut farming	1113	1113	12954	11669	7,1	6,3	-1285
Greenhouse and nursery production	1114	1114	5627	5631	3,9	3,9	4
Other crop farming	1119	1119	4143	4020	6,5	6,5	-123
Cattle ranching and farming	1121	1121	3800	3421	2,9	2,5	-379

Continued on next page

Table 2 – Continued from previous page

Industry	NAICS[1]	NAICS 4d[4]	GGS Employment[2]		GGS Percent[3]		GGS change
			2010	2011	2010	2011	
Hog and pig farming	1122	1122	536	0	1,9	0,0	–
Poultry and egg production	1123	1123	1787	1798	4,6	4,6	11
Sheep and goat farming	1124	1124	0	0	0,0	0,0	–
Aquaculture	1125	1125	382	426	6,5	7,5	44
Other animal production	1129	1129	0	0	0,0	0,0	–
Timber tract operations	1131	1131	1061	1292	29,7	35,6	231
Forest nursery and gathering forest products	1132	1132	528	434	17,9	14,1	-94
Logging	1133	1133	7844	8837	15,8	18,1	993
Support activities for crop production	1151	1151	5395	5761	1,9	2,0	366
Support activities for animal production	1152	1152	0	0	0,0	0,0	–
Support activities for forestry	1153	1153	0	0	0,0	0,0	–
Hydroelectric power generation	221111	2211	5124	3780	72,7	64,8	-1344
Sewage treatment facilities	22132	2213	6439	6448	87,7	88,1	9
Residential building construction	2361	2361	31498	57016	5,5	10,1	25518
Nonresidential building construction	2362	2362	46615	60247	7,2	9,3	13632
Utility system construction	2371	2371	34642	39330	9,1	9,9	4688
Land subdivision	2372	2372	1889	1664	3,7	3,7	-225
Other heavy construction	2379	2379	8028	8618	8,5	9,1	590
Building foundation and exterior contractors	2381	2381	39585	51190	5,9	7,7	11605
Building equipment contractors	2382	2382	164809	194476	10,1	11,9	29667
Building finishing contractors	2383	2383	38185	49119	6,0	7,9	10934
Other specialty trade contractors	2389	2389	20526	26049	4,0	5,0	5523
Textile furnishings mills	3141	3141	9461	9271	16,5	17,0	-190
Other textile product mills	3149	3149	1023	859	1,7	1,4	-164
Sawmills and wood preservation	3211	3211	498	323	0,6	0,4	-175
Hardwood veneer and plywood mfg.	321211	3212	1516	1992	10,3	13,2	476
Wood window and door mfg.	321911	3219	18055	19041	40,1	44,8	986
Pulp mills	32211	3221	1208	1078	20,3	18,0	-130
Petroleum and coal products mfg.	3241	3241	3244	3278	2,9	3,0	34
Basic chemical mfg.	3251	3251	10600	10842	7,5	7,6	242
Agricultural chemical mfg.	3253	3253	639	518	1,8	1,4	-121
Paint and coating mfg.	32551	3255	2731	3078	7,5	8,2	347

Continued on next page

Table 2 – Continued from previous page

Industry	NAICS[1]	NAICS 4d[4]	GGS Employment[2]		GGS Percent[3]		GGS change
			2010	2011	2010	2011	
Soap and other detergent mfg.	325611	3256	674	806	2,8	3,4	132
Printing ink mfg.	32591	3259	1357	1400	14,3	14,9	43
Plastics plumbing fixture mfg.	326191	3261	409	801	3,3	6,7	392
Tire retreading	326212	3262	3008	3221	45,4	46,4	213
Clay product and refractory mfg.	3271	3271	4878	4706	12,1	11,6	-172
Glass and glass product mfg.	3272	3272	7991	9079	10,1	11,4	1088
Cement and concrete product mfg.	3273	3273	9963	9495	5,9	5,8	-468
Lime and gypsum product mfg.	3274	3274	2397	2433	17,8	18,3	36
Mineral wool mfg.	327993	3279	3597	3311	22,3	20,8	-286
Iron and steel mills and ferroalloy mfg.	3311	3311	37831	33812	44,1	36,9	-4019
Alumina and aluminum production	3313	3313	8316	8200	15,4	14,4	-116
Other nonferrous metal production	3314	3314	9788	10493	16,9	17,2	705
Foundries	3315	3315	8925	10787	8,0	8,9	1862
Forging and stamping	3321	3321	1565	1527	1,8	1,6	-38
Metal window and door mfg.	332321	3323	12213	12668	24,1	25,5	455
Industrial valve mfg.	332911	3329	3597	3579	15,5	14,8	-18
Ag., construction, and mining machinery mfg.	3331	3331	0	0	0,0	0,0	–
Commercial and service industry machinery	3333	3333	10618	10577	11,5	11,5	-41
Heating equipment, except warm air furnaces	333414	3334	5550	5736	34,8	33,3	186
Metalworking machinery mfg.	3335	3335	0	0	0,0	0,0	–
Turbine and turbine generator set units mfg.	333611	3336	13400	14439	50,3	49,7	1039
Computer and peripheral equipment mfg.	3341	3341	23706	24723	14,9	15,7	1017
Communications equipment mfg.	3342	3342	2827	2688	2,4	2,3	-139
Audio and video equipment mfg.	3343	3343	628	770	3,1	3,9	142
Semiconductor and electronic component mfg.	3344	3344	22491	27454	6,1	7,2	4963
Automatic environmental control mfg.	334512	3345	2310	2515	12,7	14,0	205
Totalizing fluid meters and counting devices	334514	3345	2488	3302	23,0	30,0	814
Electric lamp bulb and part mfg.	33511	3351	3844	4058	42,4	45,5	214

Continued on next page

Table 2 – Continued from previous page

Industry	NAICS[1]	NAICS 4d[4]	GGS Employment[2]		GGS Percent[3]		GGS change
			2010	2011	2010	2011	
Household refrigerator and home freezer mfg.	335222	3352	0	3443	0,0	25,8	–
Electric power and specialty transformer mfg.	335311	3353	3979	4328	16,6	18,0	349
Miscellaneous electrical equipment mfg.	335999	3359	4147	4245	15,7	15,2	98
Motor vehicle mfg.	3361	3361	12740	11888	8,3	7,4	-852
Motor vehicle parts mfg.	3363	3363	22615	25490	5,4	5,7	2875
Railroad rolling stock mfg.	3365	3365	0	0	0,0	0,0	–
Ship and boat building	3366	3366	0	0	0,0	0,0	–
Office furniture and fixtures mfg.	3372	3372	9585	9779	10,0	10,0	194
Other furniture related product mfg.	3379	3379	2481	2690	6,8	7,6	209
Misc. durable goods merchant wholesalers	4239	4239	94916	104913	34,4	36,1	9997
Used merchandise stores	4533	4533	110651	118166	88,2	88,7	7515
Sea, coastal, and Great Lakes transportation	4831	4831	1751	1586	4,7	4,1	-165
Inland water transportation	4832	4832	642	595	2,6	2,4	-47
Urban transit systems	4851	4851	34935	34956	84,7	84,5	21
Interurban and rural bus transportation	4852	4852	11528	11494	62,7	62,5	-34
School and employee bus transportation	4854	4854	167924	166916	91,9	90,9	-1008
Charter bus industry	4855	4855	17326	15194	58,4	50,2	-2132
Other ground passenger transportation	4859	4859	8030	8014	10,1	9,5	-16
Newspaper, book, and directory publishers	5111	5111	12118	11025	2,4	2,3	-1093
Software publishers	5112	5112	10237	10135	4,0	3,8	-102
Motion picture and video industries	5121	5121	0	0	0,0	0,0	–
Radio and television broadcasting	5151	5151	0	0	0,0	0,0	–
Cable and other subscription programming	5152	5152	0	0	0,0	0,0	–
Other information services	5191	5191	0	0	0,0	0,0	–
Securities, commodity contracts, investments	523	523	462	475	0,1	0,1	13
Legal services	5411	5411	0	0	0,0	0,0	–

Continued on next page

Table 2 – Continued from previous page

Industry	NAICS[1]	NAICS 4d[4]	GGS Employment[2]		GGS Percent[3]		GGS change
			2010	2011	2010	2011	
Architectural and related services excl. engineering services	54138	5413	71597	69774	17,7	17,0	15636
Specialized design services	5414	5414	3088	3077	2,7	2,7	-11
Computer systems design and related services	5415	5415	54792	67348	3,8	4,4	12556
Management and technical consulting services	5416	5416	68476	72121	6,8	6,7	3645
Other physical and biological research	541712	5417	33268	35706	7,8	8,2	2438
Advertising, PR, and related services	5418	5418	0	0	0,0	0,0	–
Other professional and technical services	5419	5419	0	0	0,0	0,0	–
Management of companies and enterprises	5511	5511	62630	69310	3,4	3,6	6680
Travel arrangement and reservation services	5615	5615	405	537	0,2	0,3	132
Services to buildings and dwellings	5617	5617	24557	19903	1,4	1,1	-4654
Waste collection	5621	5621	124712	131048	89,8	90,1	6336
Hazardous waste treatment and disposal	562211	5622	35287	34211	94,6	93,4	-1076
Materials recovery facilities	56292	5629	11219	12474	90,6	93,0	1255
Educational services	611	611	28789	26123	1,2	1,0	-2666
Museums, historical sites, zoos, and parks	7121	7121	20642	23696	16,2	18,1	3054
Automotive repair and maintenance	8111	8111	7757	6652	1,0	0,8	-1105
Electronic equipment repair and maintenance	8112	8112	5247	4857	5,4	4,9	-390
Commercial machinery repair and maintenance	8113	8113	5319	7200	3,1	3,9	1881
Household goods repair and maintenance	8114	8114	2811	3391	4,2	5,0	580
Grantmaking and giving services	8132	8132	2817	3662	2,3	2,9	845
Social advocacy organizations	8133	8133	20277	20800	10,6	10,7	523
Professional and similar organizations	8139	8139	7613	9695	1,8	2,3	2082

3.2.1.2 GGS 3 digits .

Following the creation of the 4-digit NAICS dataset (table 2), we decided to pursue a more general approach by opting for a **3-digit NAICS** analysis to obtain a broader view of Green Goods and Services (GGS) employment. While using the 4-digit classification allowed for a balanced level of detail, we determined that conducting the analysis at the 3-digit level would be sufficient to capture the key industry trends relevant to our study. The 3-digit NAICS codes allow grouping industries into broader categories without losing the essential distinctions necessary for understanding GGS employment distribution. This level of generalization was deemed appropriate for the scope of our analysis, as it helps to represent industry patterns more clearly while still preserving the core insights from the more detailed classifications. The resulting 3-digit dataset (table 3) thus serves to provide a higher-level perspective, striking an appropriate balance between achieving analytical clarity and maintaining sectoral differentiation.

Table 3: Green Goods and Services (GGS) 3 digits precision

Industry	NAICS[1]	NAICS 3d[4]	GGS Employment[2]		GGS Percent[3]		GGS change
			2010	2011	2010	2011	
Vegetable and melon farming	1112	111	10.045	10.701	10,7	11,3	656
Aquaculture	1125	112	382	426	6,5	7,5	44
Timber tract operations	1131	113	1.061	1.292	29,7	35,6	231
Support activities for crop production	1151	115	5.395	5.761	1,9	2,0	366
Sewage treatment facilities	22132	221	6.439	6.448	87,7	88,1	9
Residential building construction	2361	236	31.498	57.016	5,5	10,1	25518
Utility system construction	2371	237	34642	39330	9,1	9,9	4688
Building equipment contractors	2382	238	164.809	194.476	10,1	11,9	29667
Textile furnishings mills	3141	314	9461	9271	16,5	17,0	-190
Wood window and door mfg.	321911	321	18055	19041	40,1	44,8	986

Continued on next page

[1] North American Industry Classification System, 2012.

[2] GGS employment is the number of jobs related to the production of Green Goods and Services. This table reflects private ownership only.

[3] GGS percent is the percentage of the GGS employment compared to the total employment. This value is derived by dividing the GGS employment by the total employment.

[4] North American Industry Classification System at 4 digits precision.

Table 3 – Continued from previous page

Industry	NAICS[1]	NAICS 3d[4]	GGS Employment[2]		GGS Percent[3]		GGS change
			2010	2011	2010	2011	
Pulp mills	32211	322	1208	1078	20,3	18,0	-130
Petroleum and coal products mfg.	3241	324	3.244	3.278	2,9	3,0	34
Printing ink mfg.	32591	325	1357	1400	14,3	14,9	43
Tire retreading	326212	326	3.008	3.221	45,4	46,4	213
Mineral wool mfg.	327993	327	3.597	3.311	22,3	20,8	-286
Iron and steel mills and ferroalloy mfg.	3311	331	37831	33812	44,1	36,9	-4019
Metal window and door mfg.	332321	332	12213	12668	24,1	25,5	455
Turbine and turbine generator set units mfg.	333611	333	13.400	14.439	50,3	49,7	1.039
Totalizing fluid meters and counting devices	334514	334	2.488	3.302	23,0	30,0	814
Electric lamp bulb and part mfg.	33511	335	3.844	4.058	42,4	45,5	214
Motor vehicle mfg.	3361	336	12.740	11.888	8,3	7,4	-852
Office furniture and fixtures mfg.	3372	337	9.585	9.779	10,0	10,0	194
Misc. durable goods merchant wholesalers	4239	423	94.916	104.913	34,4	36,1	9997
Used merchandise stores	4533	453	110.651	118.166	88,2	88,7	7515
Sea, coastal, and Great Lakes transportation	4831	483	1.751	1.586	4,7	4,1	-165
School and employee bus transportation	4854	485	167.924	166.916	91,9	90,9	-1.008
Software publishers	5112	511	10.237	10.135	4,0	3,8	-102
Motion picture and video industries	5121	512	0	0	0,0	0,0	–
Radio and television broadcasting	5151	515	0	0	0,0	0,0	–
Other information services	5191	519	0	0	0,0	0,0	–
Securities, commodity contracts, investments	523	523	462	475	0,1	0,1	13
Architectural and related services excl. engineering services	54138	541	71.597	69.774	17,7	17,0	-1823
Management of companies and enterprises	5511	551	62.630	69.310	3,4	3,6	6680
Services to buildings and dwellings	5617	561	24.557	19.903	1,4	1,1	-4654
Hazardous waste treatment and disposal	562211	562	35.287	34.211	94,6	93,4	-1076
Educational services	611	611	28.789	26.123	1,2	1,0	-2666
Museums, historical sites, zoos, and parks	7121	712	20642	23696	16,2	18,1	3054

Continued on next page

Table 3 – Continued from previous page

Industry	NAICS[1]	NAICS 3d[4]	GGS Employment[2]		GGS Percent[3]		GGS change
			2010	2011	2010	2011	
Household goods repair and maintenance	8114	811	2.811	3.391	4,2	5,0	580
Social advocacy organizations	8133	813	20277	20800	10,6	10,7	523

3.2.2 OECD's product list of environmental goods

The **Organisation for Economic Co-operation and Development** (OECD) developed an illustrative list of environmental goods to facilitate analysis of trade liberalization in the context of environmental protection. This list categorizes goods into specific environmental sectors, providing a framework for examining trade and tariff barriers associated with these goods. The primary purpose of the OECD list was analytical, designed for economic and trade studies, rather than for immediate policy implementation.

The development of the OECD list resulted from collaborative efforts involving the OECD, Eurostat, and national experts tasked with gathering and analyzing data on the environmental goods and services industry. This industry comprises activities that produce goods and services aimed at preventing, limiting, or correcting environmental damage to air, water, and soil, as well as managing issues related to waste, noise, and ecosystems. The broad definition of the environmental industry allowed for the inclusion of a wide range of goods that could be classified as environmental in nature.

To collect the data for the list, the OECD used the **6-digit Harmonized System** (HS) code nomenclature, which is a globally recognized system for classifying goods in trade and tariffs. The environmental goods identified in the list are grouped into major categories such as pollution management, cleaner technologies, and resource management. Each of these categories is further subdivided, with specific goods identified by

[1] North American Industry Classification System, 2012.

[2] GGS employment is the number of jobs related to the production of Green Goods and Services. This table reflects private ownership only.

[3] GGS percent is the percentage of the GGS employment compared to the total employment. This value is derived by dividing the GGS employment by the total employment.

[4] North American Industry Classification System at 3 digits precision.

their corresponding HS codes. For example, in the air pollution control category, products like vacuum pumps, catalytic converters, and dust collectors are included, each linked to its relevant HS code to reflect its role in mitigating air pollution (Steenblik 2005).

It is important to note that the OECD list was developed with the intention of being illustrative, not exhaustive. It was acknowledged that not all environmental goods are included, and some HS codes may cover goods that are not strictly environmental. As a result, the list provides a framework for analysis rather than a comprehensive catalog. The goal was to enable a better understanding of the environmental goods industry and its interactions with trade and tariff policies, offering a foundation for examining trade flows and tariff barriers.

In conclusion, the OECD's illustrative list of environmental goods (table 4) offers a structured approach to classifying products that contribute to environmental protection and resource management. By utilizing the 6-digit HS classification system, the list provides a valuable tool for analyzing trade flows and tariff barriers related to environmental goods. Despite its limitations, the list marks a significant step in defining the scope of the environmental goods industry for analytical purposes.

Table 4: The OECD's illustrative product list of environmental goods

Category and product description	**HS code**[1]
A. POLLUTION MANAGEMENT	
1. Air pollution control	
1.1 Air-handling equipment	
Vacuum pumps	8414.10
Compressors of a kind used in refrigerating equipment	8414.30
Air compressors mounted on a wheeled chassis for towing	8414.40
Other air or gas compressors or hoods	8414.80
Parts for air or gas compressors, fans or hoods	8414.90
1.2 Catalytic converters	
Filtering or purifying machinery and apparatus for gases	8421.39
Parts for filtering or purifying machinery	8421.99
1.3 Chemical recovery systems	
Limestone flux	2521.00
Slaked (hydrated) lime	2522.20
Magnesium hydroxide and peroxide	2816.10

Continued on next page

Table 4 – Continued from previous page

Category and product description	HS code[1]
Activated earths	
Filtering or purifying machinery and apparatus for gases[2]	8421.39
Parts for filtering or purifying machinery[2]	8421.99
1.4 Dust collectors	
Filtering or purifying machinery and apparatus for gases[2]	8421.39
Parts for filtering or purifying machinery[2]	8421.99
1.5 Separators/precipitators	
Other glass fibre products	7019.90
Machinery for liquefying air or other gases	8419.60
Other machinery for treatment of materials by change of temperature	8419.89
Filtering or purifying machinery and apparatus for gases[2]	8421.39
Parts for filtering or purifying machinery[2]	8421.99
1.6 Incinerators, scrubbers	
Other furnaces, ovens, incinerators, non-electric	8417.80
Filtering or purifying machinery and apparatus for gases[2]	8421.39
Parts for filtering or purifying machinery[2]	8421.99
Industrial or laboratory electric resistance furnaces	8514.10
Industrial or laboratory induction or dielectric furnaces	8514.20
Other industrial or laboratory electric furnaces and ovens	8514.30
Parts, industrial or laboratory electric furnaces	8514.90
1.7 Odour control equipment	
Parts for sprayers for powders or liquids	8424.90
2. Wastewater management	
2.1 Aeration systems	
Compressors of a kind used in refrigerating equipment[2]	8414.30
Air compressors mounted on a wheeled chassis for towing[2]	8414.40
Other air or gas compressors or hoods[2]	8414.80
Parts for air or gas compressors, fans or hoods[2]	8414.90
2.2 Chemical recovery systems	
Limestone flux[2]	2521.00
Slaked (hydrated) lime[2]	2522.20
Chlorine	2801.10
Anhydrous ammonia	2814.10
Sodium hydroxide solid	2815.11
Sodium hydroxide in aqueous solution	2815.12
Magnesium hydroxide and peroxide[2]	2816.10
Activated earths[2]	
Manganese dioxide	2820.10

Continued on next page

Table 4 – Continued from previous page

Category and product description	HS code[1]
Manganese oxides (other)	2820.90
Lead monoxide	2824.10
Sodium sulphites	2832.10
Other sulphites	2832.20
Phosphinates and phosphonates	2835.10
Phosphates of triammonium	2835.21
Phosphates of monosodium or disodium	2838.22
Phosphates of trisodium	2835.23
Phosphates of potassium	2835.24
Calcium hydrogenorthophosphate	2835.25
Other phosphates of calcium	2835.26
Other phosphates (excl. polyphosphates)	2835.29
Activated carbon	3802.10
Water filtering or purifying machinery and apparatus	8421.21
Other machinery for purifying liquids	8421.29
Parts for filtering or purifying machinery[2]	8421.99
2.3 Biological recovery systems	
2.4 Gravity sedimentation systems	
Flocculating agents	
2.5 Oil/water separation systems	
Other centrifuges	842119.00
Parts of centrifuges	8421.91
Water filtering or purifying machinery and apparatus[2]	8421.21
Other machinery for purifying liquids[2]	8421.29
Parts for filtering or purifying machinery[2]	8421.99
2.6 Screens/strainers	
Other articles of plastic	3926.90
Water filtering or purifying machinery and apparatus[2]	8421.21
Other machinery for purifying liquids[2]	8421.29
Parts for filtering or purifying machinery[2]	8421.99
2.7 Sewage treatment	
Flocculating agents	
Woven pile & chenille fabrics of other textile materials	5801.90
Tanks, vats, etc., > 300l	7309.00
Tanks, drums, etc., >50 l < 300 l	7310.10
Cans < 50 l, closed by soldering or crimping	7310.21
Other cans < 50 l	7310.29
Hydraulic turbines	8410.00-13[3]

Continued on next page

Table 4 – Continued from previous page

Category and product description	HS code[1]
Parts for hydraulic turbines	8410.90
Incinerators, non-electric[2]	8417.80
Weighing machines capacity <30 kg	8423.81
Weighing machines capacity >30 kg <500 kg	8423.82
Weighing machines	8423.89
Parts for sprayers for powders or liquids[2]	8424.90
Industrial/lab electric resistance furnaces[2]	8514.10
Industrial/lab induction, dielectric furnaces[2]	8514.20
Industrial/lab electric furnaces & ovens, n.e.s.[2]	8514.30
Parts, industrial & lab electric furnaces[2]	8514.90
2.8 Water pollution control, wastewater reuse equipment	
2.9 Water handling goods and equipment	
Articles of cast iron	7325.10
Root control equipment	
Positive displacement pumps, hand-operated	8413.20
Other reciprocating positive displacement pumps	8413.50
Other rotary positive displacement pumps	8413.60
Other centrifugal pumps	8413.70
Other pumps	8413.81
Valves, pressure reducing	8481.10
Valves, check	8481.30
Valves, safety	8481.40
Other taps, cocks, valves, etc.	8481.80
Instruments for measuring the flow or level of liquids	9026.10
Instruments for measuring or checking pressure	9026.20
3. Solid waste management	
3.1 Hazardous waste storage and treatment equipment	
Other articles of cement, concrete	6810.99
Other articles of lead	7806.00
Other electric space heating and soil heating apparatus	8516.29
Lasers	9013.20
Vitrification equipment[2]	
3.2 Waste collection equipment	
Household & toilet articles of plastic	3924.90
Brooms, hand	9603.10
Brushes as parts of machines, appliances	9603.50
Mechanical floor sweepers	9803.90
Trash bin liners (plastic)	

Continued on next page

Table 4 – Continued from previous page

Category and product description	HS code[1]
3.3 Waste disposal equipment	
Compactors	
Refuse disposal vehicles	
Polypropylene sheeting, etc.	3920.20
3.4 Waste handling equipment	
3.5 Waste separation equipment	
Magnetic separators	
3.6 Recycling equipment	
Magnetic separators[2]	
Machinery to clean, dry bottles, etc.	8422.20
Other mixing or kneading machines for earth, stone, sand, etc.	8474.39
Other machines for mixing/grinding, etc.	8479.82
Other machines, n.e.s., having individual functions	8479.89
Tire-shredding machinery	
3.7 Incineration equipment	
Other furnaces, ovens, incinerators, non-electric[2]	8417.80
Parts of furnaces, non-electric	8417.90
Industrial or laboratory electric resistance furnaces[2]	8514.10
Industrial or laboratory induction or dielectric furnaces[2]	8514.20
Other industrial or laboratory electric furnaces and ovens[2]	8514.30
Parts, industrial or laboratory electric furnaces[2]	8514.90
4. Remediation and cleanup	
4.1 Absorbents	
4.2 Cleanup	
Other electric space heating and soil heating apparatus[2]	8516.29
Lasers[2]	9013.20
Vitrification equipment[2]	
4.3 Water treatment equipment	
Surface active chemicals (not finished detergents)	
Oil spillage cleanup equipment	
Other electrical machines and apparatus with one function	8543.89
5. Noise and vibration abatement	
5.1 Mufflers/silencers	
Parts for spark-ignition internal combustion piston engines	8409.91
Parts for diesel or semi-diesel engines	8409.99
Silencers and exhaust pipes, motor vehicles	8708.92
5.2 Noise deadening material	
5.3 Vibration control systems	

Continued on next page

Table 4 – Continued from previous page

Category and product description	HS code[1]
5.4 Highway barriers	
6. Environmental monitoring, analysis and assessment	
6.1 Measuring and monitoring equipment	
Thermometers, pyrometers, liquid-filled	9025.11
Other thermometers, pyrometers	9025.19
Hydrometers, barometers, hygrometers, etc.	9025.80
Other instruments for measuring liquids or gases	9026.80
Parts of instruments for measuring, checking liquids or gases	9026.90
Instruments for analysing gas or smoke	9027.10
Chromatographs, etc.	9027.20
Spectrometers, etc.	9027.30
Exposure meters	9027.40
Other instruments using optical radiation	9027.50
Other instruments for physical or chemical analysis	9027.80
Parts for instruments, incl. microtomes	9027.90
Ionising radiation measuring & detecting instruments	9030.10
Other optical instruments	9031.49
Other measuring or checking instruments	9031.80
Manostats	9032.20
Hydraulic/pneumatic automatic regulate, control instruments	9032.81
Other automatic regulate, control instruments	9032.89
Auto emissions testers	
Noise measuring equipment	
6.2 Sampling systems	
6.3 Process and control equipment	
Thermostats	9032.10
Electrical process control equipment	
On-board monitoring/control	
6.4 Data acquisition equipment	
6.5 Other instruments/machines	
B. CLEANER TECHNOLOGIES AND PRODUCTS	
1. Cleaner/resource efficient technologies and processes	
Electrochemical apparatus/plant	
Extended cooking (pulp)	
Oxygen delignification	
Ultrasonic cleaning	
Fluidised bed combustion	
2. Cleaner/resource efficient products	

Continued on next page

Table 4 – Continued from previous page

Category and product description	HS code[1]
CFC substitutes	
Hydrogen peroxide	2801.10
Peat replacements (e.g. bark)	
Water-based adhesives	
Paints and varnishes, in aqueous medium, acrylic or vinyl	3209.10
Other paints and varnishes, in aqueous medium	3209.90
Double-hulled oil tankers	
Low-noise compressors	
C. RESOURCES MANAGEMENT GROUP	
1. Indoor air pollution control	
2. Water supply	
2.1 Potable water treatment	
2.2 Water purification systems	
Chlorine[2]	2801.10
2.3 Potable water supply and distribution	
Water, incl. natural or artificial mineral water	2201.00
Distilled and conductivity water	2851.00
Ion exchangers (polymer)	3914.00
3. Recycled materials	
3.1 Recycled paper	
3.2 Other recycled products	
4. Renewable energy plant	
4.1 Solar	
Instantaneous gas water heaters	8419.11
Other instantaneous or storage water heaters, non-electric	8419.19
Photosensitive semiconductor devices, incl. solar cells	8541.40
4.2 Wind	
Windmills	
Wind turbines	
4.3 Tidal	
4.4 Geothermal	
4.5 Other	
Methanol	2905.11
Ethanol	2207.10
Hydroelectric plant	
5. Heat/energy savings and management	
Catalysts	3815.00
Multiple walled insulating units of glass	7008.00

Continued on next page

Table 4 – Continued from previous page

Category and product description	HS code[1]
Other glass fibre products[2]	7019.90
Heat exchange units	8419.50
Parts for heat exchange equipment	8419.90
Heat pumps	
District heating plant	
Waste heat boilers	
Burners: fuel other than oil or gas	
Fluorescent lamps, hot cathode	8539.31
Electric cars	
Fuel cells	
Gas supply, production and calibrating metres	9028.10
Liquid supply, production and calibrating metres	9028.20
Thermostats[2]	9032.10
6. Sustainable agriculture and fisheries	
7. Sustainable forestry	
8. Natural risk management	
Satellite imaging	
Seismic instruments	
9. Eco-tourism	
10. Other	

3.3 Data elaboration

All data analysis in this study has been conducted using the statistical software **Stata**[4], a robust tool widely employed in econometrics and statistical research. Stata allows for comprehensive data management, statistical analysis, and graphical representation, making it ideal for handling complex datasets such as those used in this research. Its capacity to manage large volumes of data and execute sophisticated regression models ensures the reliability and precision of the findings presented.

In this analysis, two distinct yet parallel approaches are pursued to assess sustainability. The first approach uses the Green Goods and Services **(GGS)** table, focusing

[1] Harmonized System Code.
[2] Indicates that the HS code appears previously in the table.
[3] Indicating all the HS Code between 8410.00 and 8410.13.
[4] Stata IC 16.0.

on industries classified by the **3-digit NAICS** codes. This industry-based classification enables the study to track employment trends within sectors engaged in green production. By aggregating data at the 3-digit level, the analysis captures broader industry patterns while maintaining enough specificity to highlight key trends in green employment.

The second line of analysis applies the **OECD** table, which utilizes the **Harmonized System (HS)** codes to classify environmental goods. This product-based approach examines the trade of goods contributing to environmental sustainability, offering a complementary perspective to the industry-based NAICS classification. The HS code system allows for the identification of specific products within global trade flows, enabling the study to analyze how these goods interact with international markets and contribute to broader sustainability goals.

In the following sections, detailed explanations will be provided on how the data from these two classifications were processed. For both the NAICS-based and HS-based analyses, Stata's advanced capabilities were used to clean, organize, and analyze the data, ensuring a rigorous approach to understanding sustainability through these two complementary lenses.

3.3.1 Employment in GGS with 3 digits NAICS

3.3.1.1 Creation of GGS dataset .

The creation of the Green Goods and Services (GGS) dataset began by organizing and sorting the data according to NAICS codes at the 3-digit precision. This level of detail allows for a focused analysis of industries engaged in green production, providing a balance between specificity and generalization. The resulting dataset, referred to as table 3, offers a structured and comprehensive overview of GGS employment by sector. Once the dataset was constructed, it was imported into Stata and converted into a file with the *.dta* extension, ensuring compatibility with the statistical software. Following the conversion, further manipulation was performed, including renaming the column containing the NAICS 3-digit code to "*code 3d*" to standardize it for subsequent merging operations with other datasets.

Algorithm 1: Stata code: from GGS Table to GGS Table modified

Data: GGS Table

Result: GGS Table modified

```
begin
    * Open the GGS table dataset;
    clear;
    use GGS table 3d.dta;
    * Rename the column for the merge;
    rename NAICS 3d code 3d;
```

3.3.1.2 Adaption of the Trade Sample dataset .

Following this, attention was turned to the Trade Sample dataset (Table 1), which required adaptation before it could be integrated into the analysis. Using a specific Stata algorithm (detailed after in Algorithm 2), the dataset was cleaned by removing columns that were not relevant to the analysis. This step was crucial to streamline the dataset and focus only on variables pertinent to the study's objectives. In addition to cleaning, the columns were renamed to improve clarity and ease of use. Most importantly, the column designated for merging the datasets, a critical aspect for performing cross-dataset operations, was renamed to "*code 3d*". This renaming aligned the key identifier with the 3-digit NAICS codes, facilitating the seamless integration of the GGS and Trade Sample datasets for the analysis to follow.

Algorithm 2: Stata code: from Trade Sample to Trade Sample modified

Data: Trade Sample

Result: Trade Sample modified

```
begin
    * Open file;
    clear;
    use trade sample.dta;
    * Rename and drop some of the column for the merge;
    rename anno year;
    drop ateco2007 str;
    rename paese country;
    rename provincia province;
    * Rename column for merge;
    rename ateco2007 3d str code 3d;
```

3.3.1.3 Merging .

A merge in data analysis involves combining two or more datasets based on a shared key variable, aligning records that correspond across these datasets. This process allows for the **integration** of related but separate data sources into a single, cohesive dataset, facilitating a more comprehensive and detailed analysis. In this study, we merged the **Trade Sample dataset** (Table *trade sample modified*) with the **Green Goods and Services (GGS) dataset** (Table *GGS Table modified*) using the NAICS 4-digit code as the key column, labeled "code 4d". The NAICS 4-digit code is a detailed industry classification code used to identify specific industries at a finer level of precision, thus allowing us to merge company-level data from the Trade Sample with corresponding industry information from the GGS dataset.

Although the Trade Sample dataset (Table 1) classifies industries using the ATECO system, and the GGS dataset (Table 3) uses the NAICS system, no conversion between these two classification systems was necessary. This is because the NAICS and ATECO classifications are coincident, meaning they align perfectly without any discrepancies. This feature simplified the merging process, as no additional transformation of industry codes was required, allowing for a direct comparison of the datasets.

The merging process was executed in Stata, a statistical software that allows for complex data operations with precision. We used the _merge = 2 option in Stata, which ensures that only the values originally present in the *Trade Sample dataset* were retained. This decision was made to focus the analysis solely on the trade data, while still enriching it with the relevant information from the *GGS dataset* wherever applicable. By using this option, we excluded any records from the GGS dataset that did not have corresponding entries in the Trade Sample, ensuring that the final dataset remained relevant to our specific scope of analysis.

Once the merging operation was completed, additional data manipulation was performed to prepare the dataset for analysis. This involved renaming several columns to standardize the labeling, making the dataset easier to work with. Additionally, unnecessary columns that did not contribute to the analysis were deleted to streamline the data and focus on the key variables. During this process, we also created new columns to support future analyses. One such column, **"***offshoring 4d***"**, was designed to identify whether a given transaction qualified as offshoring. This was determined by comparing the 4-digit ATECO code of the transaction with the 4-digit code of the company. If the codes concur, the transaction was classified as offshoring, meaning the company sourced goods or services from a different industry.

Similarly, another column called “$offshoring\ 3d$” was created, applying the same logic but using 3-digit ATECO codes. This allowed us to analyze offshoring at a slightly broader industry level, providing insights into whether companies outsourced within the same broader industry category or across different sectors altogether. These newly created columns will play a crucial role in the later stages of the study, particularly in assessing the prevalence and patterns of offshoring within different sectors of the economy. By analyzing offshoring at both the 3-digit and 4-digit levels, the study gains the flexibility to examine industry relationships with varying degrees of specificity, enabling a deeper understanding of the dynamics involved in sourcing decisions.

Algorithm 3: Stata code: Merge Trade Sample modified and GGS Table modified Part 1

Data: Merge Trade Sample modified, GGS Table modified

Result: Trade Sample Merged

```
begin
    use "trade sample modified", replace;
    merge m:m code 3d using "GGS table modified.dta";
    drop if _merge == 2;
    rename code 3d ateco2007 3d str;
    * Define if transaction is an import or export gen import=. ;
    replace import = 1 if import val != . ;
    replace import = 0 if import val == . ;
    label define Import 1 "Import" 0 "Export";
    label values import Import;
    * Define if it is a transaction of offshoring;
    gen offshoring 4d=. ;
    replace offshoring 4d = 1 if ateco2007impr 4d == ateco2007 4d;
    replace offshoring 4d = 0 if ateco2007impr 4d != ateco2007 4d;
    label variable offshoring 4d "Offshoring comparing ateco2007 in 4d";
    gen offshoring 3d=. ;
    replace offshoring 3d = 1 if ateco2007impr 3d == ateco2007 3d;
    replace offshoring 3d = 0 if ateco2007impr 3d != ateco2007 3d;
    label variable offshoring 3d "Offshoring comparing ateco2007 in 3d";
    label define Offshoring 1 "Yes" 0 "No";
    label values offshoring 4d Offshoring;
    label values offshoring 3d Offshoring;
    * Clean column drop ateco2007impr;
    drop ateco2007impr str;
    drop ateco2007impr 5d str;
    drop ateco2007impr 5d;
```

Algorithm 4: Stata code: Merge Trade Sample modified and GGS Table modified Part 2

Data: Merge Trade Sample modified, GGS Table modified

Result: Trade Sample Merged

```
begin
    drop ateco2007impr 4d, str ateco2007impr 3d, str ateco2007 4d;
    drop movim;
    drop GGS 2010, GGS 2011, GGS perc 2010, GGS change, NAICS _merge;
    drop manufacturing, ateco2007impr 3d, ateco2007 3d, industry;
    replace GGS perc 2011 = 0 if GGS perc 2011 == . ;
    drop _merge;
```

3.3.2 OECD's product list of environmental goods with HS code

Creation of HS dataset .

The creation of the **HS dataset** began with the importation of data from the **OECD's product list** of environmental goods, classified using the Harmonized System (HS) codes (Table 4). This product list, designed to categorize goods that contribute to environmental sustainability, provides an essential framework for analyzing trade in environmentally beneficial products. The dataset was imported into Stata[1] and converted into a file with the *.dta* extension to facilitate further analysis. Unlike the GGS dataset, no modifications were made to the existing columns during this initial step, as the original structure was preserved to ensure the integrity of the data.

However, to prepare the HS dataset for merging with the Trade Sample dataset, some additional adjustments were necessary. An extra column was created to convert the *HS code* from its original numeric format into a string format, a step required for compatibility during the merging process. This conversion ensures that the HS codes align properly between the two datasets, avoiding issues related to differing data types.

Additionally, a new column titled **"***Green HS***"** was added to the HS dataset. This column will later serve to identify environmental goods after the merge with the Trade Sample dataset. By tagging products that fall under the HS codes listed in the OECD's environmental goods list, the "*Green HS*" column enables the analysis to focus specifically on environmentally significant trade flows.

The OECD's product list includes detailed descriptions of various environmental goods,

[1] Stata IC 16.0

each corresponding to a **6-digit HS code**. This HS code system is an internationally standardized method for classifying traded goods. It consists of 6 digits, where the first two represent the product's chapter, the next two define the heading, and the final two digits provide a more detailed subheading. This globally recognized classification system facilitates consistent trade analysis across countries, making it an essential tool for evaluating international trade patterns, particularly for goods that contribute to environmental sustainability. Retaining all original columns in the OECD list while adding the new "*Green HS*" column ensures that the dataset remains comprehensive and well-prepared for future analyses focused on environmental goods.

Algorithm 5: Stata code: HS table creation

Data: HS Table

Result: HS Table Merged

```
begin
    * Open the HS table dataset;
    clear;
    use HS table.dta;
    * Convert HS code from number format to string format;
    rename HS code HS code num;
    generate HS code = string(HS code num, "%12.0f");
    * Generate new column HS Green;
    generate HS Green = "Yes";
```

3.3.2.1 Adaption of the Trade Sample dataset .

Before merging the *Trade Sample dataset* with the *HS dataset*, it was necessary to make certain adjustments to ensure compatibility between the two datasets. Specifically, a key column was needed to match the HS codes in the OECD's product list. To facilitate this, an additional column named "*HS code*" was created in the Trade Sample dataset. This column was derived from the existing $NC8$ variable, which is an 8-digit product classification system used in European trade statistics, offering more detailed product information than the standard 6-digit HS code. To align the data with the HS codes in the OECD list, the last two digits of the NC8 code were removed, reducing it to the 6-digit HS code. This modification ensured that both datasets could be merged based on the standardized HS classification, allowing for a smooth integration of trade data with environmental goods information.

Algorithm 6: Stata code: Trade sample modified for matching with HS table

Data: Trade Sample

```
begin
    * Open file;
    clear;
    use trade sample.dta;
    * Convert NC8 from number format to string format;
    generate str NC8 = string(NC8, "%12.0f");
    * Generate new column HS code;
    generate HS code = substr(str NC8, 1, 6);
    drop str NC8;
```

3.3.2.2 Merging .

The merging process between the modified *HS dataset* (table modified in the Paragraph 3.3.2) and the adapted *Trade Sample dataset* (look at the Paragraph 9) was executed using the *HS code* in string format as the key column. This shared identifier ensured a precise alignment of product data between the two datasets, allowing for the integration of trade information with the environmental goods classification from the OECD's product list. The HS code, now in string format in both datasets, facilitated an efficient and accurate merge, ensuring consistency across the combined data.

The merge was performed using the _merge = 2 option in Stata, which preserved all the original entries from the Trade Sample dataset while adding the additional details provided by the HS dataset. This approach allowed us to maintain the full scope of the trade sample while enriching it with the environmental classifications brought in through the OECD list. The option ensured that no data was lost from the trade sample, while still gaining the valuable information related to environmental goods. As a result, each trade record in the merged dataset retained its original structure but was supplemented with the newly created "*Green HS*" column from the HS dataset.

The "*Green HS*" column, introduced during the creation of the HS dataset, plays a crucial role in identifying which products are classified as environmentally significant according to the OECD's environmental goods list. This column enables the merged dataset to highlight specific trade flows that involve green products, enhancing the analytical capabilities of the study. Moreover, this structure allows for a seamless integration of trade data and environmental classifications, ensuring that the analysis remains focused on understanding the patterns and impacts of trade in sustainable products. Thus, the merge not only preserves the integrity of the original trade data but also enhances it with a layer of environmental significance that will be key for the subsequent stages of the analysis.

Algorithm 7: Stata code: HS Table merge with Trade Sample Table

Data: HS Table, Trade Sample Table

```
begin
    use trade sample.dta;
    merge m:m HS code using HS table.dta;
    drop if _merge == 2;
    drop _merge;
```

3.3.3 Resulting Dataset

The final merging step involved combining the two resulting datasets: the one created from the *HS dataset* (generated in the Paragraph 9) and the other from the *NAICS dataset* (look at the Paragraph 11 for details on the table), both of which had been merged individually with the Trade Sample dataset. The key column for this merge was the **transaction ID** (referred to as "*id*"), which is present in the *Trade Sample dataset*. Since both datasets originated from the same base data (the Trade Sample), the merge was perfect, ensuring complete alignment and no loss of information. This merging process simply added the additional variables derived from the HS and NAICS datasets to the corresponding transactions without creating any discrepancies.

Following the merge, it was necessary to **clean** the resulting dataset by removing unnecessary columns and duplicated data that had been introduced during the merging process. This included columns that were redundant or irrelevant for the analysis, streamlining the dataset to focus solely on the variables of interest. This step ensured that the dataset remained concise and organized, making it easier to manage and analyze.

Once the dataset was cleaned, a thorough review was conducted to ensure that all columns were properly filled and labeled. For instance, the column "*developed*" required attention as it contained undefined values for certain countries. These undefined entries were updated with appropriate values to ensure consistency across the dataset. Additionally, a label was added to this column for clarity, providing a better understanding of what the “*developed*” classification represented in terms of the countries involved in the transactions.

A similar procedure was applied to the “*GGS Green*” column, which was created based on the “*GGS perc* 2011” variable. This column was used to classify transactions as either green (labeled “*yes*”) or non-green (labeled “*no*”) based on the percentage of green goods and services (GGS) reported in 2011. To make this classification, a threshold of 50% was applied to the GGS perc 2011 variable (discussed in detail in Paragraph 3.2.1). Transactions where 50% or more of the goods or services were classified as green were labeled as “*yes*” in the “*GGS Green*” column, while those below this threshold were labeled “*no*”. This classification was essential for identifying which transactions were primarily linked to environmentally sustainable activities, further enriching the dataset for future analysis.

With the merging and data cleaning complete, the dataset was fully prepared for the next stage of analysis. All redundant information was removed, undefined values were corrected, and columns necessary for the study were carefully filled and labeled. An extract of the final dataset resulting from all the edits and modifications can be found behind (Table 5), showcasing the cleaned and fully processed data ready for analysis.

Algorithm 8: Stata code: HS Table merge with Trade Sample Table Part 1

Data: HS Table merged, GGS Table merged

Result: Final Dataset

```
begin
    clear;
    use "GGS Table merged.dta"
    merge m:m id using "HS Table merged.dta";
    drop province ateco2007impr 4d str, ateco2007impr 4d, ateco2007impr 3d str;
    drop ateco2007 4d str, ateco2007 4d, NAICS 4d, anno, ateco2007 str;
    drop provincia, movim, ateco2007impr, ateco2007impr str, ateco2007impr 5d str, ateco2007impr 5d;
    drop ateco2007impr 3d, manufacturing, ateco2007 3d str, paese;
    drop Categoryandproductdescription, HScode num, _merge, NC8, ateco2007, code 3d;
    * Fill the HS Green column for the non Green products into the dataset;
    replace HS Green = "No" if HS Green == "";
    * Fill the developed column, adding the label for better understanding;
    replace developed=2 if developed == . ;
    label define dev 1 "Yes" 0 "No" 2 "Not defined";
    label values developed dev;
```

Algorithm 9: Stata code: HS Table merge with Trade Sample Table Part 2

Data: HS Table merged, GGS Table merged

Result: Final Dataset

```
begin
    *Create a new column for the classification of the Green products according to the GGS table;
    replace GGS Green = 1 if GGS perc 2011 >= 50;
    replace GGS Green = 0 if GGS perc 2011 < 50;
    label define green 1 "Yes" 0 "No";
    label values GGS Green dev;
    save "final dataset.dta";
```

Table 5: Final Dataset Sample

id	year	firmid	country	imp[1]	exp[2]	dev[3]	GGSperc[4]	import	OF[5]4d	OF[5]3d	ateco[6]	HScode	HS_Green	GGS_Green
69280	2008	1822	1		8559	Yes	0	Export	No	No	329	950510	No	No
69281	2008	2444	1	44621		Yes	0	Import	No	No	282	841899	No	No
69282	2008	2444	1	2985		Yes	0	Import	No	No	282	841790	Yes	No
69283	2008	2444	1	57880		Yes	0	Import	No	No	139	591132	No	No
69284	2008	3121	1	51		Yes	0	Import	No	No	329	960622	No	No
69285	2008	4390	1	1221		Yes	0	Import	No	No	329	960810	No	No
69286	2008	2444	1	30003		Yes	0	Import	No	No	309	871680	No	No
69287	2008	2185	1		2990	Yes	0	Export	No	No	203	320730	No	No
69288	2008	4583	1		22	Yes	0	Export	Yes	Yes	132	521039	No	No
69289	2008	4670	1		677954	Yes	0	Export	Yes	Yes	132	511130	No	No
69290	2008	4653	1		12137	Yes	0	Export	Yes	Yes	132	551519	No	No
69291	2008	4037	1		164846	Yes	0	Export	No	No	259	761699	No	No
69292	2008	4235	1		5245	Yes	0	Export	Yes	Yes	289	847790	No	No
69293	2008	3929	1		996	Yes	0	Export	Yes	Yes	132	520813	No	No
69294	2008	1135	1		4713	Yes	0	Export	No	Yes	141	621040	No	No
69295	2008	1648	1		27559	Yes	0	Export	No	No	124	809301	No	No
69296	2008	2473	1		2369	Yes	0	Export	No	Yes	310	940130	No	No

[1] Import value.
[2] Export Value.
[3] Developed.
[4] GGS_perc_2011.
[5] OffShoring.
[6] Ateco 2007 3 digits.

4 Results of the Analysis

4.1 Assumptions

In this paper, several assumptions have been made to facilitate the analysis. These assumptions should be carefully considered when interpreting the results presented in the following sections. The methodology and data employed come with inherent limitations, and acknowledging these constraints is essential for understanding the findings of this study. Below, we outline the key assumptions and their implications.

4.1.1 Statistical Sampling on the Dataset

The assumptions and measures taken to ensure data quality during the sampling and collection process of the Intrastat dataset are critical to the **reliability** and **validity** of the statistics generated. One of the primary assumptions relates to the **statistical sampling** used in this analysis. While the dataset contains over 2.7 million observations, it does not cover the entire universe of global trade transactions. This means that many transactions have been excluded from the scope of the study. As a result, the conclusions drawn reflect only a subset of all potential trade activities, and certain trends or patterns that might exist in the broader trade environment may not be fully captured. When analyzing the results, it is important to bear in mind that the dataset represents a sample of the overall population, which may limit the generalizability of the findings to all trade flows. However, given the large size and comprehensive nature of the sample, the analysis can still provide valuable insights.

In the Intrastat system, data quality is ensured through several mechanisms. Firstly, the threshold-based reporting system ensures that the dataset captures a significant portion of Italy's intra-EU trade. Businesses that exceed the trade thresholds (set by EU regulations) are required to submit more frequent and detailed reports, which helps to ensure that the bulk of trade is regularly monitored. Although smaller businesses are allowed to report less frequently, the assumption is that their overall contribution to the trade volume is sufficiently low not to skew the overall statistics.

The **dataset's quality** is also maintained through rigorous validation processes applied by the Italian National Institute of Statistics (ISTAT). Once the data are collected, they are subjected to a series of statistical checks to identify any inconsistencies or errors. These checks include comparing the declared values with historical data, verifying the accuracy of the classifications (such as the Combined Nomenclature for goods), and ensuring that the reported transaction values and quantities are plausible. In case of any discrepancies, businesses may be contacted for clarification, and necessary corrections are made to ensure the accuracy of the data.

The sampling process is structured to maximize the **representativeness of the data**. Although Intrastat does not involve a random sampling process per se, the use of reporting thresholds ensures that the most significant contributors to Italy's intra-EU trade are captured. This method ensures that statistical values derived from the dataset, such as trade balances, growth rates, and commodity flows, are based on comprehensive data. For businesses that fall below the reporting thresholds, statistical methods such as imputation or extrapolation may be used to estimate their contribution to the overall trade volume.

One of the primary assumptions relates to the statistical sampling used in this analysis. While the dataset contains over 2.7 million observations, it does not cover the entire universe of global trade transactions. This means that many transactions have been excluded from the scope of the study. As a result, the conclusions drawn reflect only a subset of all potential trade activities, and certain trends or patterns that might exist in the broader trade environment may not be fully captured. When analyzing the results, it is important to bear in mind that the dataset represents a sample of the overall population, which may limit the generalizability of the findings to all trade flows. However, given the large size and comprehensive nature of the sample, the analysis can still provide valuable insights.

In addition to these procedures, timeliness and completeness of the data are key quality dimensions monitored throughout the collection and processing stages. Data submissions are expected to occur within set deadlines, and delays or missing reports are addressed through follow-ups. This ensures that the dataset is not only accurate but also up-to-date, allowing for more timely economic analysis and decision-making.

The overall confidence in the Intrastat data stems from the robust legal framework under which the data is collected, the established processes for ensuring compliance, and the continuous data monitoring and correction mechanisms that are in place. This ensures that the dataset is of high quality, providing valuable insights into Italy's economic exchanges within the European Union and supporting a variety of policy and economic planning activities.

4.1.2 Sustainability Assumptions

The second set of assumptions involves **sustainability** considerations. This analysis relies on two main studies: the *OECD's* environmental goods classification (Harris et al. 2002) and the *Bureau of Labor Statistics* **(BLS)** Green Goods and Services (GGS) classification (United States 2012). Both studies focus on the **environmental impact** of the production processes of goods and services, but they do not consider the environmental footprint of the transportation of these goods. Therefore, while the sustainability of production is assessed, the greenness of transporting these products across global supply chains is not factored into the analysis. This exclusion can be significant, as transportation contributes to carbon emissions and environmental degradation, yet it falls outside the scope of this study due to data limitations.

Furthermore, the analysis does not address the other two pillars of sustainability as defined by the United Nations (UN): **economic sustainability** and **social sustainability** (United Nations 1987). Economic sustainability considers the long-term viability of production methods in terms of profitability and resource use, while social sustainability focuses on fair labor practices, community development, and equity. These aspects are critical for a holistic view of sustainability, but the available data in this study focuses exclusively on the environmental impact of production. The lack of economic and social sustainability data limits the analysis to one dimension of sustainability, which should be acknowledged when interpreting the results.

An additional assumption in this context is the application of the OECD and BLS studies to the entire dataset, regardless of the geographical location of the transaction. The *OECD* study focuses on Europe's manufacturing sector, while the *BLS* study pertains to USA's manufacturing and service sectors. However, in this analysis, we extend the sustainability classifications from these regions to all transactions in the dataset, even for countries outside Europe and the USA. This means that a product classified as "*green*" in Europe or the USA is assumed to be green globally, whether produced in a developed or non-developed country. This is a strong assumption, and while it introduces potential bias, it was necessary due to the limited availability of comparable sustainability data from other countries. The results, therefore, reflect this generalization and should be interpreted with caution in terms of global applicability.

To all this add additional assumptions related to the green sustainability. In particular for the GGS it was used the **3 digits precision** as it was a sufficient details and it provides an enough good results. Again, for the GGS, the assumption taken is related to the **50% threshold** taken as the limit between green and non green products and services. This is because we wanted to have a more rigid classification for better identification of the real green transactions. The results of this last assumptions will be clearly visible in the analysis process.

4.1.3 Temporal Assumptions

Another important assumption pertains to the **timing** of the sustainability studies used in this paper. The BLS study is based on data from 2011, which was released in 2013, and is the most recent dataset available for the USA, as the BLS ceased collecting green jobs data after 2013. Similarly, the $OECD$ study dates back to 2003, and no subsequent updates have been made available. Despite the age of these studies, we apply their sustainability classifications to the entire period covered by the dataset, **from 2008 to 2019**. This approach assumes that the sustainability profile of products and sectors has remained constant over this period, even though we recognize that industries may have evolved, and new technologies or standards could have emerged in recent years.

By applying these older sustainability classifications to the full dataset, we lose the ability to track any potential evolution in the sustainability of products over time. For instance, industries that were classified as non-green in 2003 or 2011 may have adopted more sustainable practices in subsequent years, but this would not be reflected in our analysis. As a result, there is no indication of changing environmental impacts or improvements in green technology during the later years of the dataset. This is an inherent limitation of relying on static classifications, and it should be considered when interpreting the findings.

4.1.4 Precision and Threshold Assumptions in Green Goods and Services (GGS)

In the context of green sustainability, additional assumptions were applied, particularly concerning the classification of Green Goods and Services (GGS). The analysis used a three-digit precision for classifying GGS, as this was considered sufficient for identifying green transactions with a high level of detail while maintaining manageable complexity in the data. This precision strikes a balance between granularity and accuracy, producing results that are robust for the purposes of this study.

Another key assumption is the use of a 50% threshold to distinguish between green and non-green products and services. This threshold was chosen to create a more rigid classification, ensuring that only transactions meeting a higher standard of "greenness" were included. This decision was taken to sharpen the identification of truly green transactions, as opposed to including those with only marginal green characteristics. The impact of this assumption will be further illustrated in the analysis of results, where the threshold is expected to produce clearer distinctions between green and non-green goods.

4.1.5 Developed and Undeveloped Countries classification

In this study, the classification of countries as developed or undeveloped was based on the **International Monetary Fund (IMF) Country Composition of World Economic Outlook (WEO) groups**, specifically from the 2018 version (International Monetary Fund 2023). The IMF's classification system distinguishes between advanced economies and emerging market and developing economies. This division is widely used in economic research and policy discussions due to its comprehensive nature and the extensive criteria applied to categorize nations based on their economic status and growth potential.

The IMF's 2018 classification is grounded in multiple indicators, including per capita income levels, export diversification, and degree of integration into the global financial system. Advanced economies, often referred to as developed economies, are those that demonstrate higher levels of industrialization, technological advancement, and relatively stable institutions. They tend to have a higher gross domestic product (GDP) per capita, diversified economies not overly reliant on a single export commodity, and sophisticated financial markets that are well-integrated into the global economy.

On the other hand, the IMF classifies countries as emerging market and developing economies when they are characterized by lower per capita income levels, economies that are less diversified, and financial systems that are less integrated into global markets. These countries often experience more volatile economic growth, with greater exposure to external shocks. Notably, some countries that were classified as developing in previous versions of the IMF WEO groups, such as China, have since undergone substantial economic transformations. China, for example, while still categorized as a developing economy by the IMF in 2018, has made significant strides in terms of industrial capacity, technological advancement, and global economic influence, thus raising questions about the relevance of older classifications for certain nations.

The data used in this study relies on the IMF's 2018 classification to maintain consistency across timeframes and facilitate historical comparisons. Following this text, the complete IMF tables from the 2018 WEO groups are presented, which provide the detailed composition of countries classified as advanced or emerging market and developing economies during the year of analysis (Tables 6, 7, 8, 9, 10, 11 and 12).

Table 6: Euro Area IMF Countries (International Monetary Fund 2023)

Euro Area		
Austria	Germany	Malta
Belgium	Greece	The Netherlands
Croatia	Ireland	Portugal
Cyprus	Italy	Slovak Republic
Estonia	Latvia	Slovenia
Finland	Lithuania	Spain
France	Luxembourg	

Table 7: Advanced Economies IMF Countries (International Monetary Fund 2023)

Advanced Economies		
Andorra	Hong Kong SAR	Norway
Australia	Iceland	Portugal

Continued on next page

Advanced Economies		
Austria	Ireland	Puerto Rico
Belgium	Israel	San Marino
Canada	Italy	Singapore
Croatia	Japan	Slovak Republic
Cyprus	Korea	Slovenia
Czech Republic	Latvia	Spain
Denmark	Lithuania	Sweden
Estonia	Luxembourg	Switzerland
Finland	Macao SAR	Taiwan Province of China
France	Malta	United Kingdom
Germany	The Netherlands	United States
Greece	New Zealand	

Table 8: Major Advanced Economies (G7) IMF Countries (International Monetary Fund 2023)

Major Advanced Economies (G7)		
Canada	Germany	Japan
France	Italy	United Kingdom

Table 9: Other Advanced Economies IMF Countries (International Monetary Fund 2023)

Other Advanced Economies		
Andorra	Israel	San Marino
Australia	Korea	Singapore
Czech Republic	Macao SAR	Sweden
Denmark	New Zealand	Switzerland
Hong Kong SAR	Norway	Taiwan Province of China
Iceland	Puerto Rico	

Table 10: European Union IMF Countries (International Monetary Fund 2023)

European Union		
Austria	France	Malta
Belgium	Germany	The Netherlands

Continued on next page

European Union		
Bulgaria	Greece	Poland
Croatia	Hungary	Portugal
Cyprus	Ireland	Romania
Czech Republic	Italy	Slovak Republic
Denmark	Latvia	Slovenia
Estonia	Lithuania	Spain
Finland	Luxembourg	Sweden

Table 11: ASEAN-5 IMF Countries (International Monetary Fund 2023)

ASEAN-5		
Indonesia	Philippines	Thailand
Malaysia	Singapore	

Table 12: Emerging and Developing Economies IMF Countries (International Monetary Fund 2023)

Emerging and Developing Economies		
Afghanistan	Guatemala	Peru
Albania	Guinea	Philippines
Algeria	Guinea-Bissau	Poland
Angola	Guyana	Qatar
Antigua and	Haiti	Republic
Argentina	Honduras	Republic of Congo
Armenia	Hungary	Romania
Aruba	India	Russia
Azerbaijan	Indonesia	Rwanda
Bahrain	Iran	Samoa
Bangladesh	Iraq	São Tomé and Príncipe
Barbados	Jamaica	Saudi Arabia
Barbuda	Jordan	Senegal
Belarus	Kazakhstan	Serbia
Belize	Kenya	Seychelles
Benin	Kiribati	Sierra Leone
Bhutan	Kosovo	Solomon Islands
Bolivia	Kuwait	Somalia
Bosnia and Herzegovina	Kyrgyz Republic	South Africa

Continued on next page

Emerging and Developing Economies		
Botswana	Lao P.D.R.	South Sudan
Brazil	Lebanon	Sri Lanka
Brunei Darussalam	Lesotho	St. Kitts and Nevis
Bulgaria	Liberia	St. Lucia
Burkina Faso	Libya	St. Vincent and the Grenadines
Burundi	Madagascar	Sudan
Cabo Verde	Malawi	Suriname
Cambodia	Malaysia	Syria
Cameroon	Maldives	Tajikistan
Central African	Mali	Tanzania
Chad	Marshall Islands	Thailand
Chile	Mauritania	The Bahamas
China	Mauritius	The Gambia
Colombia	Mexico	Timor-Leste
Comoros	Micronesia	Togo
Costa Rica	Moldova	Tonga
Côte d'Ivoire	Mongolia	Trinidad and Tobago
Democratic Republic of the Congo	Montenegro	Tunisia
Djibouti	Morocco	Türkiye
Dominica	Mozambique	Turkmenistan
Dominican Republic	Myanmar	Tuvalu
Ecuador	Namibia	Uganda
Egypt	Nauru	Ukraine
El Salvador	Nepal	United Arab
Emirates	Nicaragua	Uruguay
Equatorial Guinea	Niger	Uzbekistan
Eritrea	Nigeria	Vanuatu
Eswatini	North Macedonia	Venezuela
Ethiopia	Oman	Vietnam
Fiji	Pakistan	West Bank and Gaza
Gabon	Palau	Yemen
Georgia	Panama	Zambia
Ghana	Papua New Guinea	Zimbabwe
Grenada	Paraguay	

Additionally, this study incorporates the classification system provided by the **United Nations Development Programme (UNDP)**, which is based on the **Human De-**

velopment Index (HDI) (United Nations Development Programme 2024). The HDI is a composite index that measures a country's average achievements in three basic dimensions of human development: life expectancy at birth (as an indicator of health), mean years of schooling and expected years of schooling (as indicators of education), and gross national income per capita (as an indicator of standard of living). By combining these three key factors, the HDI provides a more holistic understanding of a country's development status than purely economic measures like GDP.

For this analysis, the HDI data from the 2024 report, which uses statistics collected in 2022, has been used. This allows for a more up-to-date and comprehensive assessment of development compared to the 2018 IMF classification. The HDI not only reflects a country's economic capacity but also incorporates important **social dimensions** that are crucial to understanding human well-being and the real quality of life experienced by a population. By including this classification alongside the IMF's division, the study seeks to present a broader and more nuanced analysis of the countries' development levels, allowing for a deeper exploration of the impacts and implications of each classification system.

For the purposes of this study, countries have been divided into **two primary group**s based on their **HDI scores**: those classified as developed have an HDI of 0.80 or higher, while those with an HDI below 0.80 are categorized as developing or undeveloped. This binary division simplifies the comparison and allows for clearer insights into the relationship between different development classifications. The full list of countries and their HDI rankings as used in this study is available in the annex (Table 31).

4.2 Data Analysis

In this section, we will conduct a detailed analysis of the data that has been previously described and manipulated. The dataset, after undergoing cleaning, merging, and processing, will now be examined to uncover insights related to international trade and sustainability. Each of the following paragraphs will provide a comprehensive examination of the variables within the dataset, their relationships, and their implications for the study.

4.2.1 General overview analysis

The analysis of Italian trade data for the period 2008-2019, spanning 12 years, reveals that the total **import** value over this period amounted to **114,266 million EUR**, while the total **export** value was **227,260 million EUR**. This substantial difference highlights a significant trade surplus, with the value of exports more than doubling that of imports during the analyzed period. This surplus reflects the strong export-oriented nature of the economy under study, with considerably more goods being sold abroad than purchased from other countries.

To gain further insights, we can calculate the average annual import and export values over the 12-year period. The average import per year is approximately $9,522$ *million EUR*, while the average export per year amounts to $18,938$ *million EUR*. This shows a consistent pattern of exports significantly outpacing imports year after year, contributing to a sustained trade surplus. On average, the export value is nearly twice the import value annually, reinforcing the notion that this economy is more focused on exporting goods than relying on imports.

The relationship between imports and exports can also be analyzed through their ratio. The **import-to-export ratio** over the period is **0.50**, indicating that for every dollar of goods imported, approximately two dollars' worth of goods are exported. This reflects a strong position in global trade, where the economy in question appears to generate considerable value through its exports, while maintaining relatively modest import levels.

This statistical overview sets the stage for a more detailed analysis of the composition and sustainability of trade flows, particularly the green classification of goods, which will be explored in subsequent sections. Understanding these trade dynamics is crucial for contextualizing the environmental impact and sustainability of international trade practices.

4.2.2 Export and Import evolution

The graph (Figure 2) illustrates the evolution of exports and imports from 2008 to 2019, with exports represented in green and imports in orange. Throughout the observed period, exports consistently outpace imports, and both categories exhibit an **upward**

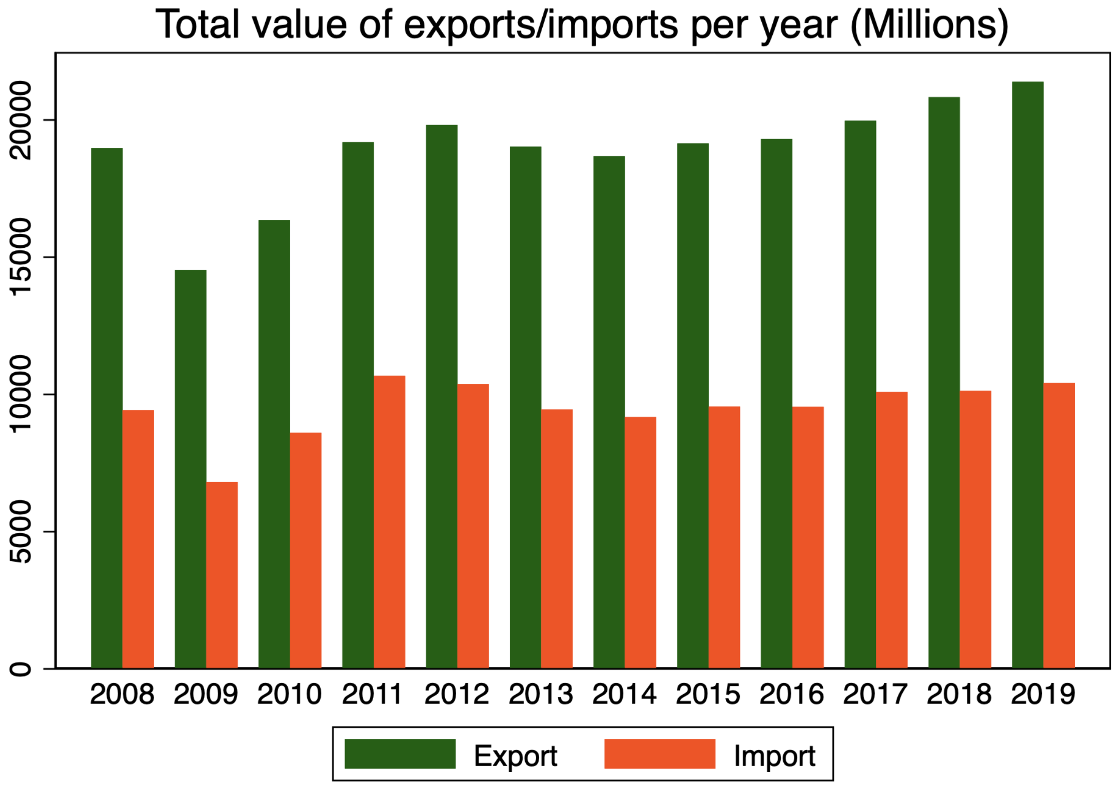

Figure 2: Import and Export evolution in the period 2008-2019

trajectory, although with noticeable fluctuations in certain years.

In the early period from 2008 to 2009, there is a marked decline in both exports and imports, a trend that corresponds with the global financial crisis. This period of economic turmoil led to a contraction in international trade as demand for goods and services decreased worldwide. Following this downturn, the years 2010 and 2011 show a sharp recovery, particularly in export values, reflecting a global economic rebound. During this phase, imports also increase, though at a slower rate than exports.

From 2012 to 2013, export growth slows down, while imports remain relatively stable. This stagnation can be attributed to the European debt crisis, which affected many economies and may have suppressed international trade during these years. The period from 2014 to 2016 displays a more stable trend, with both exports and imports showing minor fluctuations, indicating a phase of steady trade activity. However, exports maintain a consistently higher value than imports, suggesting a continued trade surplus.

In the final years, from 2017 to 2019, both exports and imports rise again, with exports reaching their peak in 2019. This reflects a period of stronger global economic growth and possibly favorable trade agreements, which bolstered export activity. Imports, while also increasing, remain at a lower level compared to exports, continuing the trend of a trade surplus.

Overall, the fluctuations in trade values can be closely tied to major global economic events such as the financial crisis of 2008 and the Eurozone crisis, both of which heavily impacted international trade. The upward trend towards the end of the period indicates a recovery and growing momentum in global trade activities leading into 2019.

Algorithm 10: Stata code: Import and Export evolution graph

Data: Final Dataset

```
begin
    * Graph export/import;
    use final_dataset.dta;
    collapse (sum) export_val import_val, by(year);
    * Scale export_val and import_val to millions;
    gen export_val_millions = export_val / 1e6;
    gen import_val_millions = import_val / 1e6;
    * Create a bar graph with values in millions;
    graph bar (sum) export_val_millions import_val_millions, over(year) /// ;
    title("Total value of exports/imports per year (Millions)") /// ;
    ylabel(, format(%9.0f) nogrid) /// ;
    legend(label(1 "Export") label(2 "Import"));
    graph export graph import+export.png, as(png) replace;
    clear;
```

4.2.3 Green Export and Green Import evolution

The two graphs represent the total value of green exports and imports classified according to two different methodologies: the *BLS* (Bureau of Labor Statistics) classification and the OECD (Organisation for Economic Co-operation and Development) classification.

Looking at the **BLS green exports/imports** graph (Figure 3), the value of green exports starts at a high level in 2008, reaching approximately 120 million, and then decreases slightly but remains relatively stable from 2010 onwards, oscillating between 80 and 100 million. Imports, on the other hand, remain relatively low compared to exports, fluctuating around 30-40 million throughout the entire period. The trend for both exports and imports shows little variation after the initial decline, with no

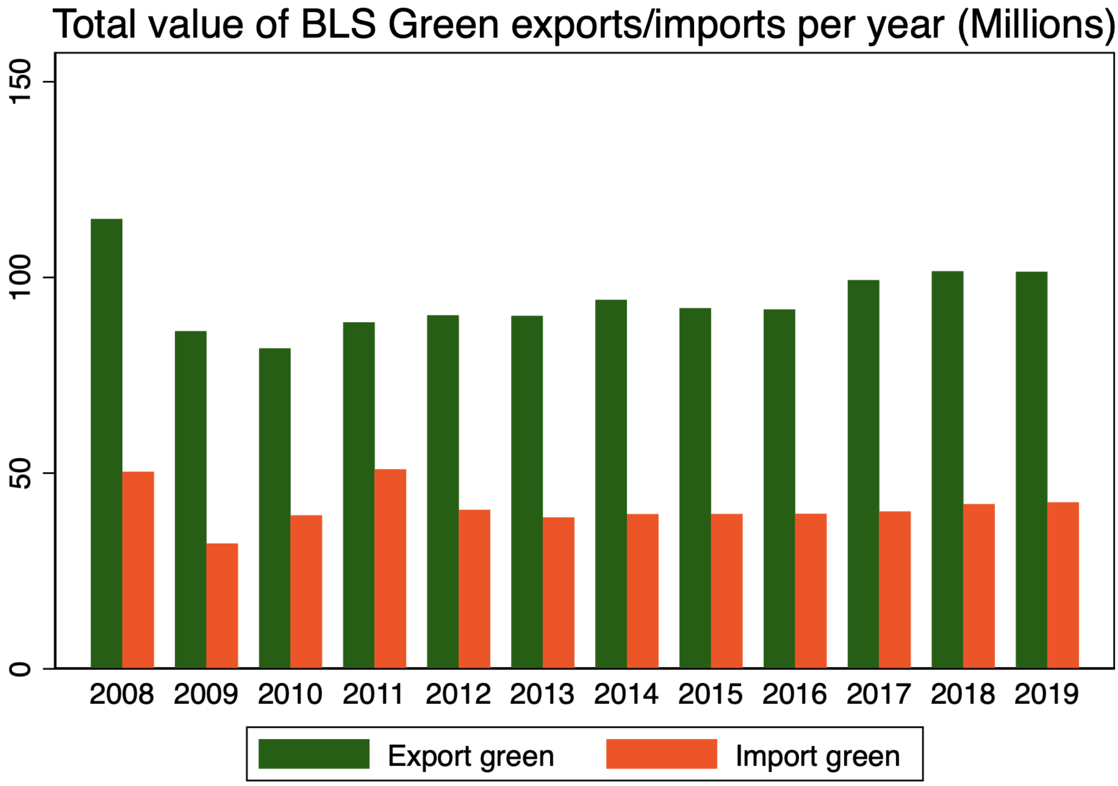

Figure 3: Green Import and Green Export evolution in the period 2008-2019 with the BLS classification

significant growth or decline visible over time.

Comparing this with the **OECD green exports/imports** graph (Figure 4), the values of green exports and imports are noticeably higher, with exports starting at around 1,100 million in 2008. A dip is visible around 2010, but the trend stabilizes from 2012 onwards, with exports remaining between 1,000 and 1,400 million. Imports follow a similar pattern but at a much lower scale, fluctuating around 200 million throughout the period.

Both graphs show a consistent gap between the value of green exports and imports, with exports far exceeding imports, indicating that the economy is more oriented towards exporting green goods than importing them. The stability in both exports and imports suggests that there hasn't been a significant shift in the green economy, at least in terms of trade volume, over this period (always taking into consideration the assumptions showed in Paragraph 4.1).

When comparing these trends to the overall import and export graph, it's clear that while the total trade (green and non-green combined) has shown more fluctuation, particularly in the wake of the financial crisis around 2009-2010, green trade has remained more stable. This stability in green trade, particularly for exports, could reflect longer-term contracts or steady demand for sustainable products. However, it also suggests that green goods, as classified by BLS and OECD, haven't experienced rapid growth in trade over this period, which could point to either market saturation or limited global demand expansion (or could be due to the assumptions).

Moreover, the significant difference in volume between the two classifications can be attributed to the *OECD*'s broader, less rigid definition of green goods and services compared to the more stringent criteria used by the *BLS* (see Paragraph 4.1 for more details).

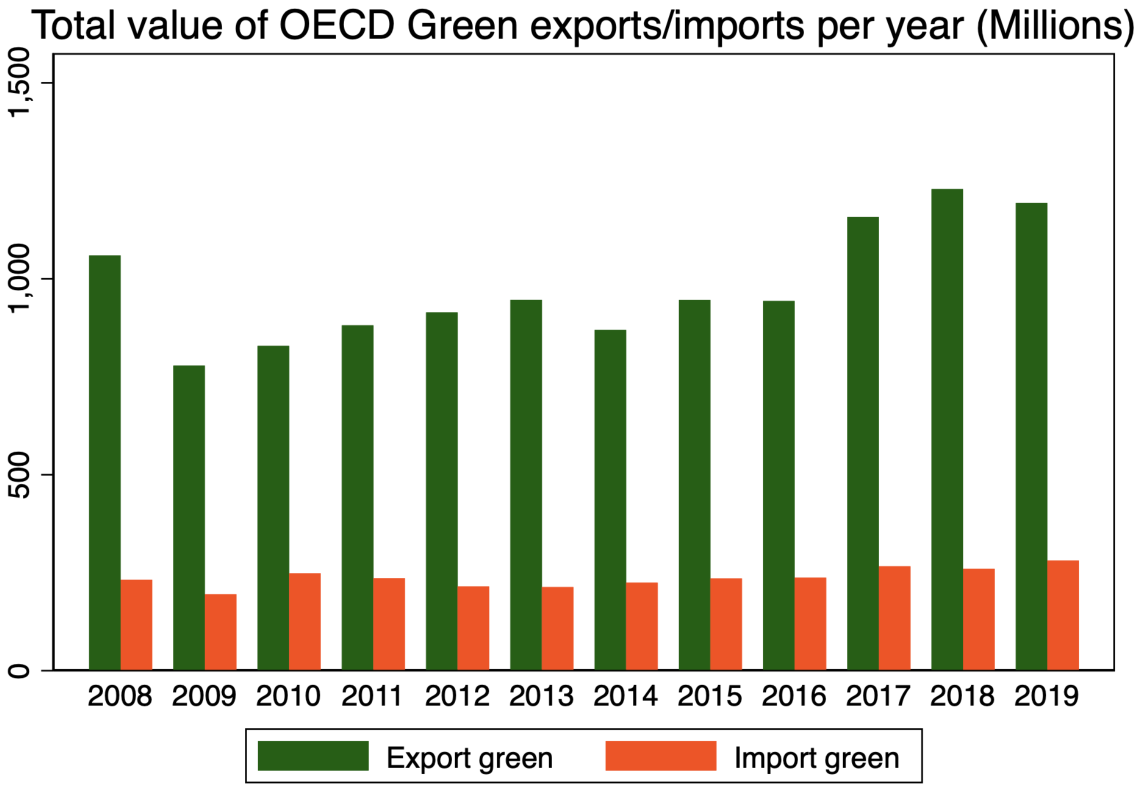

Figure 4: Green Import and Green Export evolution in the period 2008-2019 with the OECD classification

The Stata code used to create these graphs is shown afterwards for transparency and reproducibility of the data analysis process.

Algorithm 11: Stata code: Green Import and Export evolution

Data: Final Dataset

```
begin
    use final dataset.dta;
    keep if GGS_Green==1;
    collapse (sum) export_val import_val, by(year);
    gen export_val_millions = export_val / 1e6;
    gen import_val_millions = import_val / 1e6;
    graph bar (sum) export_val_millions import_val_millions, ;
    over(year) title("Total value of BLS Green exports/imports per year (Millions)") ylabel(, nogrid)
      legend(label(1 "Export green") label(2 "Import green"));
    graph export "graph BLS import+export.png", as(png) replace;
    clear;
    ***********************************************************************************
    use final dataset.dta;
    keep if HS_Green == "yes";
    collapse (sum) export_val import_val, by(year);
    gen export_val_millions = export_val / 1e6;
    gen import_val_millions = import_val / 1e6;
    graph bar (sum) export_val_millions import_val_millions, ;
    over(year) title("Total value of OECD Green exports/imports per year (Millions)") ylabel(, nogrid)
      legend(label(1 "Export green") label(2 "Import green"));
    graph export "graph OECD import+export.png", as(png) replace;
    clear;
```

4.2.4 Export and Import decomposition

The decomposition of import and export data in the provided analysis is evaluated using two distinct classification systems: the $OECD$ and the BLS. Both classifications offer unique perspectives, and their differences significantly influence the reported data, especially in the Green sector. The $OECD$ classification is characterized by a broader and less restrictive approach, leading to higher volumes in the Green sector. This inclusiveness allows a wider range of activities to be categorized under the Green sector, resulting in greater reported figures for both imports and exports. On the other hand, the BLS classification is more stringent and specific in its criteria, which means that fewer activities are classified as Green, thus producing lower volumes for the same sector when compared to the $OECD$ classification.

This contrast is crucial as it underlines the impact of methodological choices on the outcomes of data analysis. When comparing the two classifications, it is evident that the **OECD framework**, by encompassing a wider array of activities, shows a larger scale for the Green sector. This implies that the same economic activities can be viewed

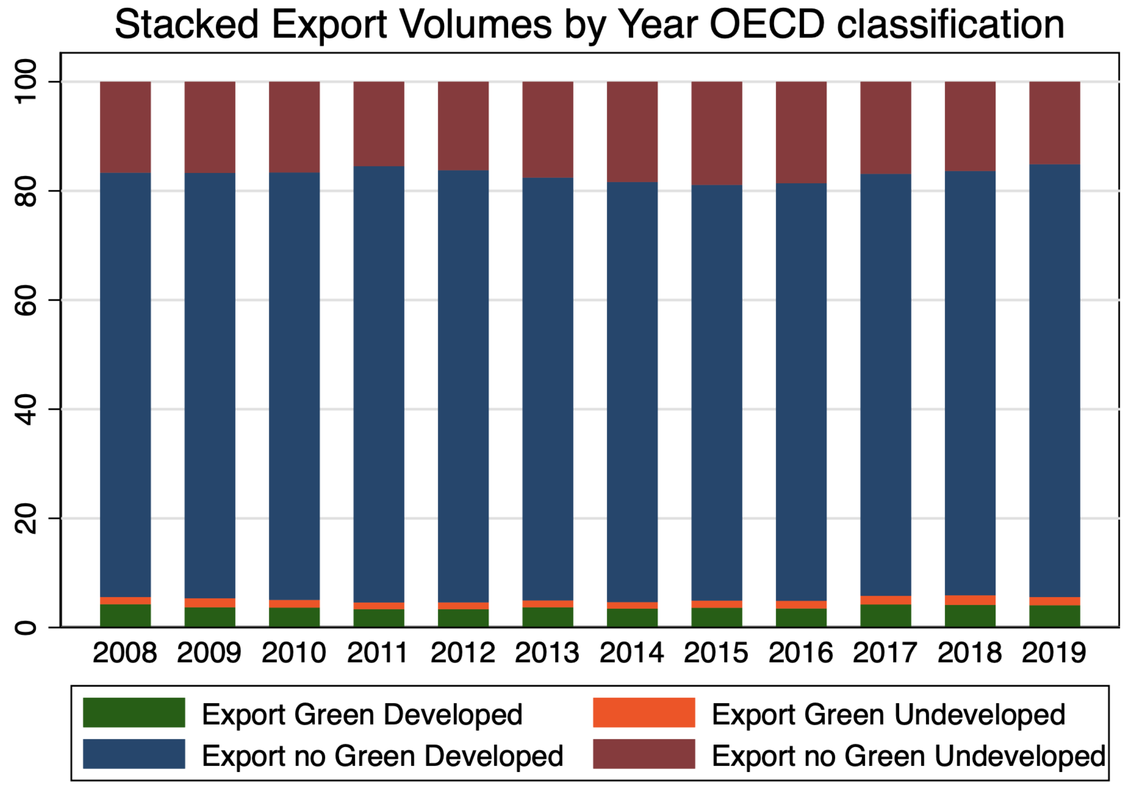

Figure 5: Green Export decomposition by source category with the OECD classification

differently depending on the classification system used, affecting the overall perception of sectoral growth and trade dynamics. The **BLS**, with its narrower definition, provides a more conservative estimate, focusing on a stricter subset of activities, which in turn suggests a smaller, more contained Green sector in terms of trade volumes.

The assumptions (look at Paragraph 4.1) underlying these classifications play a pivotal role and must be explicitly acknowledged in the analysis. They are not mere technicalities but fundamental elements that shape the data interpretation. For instance, a broader classification like the $OECD$'s might include activities that have a marginal environmental benefit, inflating the Green sector's apparent size, while the BLS's narrower criteria might exclude these, leading to a more cautious, but potentially more accurate, representation of the sector's economic weight. Therefore, it is essential to be aware of these assumptions as they directly influence the analysis and its implications for policy and economic decisions.

To support this detailed analysis, the document includes Stata code used to extract summary data, which serves as the foundation for constructing the bar graphs presented

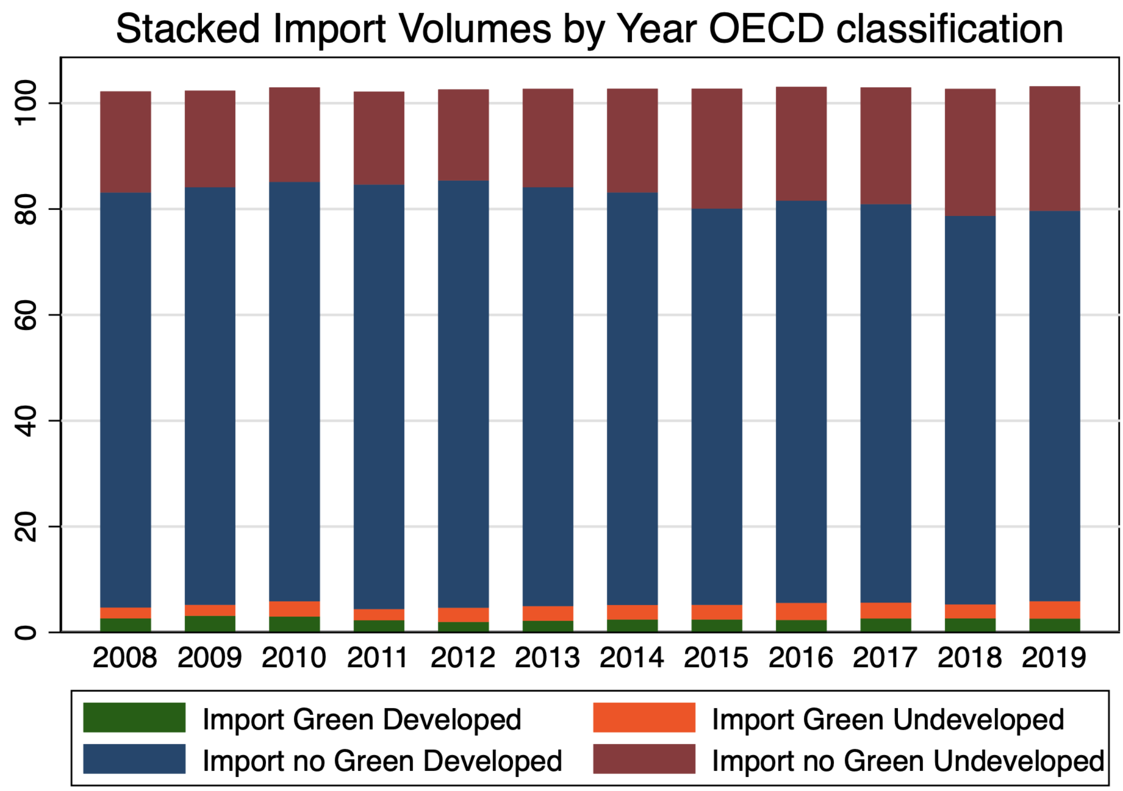

Figure 6: Green Import decomposition by source category with the OECD classification

in the Excel sheets. These visual tools provide a clear comparison of import and export decomposition across the two classifications, highlighting the discrepancies in reported volumes and offering a visual confirmation of the differences in methodological approaches. The data extraction process and subsequent visualization emphasize the necessity of transparent and precise classification criteria, as these choices significantly impact the portrayal and understanding of sectoral trade dynamics. The provided code and graphical representation are instrumental in substantiating the analytical conclusions drawn in the report.

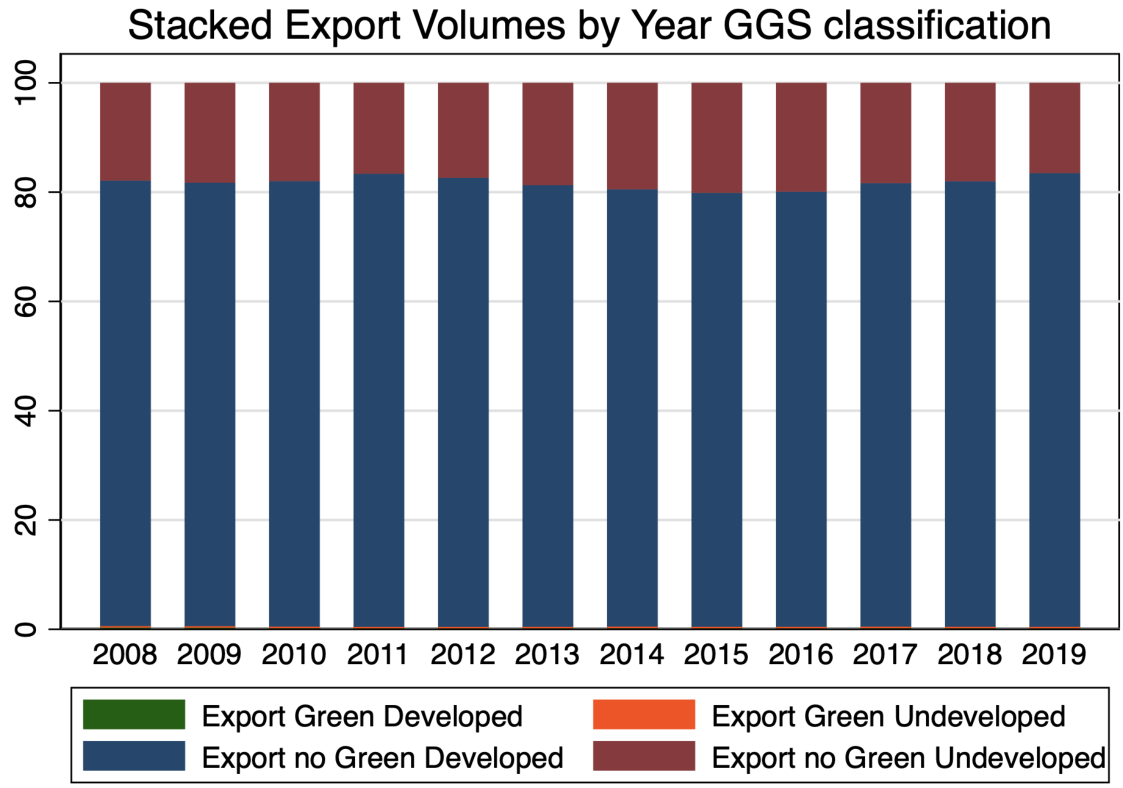

Figure 7: Green Export decomposition by source category with the BLS classification

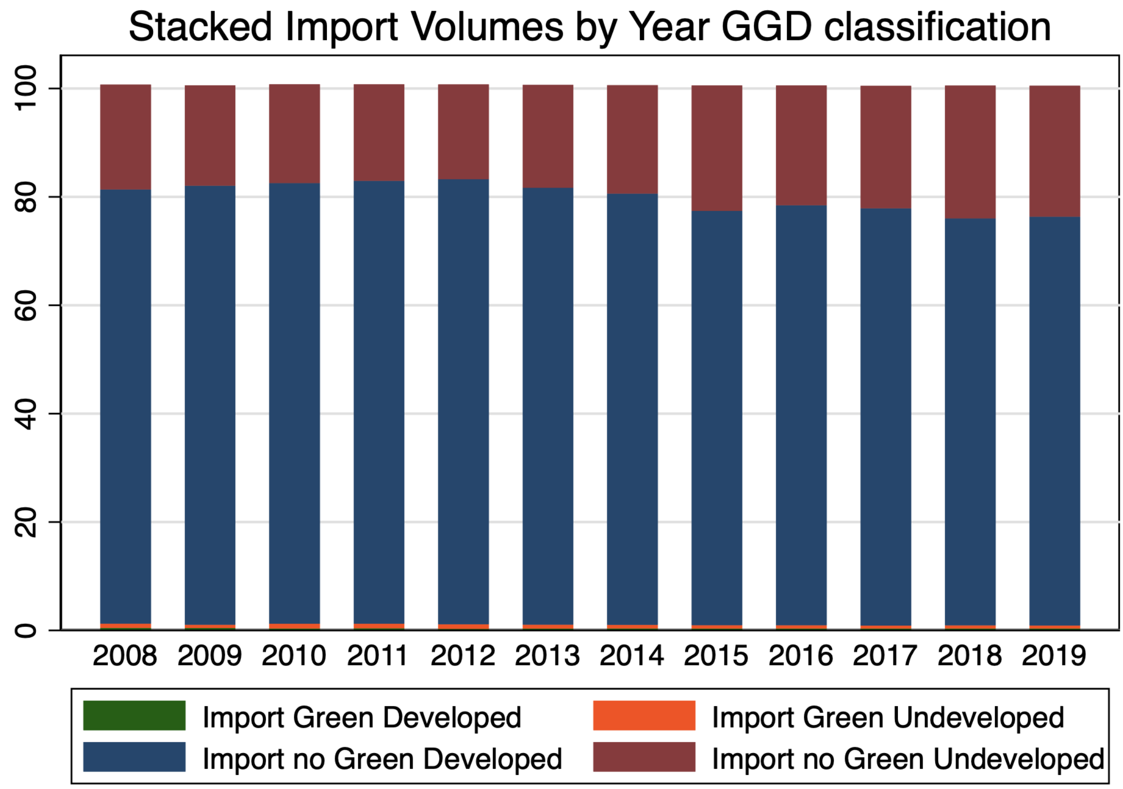

Figure 8: Green Import decomposition by source category with the BLS classification

Algorithm 12: Stata code: Export and Import decomposition Part 1

Data: Final Dataset

```
begin
    clear;
    use final dataset.dta;
    merge m:m country using Country Table.dta;
    drop if _merge==2;
    * Step 1: Create new variables with conditional values;
    gen exp_dev = export_val if developed == 1 & HS_Green == "no";
    gen exp_undev = export_val if (developed == 0 | developed == 2) & HS_Green == "no";
    gen exp_dev_HS_Green = export_val if developed == 1 & HS_Green == "yes";
    gen exp_undev_HS_Green = export_val if (developed == 0 | developed == 2) & HS_Green == "yes";
    gen imp_dev = import_val if developed == 1 & HS_Green == "no";
    gen imp_undev = import_val if (developed == 0 | developed == 2) & HS_Green == "no";
    gen imp_dev_HS_Green = import_val if developed == 1 & HS_Green == "yes";
    gen imp_undev_HS_Green = import_val if (developed == 0 | developed == 2) & HS_Green == "yes";
    * Step 2: Collapse the dataset to get the sum of the desired variables by year;
    collapse (sum) export_val exp_dev exp_undev exp_dev_HS_Green exp_undev_HS_Green import_val
      imp_dev imp_undev imp_dev_HS_Green imp_undev_HS_Green, by(year);
    * Step 3: gen perc_exp_dev_HS_Green = (exp_dev_HS_Green/export_val)*100;
    gen perc_exp_undev_HS_Green = (exp_undev_HS_Green/export_val)*100;
    gen perc_exp_dev = (exp_dev/export_val)*100;
    gen perc_exp_undev = (exp_undev/export_val)*100;
    gen perc_imp_dev_HS_Green = (imp_dev_HS_Green/imp_dev)*100;
    gen perc_imp_undev_HS_Green = (imp_undev_HS_Green/imp_undev)*100;
    gen perc_imp_dev = (imp_dev/import_val)*100;
    gen perc_imp_undev = (imp_undev/import_val)*100;
    drop exp_dev exp_undev exp_dev_HS_Green exp_undev_HS_Green imp_dev imp_undev
      imp_dev_HS_Green imp_undev_HS_Green;
    Exported data on excel file;
```

4.2.5 Most important Export Countries

The tables present the **total export** sums for the period 2008-2019, categorized by country and divided between **developed** and **undeveloped nations**. Additionally, the tables show the percentage of exports classified as green based on the OECD and BLS classifications, as previously discussed in the assumptions section.

Table 13: Export Developed Countries

State	Export (Millions)	Percentage OECD Green	Percentage BLS Green
Austria	6,720	3.049%	0.141%
Belgium	5,960	5.363%	0.234%
Czech Republic	2,840	8.875%	1.244%
France	29,300	3.814%	0.426%

Continued on next page

Table 13 – Continued from previous page

State	Export (Millions)	Percentage OECD Green	Percentage BLS Green
Germany	35,400	4.947%	0.854%
Greece	2,310	6.544%	0.354%
Netherlands	6,100	5.409%	0.361%
Poland	5,630	4.141%	1.579%
Romania	2,760	5.771%	0.611%
Russian Federation	3,910	10.594%	0.319%
Spain	10,200	4.420%	0.599%
Sweden	3,710	5.457%	0.101%
Switzerland	13,500	2.331%	0.073%
United Kindom	14,300	3.268%	0.244%
United States	16,200	4.664%	0.228%
Total	**159,000**	**5.243%**	**0.491%**

For **developed countries**, the total **export** volume reaches **159,000 million EUR**, with countries such as Germany, France, and the United States contributing significantly to this total. However, the percentage of green exports remains relatively low. For instance, Germany reports 4.947% of its exports as green under the $OECD$ classification, while France records 3.814%. The lower values reflect the broader criteria employed by the $OECD$, which captures a limited range of products as environmentally friendly. Under the stricter BLS classification, the percentages are even lower. Germany has only 0.854% of exports classified as green, and France reports 0.426%. This difference demonstrates how the more stringent BLS criteria, which focus specifically on the production impact, result in fewer exports being recognized as green.

Table 14: Export Undeveloped Countries

State	Export (Millions)	Percentage OECD Green	Percentage BLS Green
Algeria	2,150	6.101%	0.126%
Brazil	1,540	8.810%	1.172%
China	4,760	7.247%	0.646%
Egypt	1,100	12.458%	0.193%
Hong Kong	2,420	2.311%	0.164%
India	2,000	7.713%	1.392%
Korea	1,530	9.699%	0.206%
Libyan Arab Jamahiriya	870	3.528%	0.095%

Continued on next page

Table 14 – Continued from previous page

State	Export (Millions)	Percentage OECD Green	Percentage BLS Green
Mexico	1,460	5.987%	0.420%
Saudi Arabia	1,960	8.205%	0.121%
Singapore	785	8.725%	0.250%
South Africa	852	6.792%	0.330%
Tunisia	1,330	4.041%	0.806%
Turkey	3,640	5.379%	0.565%
United Arab Emirates	2,210	8.169%	0.134%
Total	**28,600**	**7.011%**	**0.441%**

In the case of **undeveloped countries**, the total export volume is smaller, amounting to **28,600 million EUR**. Despite this, the proportion of green exports tends to be higher compared to developed nations. China, for example, records 7.247% of exports as green under the *OECD* classification, while India shows 7.713%. These values are considerably higher than those seen in developed countries, reflecting a stronger alignment with the *OECD*'s broader environmental criteria. Similarly, under the *BLS* classification, the green percentages are also relatively higher for undeveloped nations, though still modest compared to the *OECD* classification. India reports 1.392% of its exports as green, and China follows with 0.646%. This suggests that undeveloped countries, while having smaller total export volumes, are seeing a larger proportion of their exports fall within the green category, potentially due to their focus on sectors that meet the *BLS* environmental criteria.

When comparing developed and undeveloped countries, it becomes evident that undeveloped countries generally have higher percentages of green exports under both the *OECD* and *BLS* classifications. This pattern is more pronounced under the *OECD* classification, where the broader environmental focus allows for more exports to be categorized as green. In contrast, the *BLS* standards are stricter, leading to lower overall percentages for both groups, though the relative differences between developed and undeveloped countries remain. Developed nations, despite their larger total export volumes, tend to show lower percentages of green exports, possibly due to the nature of their dominant industries, which may not align as closely with green classification criteria.

The difference between the *OECD* and *BLS* classifications emphasizes the impact that classification methodology can have on how sustainability in trade is measured and understood. The *OECD* classification, with its broader environmental lens, allows for a greater share of exports to be recognized as green, while the more rigid *BLS* criteria produce a more selective set of green exports. This discrepancy highlights the importance of considering the underlying assumptions and standards when analyzing sustainability trends across different nations and economic groups.

Algorithm 13: Stata code: Most important Export Countries Part 1

Data: Final Dataset, Country Table

```
begin
    *** Developed ***;
    clear;
    use final dataset.dta;
    * To view the total import and export for each of the developed country keep if developed == 1;
    gen exp_green_BLS = export_val if HS_Green=="yes";
    gen imp_green_BLS = import_val if HS_Green=="yes";
    gen exp_green_OECD = export_val if GGS_Green==1;
    gen imp_green_OECD = import_val if GGS_Green==1;
    drop firmid id year developed GGS_perc_2011 import offshoring_4d offshoring_3d ateco2007_3d HScode;
    collapse (sum) export_val import_val exp_green_BLS exp_green_OECD imp_green_BLS
      imp_green_OECD, by(country);
    gen perc_exp_green_BLS= exp_green_BLS / export_val * 100;
    gen perc_imp_green_BLS= imp_green_BLS / import_val * 100;
    gen perc_exp_green_OECD= exp_green_OECD / export_val * 100;
    gen perc_imp_green_OECD= imp_green_OECD / import_val * 100;
    * Add country lable according to the Eurostat system;
    merge m:m country using Country Table.dta";
    drop if _merge==2;
    drop _merge ISO;
    drop exp_green_BLS exp_green_OECD imp_green_BLS imp_green_OECD;
    gsort -export_val;
    keep in 1/15;
    estpost tabstat export_val perc_exp_green_BLS perc_exp_green_OECD, by(State) stats(sum);
    *** Undeveloped ***;
    clear;
    use final dataset.dta;
    * To view the total import and export for each of the developed country keep if developed == 0
    gen exp_green_BLS = export_val if HS_Green=="yes";
    gen imp_green_BLS = import_val if HS_Green=="yes";
    gen exp_green_OECD = export_val if GGS_Green==1;
    gen imp_green_OECD = import_val if GGS_Green==1;
    drop firmid id year developed GGS_perc_2011 import offshoring_4d offshoring_3d ateco2007_3d HScode;
    collapse (sum) export_val import_val exp_green_BLS exp_green_OECD imp_green_BLS
      imp_green_OECD, by(country);
```

Algorithm 14: Stata code: Most important Export Countries Part 2

Data: Final Dataset, Country Table

```
begin
    gen perc_exp_green_BLS= exp_green_BLS / export_val * 100;
    gen perc_imp_green_BLS= imp_green_BLS / import_val * 100;
    gen perc_exp_green_OECD= exp_green_OECD / export_val * 100;
    gen perc_imp_green_OECD= imp_green_OECD / import_val * 100;
    * Add country lable according to the Eurostat system;
    merge m:m country using Country Table.dta;
    drop if _merge==2;
    drop _merge ISO;
    drop exp_green_BLS exp_green_OECD imp_green_BLS imp_green_OECD;
    gsort -export_val;
    keep in 1/15;
    gsort -export_val;
    keep in 1/15;
    estpost tabstat export_val perc_exp_green_BLS perc_exp_green_OECD, by(State) stats(sum);
```

4.2.6 Most important Import Countries

The data representing the division of **total imports** between **developed** and **undeveloped countries** for the period from 2008 to 2019 reveals some interesting trends in both economic activity and environmental considerations. Developed countries, as expected, account for significantly larger import volumes. For instance, Germany leads with imports totaling 17,800 million, followed by France with 13,000 million. The percentages of green imports, as measured by both the *OECD* and *BLS* classifications, vary widely among these countries. Germany, for example, has an *OECD* green percentage of 3.528%, while its *BLS* green percentage is considerably lower at 0.448%. France exhibits a similar pattern, with 2.124% of its imports classified as green under *OECD* standards, but only 0.268% under the *BLS* classification. This difference highlights the varying criteria and environmental standards these classifications use, which can lead to substantial discrepancies in the data.

Table 15: Import Developed Countries

State	Import (Millions)	Percentage OECD Green	Percentage BLS Green
Austria	6,530	1.548%	0.420%
Belgium	4,120	1.624%	0.617%
Czech Republic	2,150	1.680%	0.515%
France	13,000	2.124%	0.268%

Continued on next page

Table 15 – Continued from previous page

State	Import (Millions)	Percentage OECD Green	Percentage BLS Green
Germany	17,800	3.528%	0.448%
Hungary	2,620	0.868%	0.100%
Japan	1,630	8.182%	0.033%
Netherlands	4,270	0.929%	0.126%
Poland	2,050	5.419%	0.550%
Romania	1,560	3.468%	1.430%
Russian Federation	1,550	3.576%	0.002%
Spain	6,490	1.336%	0.141%
Switzerland	4,120	2.715%	0.171%
United Kindom	2,900	2.052%	1.936%
United States	7,180	0.782%	0.054%
Total	**77,900**	**2.655%**	**0.454%**

In general, the **green import** percentages in developed countries tend to be relatively low when measured by the *BLS* standard, despite these countries importing large volumes of goods. Japan, for instance, stands out with an *OECD* green percentage of 8.182%, but its BLS green percentage is nearly negligible at 0.033%. This suggests that while Japan may be focusing on environmentally friendly imports according to one classification, the goods may not meet the criteria for green classification under the BLS standard, illustrating how the choice of classification system can influence the perceived "greenness" of trade.

In comparison, undeveloped countries import significantly less overall, but often show higher green percentages relative to their import volumes. China, for example, imports 8,630 million, with an BLS green percentage of 0.799%, which is much higher than many developed nations, even though its *OECD* green percentage is a more moderate 4.152%. Countries like Algeria and the Libyan Arab Jamahiriya display high *OECD* green percentages (11.012% and 10.112%, respectively), while their *BLS* percentages are both at 0%. The relatively high green percentages in some undeveloped countries, particularly under the *OECD* classification, could be attributed to the smaller total import volumes. With fewer total imports, even minor green import quantities can lead to a substantial percentage increase, making the imports appear more environmentally conscious than they might be in absolute terms.

Table 16: Import Undeveloped Countries

State	Import (Millions)	Percentage OECD Green	Percentage BLS Green
Algeria	38	11.012%	0.000%
Brazil	1,830	0.075%	0.166%
China	8,630	4.152%	0.799%
Egypt	264	1.918%	0.000%
Hong Kong	177	0.897%	0.080%
India	1,210	3.127%	0.891%
Korea	647	2.489%	0.004%
Libyan Arab Jamahiriya	102	10.112%	0.000%
Mexico	540	0.435%	0.095%
Saudi Arabia	114	0.727%	0.000%
Singapore	118	0.773%	0.016%
South Africa	207	0.217%	0.018%
Tunisia	771	1.756%	0.099%
Turkey	1,980	2.387%	0.233%
United Arab Emirates	224	0.571%	0.005%
Total	**16,900**	**2.710%**	**0.160%**

When **comparing** the data between developed and undeveloped countries, it is clear that developed nations' larger import volumes tend to dilute the impact of green imports, resulting in lower green percentages, especially by the BLS classification. Meanwhile, undeveloped countries, due to their smaller import volumes, see more pronounced shifts in green percentages even with modest increases in green goods. However, it is important to note that the uniform application of the $OECD$ and BLS classifications across all countries plays a significant role in shaping these figures. Applying the same environmental criteria universally, without considering the unique trade practices, technological capacities, or environmental standards of each country, may lead to misleading conclusions about the degree of "greenness" in a country's imports (see Paragraph 4.1). Thus, the differences in green percentages between developed and undeveloped countries may be as much a reflection of classification choices as of the actual environmental focus of their trade practices.

Algorithm 15: Stata code: Most important Import Countries

Data: Final Dataset, Country Table

```
begin
    *** Developed ***;
    clear;
    use final dataset.dta;
    * To view the total import and export for each of the developed country keep if developed == 1;
    gen exp_green_BLS = export_val if HS_Green=="yes";
    gen imp_green_BLS = import_val if HS_Green=="yes";
    gen exp_green_OECD = export_val if GGS_Green==1;
    gen imp_green_OECD = import_val if GGS_Green==1;
    drop firmid id year developed GGS_perc_2011 import offshoring_4d offshoring_3d ateco2007_3d HScode;
    collapse (sum) export_val import_val exp_green_BLS exp_green_OECD imp_green_BLS
      imp_green_OECD, by(country);
    gen perc_exp_green_BLS= exp_green_BLS / export_val * 100;
    gen perc_imp_green_BLS= imp_green_BLS / import_val * 100;
    gen perc_exp_green_OECD= exp_green_OECD / export_val * 100;
    gen perc_imp_green_OECD= imp_green_OECD / import_val * 100;
    * Add country lable according to the Eurostat system;
    merge m:m country using Country Table.dta;
    drop if _merge==2;
    drop _merge ISO;
    drop exp_green_BLS exp_green_OECD imp_green_BLS imp_green_OECD gsort -import_val;
    keep in 1/15;
    estpost tabstat import_val perc_imp_green_BLS perc_imp_green_OECD, by(State) stats(sum);
    *** Undeveloped ***;
    clear;
    use final dataset.dta;
    * To view the total import and export for each of the developed country keep if developed == 0;
    gen exp_green_BLS = export_val if HS_Green=="yes";
    gen imp_green_BLS = import_val if HS_Green=="yes";
    gen exp_green_OECD = export_val if GGS_Green==1;
    gen imp_green_OECD = import_val if GGS_Green==1;
    drop firmid id year developed GGS_perc_2011 import offshoring_4d offshoring_3d ateco2007_3d HScode;
    collapse (sum) export_val import_val exp_green_BLS exp_green_OECD imp_green_BLS
      imp_green_OECD, by(country);
    gen perc_exp_green_BLS= exp_green_BLS / export_val * 100;
    gen perc_imp_green_BLS= imp_green_BLS / import_val * 100;
    gen perc_exp_green_OECD= exp_green_OECD / export_val * 100;
    gen perc_imp_green_OECD= imp_green_OECD / import_val * 100;
    * Add country lable according to the Eurostat system;
    merge m:m country using Country Table.dta;
    drop if _merge==2;
    drop _merge ISO;
    drop exp_green_BLS exp_green_OECD imp_green_BLS imp_green_OECD;
    gsort -export_val;
    keep in 1/15;
    gsort -import_val;
    keep in 1/15;
    estpost tabstat import_val perc_imp_green_BLS perc_imp_green_OECD, by(State) stats(sum);
```

4.2.7 Relation between Import and Export

The data from the table showing import and export values from 2008 to 2019 demonstrates clear trends and fluctuations in trade activities. During this period, both imports and exports varied significantly, though exports remained consistently higher than imports across all years.

Table 17: Import Export time series (Millions USD)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Import	9,425	6,809	8,602	10,679	10,380	9,455	9,178	9,556	9,548	10,093	10,127	10,414
Export	18,979	14,540	16,355	19,193	19,821	19,030	18,683	19,148	19,311	19,974	20,831	21,394

Starting with **imports**, the values show a decline from 9,425 million EUR in 2008 to 6,809 million EUR in 2009. This sharp drop coincides with the global financial crisis, which negatively impacted trade across many economies. Following this downturn, imports rebounded in 2010 to 8,602 million EUR and continued to grow, peaking in 2012 at 10,679 million EUR. However, after 2012, there were slight fluctuations in import values, with a small decrease in 2014 and subsequent recovery. By 2019, imports reached 10,414 million EUR, marking a moderate growth from the low in 2009.

Exports followed a somewhat similar trajectory but at a much higher level. In 2008, exports were valued at 18,979 million EUR, but like imports, they experienced a significant drop in 2009, reaching 14,540 million EUR. However, exports recovered more robustly than imports, quickly climbing back to 19,193 million EUR in 2010 and maintaining a relatively high value throughout the remaining years. The peak occurred in 2019, with exports reaching 21,394 million EUR, marking a steady upward trend from 2015 onwards.

Table 18: Import Export correlation matrix from Stata

	Import	Export
Import	1.0000	
Export	0.9137	1.0000

The **correlation** analysis between import and export values provides further insight into the relationship between these two variables. The correlation coefficient of 0.9137 indicates a strong positive correlation, suggesting that changes in imports are closely related to changes in exports. This means that, generally, when exports increase, imports also tend to rise, and when exports decrease, imports follow suit. While the correlation is not perfect, it implies that factors influencing one side of trade often have a significant impact on the other. This strong relationship might be driven by economic conditions that simultaneously affect the demand for imported goods and the capacity for exports. For instance, periods of economic expansion often lead to increased consumption, raising both import demand and the production capacity necessary for exports.

The Stata code provided illustrates the method used to calculate the correlation between imports and exports over the 12-year period. By collapsing the yearly data and computing the correlation matrix, it reveals a clear picture of how closely linked these two variables are throughout the period under study. This analysis reinforces the conclusion that the two trade components, while distinct, are deeply interconnected and respond to similar global and regional economic forces.

Algorithm 16: Stata code: Import Export correlation matrix

```
Data: Final Dataset
begin
    * Open the final table dataset;
    clear;
    use final dataset.dta;
    collapse (sum) import_val export_val, by (year);
    corr import_val export_val;
```

In summary, the data shows a clear recovery in both imports and exports following the economic downturn in 2009, with exports generally outpacing imports throughout the entire period. The **strong correlation** between the two variables underscores the interplay between import and export activities, suggesting that both are influenced by common factors related to overall trade conditions and economic health.

4.2.8 Relation between Import and Green Import

The data from the table showing import values and their green classifications according to both the *BLS* and *OECD* criteria from 2008 to 2019 reveals some key insights into how green imports have evolved over time. The total import values vary over the years, while the green import values classified under both *BLS* and *OECD* standards follow their own trends, reflecting differences in the rigidity of each classification system.

Table 19: Import and Green Import time series (Millions USD)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Import	9,425	6,809	8,602	10,679	10,380	9,455	9,178	9,556	9,548	10,093	10,127	10,414
Green BLS	50	32	39	51	41	39	40	40	40	40	42	43
Green OECD	232	195	249	236	215	213	225	235	237	266	260	281

For the **BLS classification**, the values of green imports remain relatively low throughout the period. Starting at 50 million EUR in 2008, green imports drop sharply to 32 million EUR in 2009, following the broader economic downturn. This reduction is notable, especially when compared to the overall import value. Following 2009, the green BLS imports exhibit minor fluctuations, with peaks such as 51 million EUR in 2011 and stabilization around 40 million EUR from 2013 to 2017. This relatively consistent but low level of green imports under the BLS system suggests a more stringent classification, where fewer imports meet the required green criteria.

On the other hand, green imports classified under the **OECD system** are consistently higher, starting at 232 million EUR in 2008 and continuing to grow almost every year. By 2019, green $OECD$ imports reach 281 million EUR, more than six times higher than the BLS green imports. The $OECD$'s higher values reflect its broader, less rigid classification approach, capturing a larger portion of imports that qualify as green. This discrepancy between the BLS and $OECD$ classifications highlights the impact that the underlying definitions have on the measured volume of green trade (see the assumptions in Paragraph 4.1).

Table 20: Import and Green Import correlation matrix from Stata

	Import	Import BLS	Import OECD
Import	1.0000		
Import BLS	0.6589	1.0000	
Import OECD	0.5759	0.3305	1.0000

The **correlation matrix** generated using Stata provides further insights into the relationship between overall imports and their green subsets. The correlation between total imports and BLS green imports is 0.6589, suggesting a moderate positive relationship. This implies that while there is a connection between import levels and

BLS green imports, changes in overall imports do not always strongly correspond to changes in green imports under the BLS classification. The correlation between total imports and $OECD$ green imports is lower at 0.5759, indicating a weaker relationship. This could be due to the larger scope of the $OECD$ classification, where fluctuations in total import volumes may not impact the green import totals as directly.

The correlation between BLS and $OECD$ green imports is relatively weak at 0.3305, reflecting the significant differences in what each classification considers "green." This divergence underscores the importance of defining clear criteria for sustainability in international trade analysis, as different frameworks can yield substantially different outcomes.

In summary, the time series data show that green imports, as classified by the $OECD$, consistently represent a larger portion of total imports than those classified by the BLS. This difference is further illustrated by the correlation analysis, where the connection between overall imports and green imports varies significantly depending on the classification system used. The Stata code used for this analysis reinforces the need for careful consideration when interpreting the sustainability of trade, as the classification criteria play a critical role in shaping the outcomes.

Algorithm 17: Stata code: Import and Green Import correlation matrix

Data: Final Dataset

```
begin
    * Open the final table dataset;
    clear;
    use final dataset.dta;
    gen imp__green__BLS = import__val if GGS__Green == 1;
    gen imp__green__OECD = import__val if HS__Green == "yes";
    collapse (sum) import__val imp__green__BLS imp__green__OECD, by(year);
    corr import__val imp__green__BLS imp__green__OECD;
```

4.2.9 Relation between Export and Green Export

The data on export and green export values, spanning from 2008 to 2019, provides insight into the changes in both **total export** values and the portion of exports classified as green under both the BLS and $OECD$ criteria. The total export values fluctuate during this period, starting at 18,979 million EUR in 2008, dropping to 14,540 million EUR in 2009, and peaking at 21,394 million EUR by 2019. These shifts reflect broader economic and trade dynamics over the 12-year span.

Table 21: Export and Green Export time series (Millions USD)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Export	18,979	14,540	16,355	19,193	19,821	19,030	18,683	19,148	19,311	19,974	20,831	21,394
Green BLS	115	86	82	89	90	90	94	92	92	99	102	101
Green OECD	1,060	779	829	881	914	946	869	946	943	1,158	1,229	1,193

Looking at the **green export** values, as classified by the **BLS**, the trend is relatively stable but low compared to total export values. In 2008, green exports amounted to 115 million EUR, and although there is some variability, the values remain around 90-100 million EUR for most of the period, ending at 101 million EUR in 2019. This stability reflects the more rigid classification criteria of the BLS, where fewer products meet the stringent green standards.

In contrast, **green exports** under the **OECD** classification show consistently higher values and exhibit a more dynamic pattern. In 2008, $OECD$ green exports were 1,060 million EUR and, despite some fluctuations, reached 1,193 million EUR by 2019. These higher values reflect the broader and less restrictive definition of green products under the $OECD$ classification, capturing a more significant portion of trade within the green category.

Table 22: Export and Green Export correlation matrix from Stata

	Import	Import BLS	Import OECD
Export	1.0000		
Export BLS	0.5471	1.0000	
Export OECD	0.7923	0.7375	1.0000

The **correlation matrix** provided by the Stata output adds another dimension to the analysis. The correlation between total **exports and BLS green exports** is relatively weak, at 0.5471, indicating that changes in overall export values do not strongly correspond to changes in green exports classified under the BLS framework. This aligns with the more stringent nature of the BLS classification, where even substantial shifts in export volumes may not substantially affect the volume of green trade.

On the other hand, the correlation between total **exports and OECD green exports** is stronger, at 0.7923, suggesting a closer relationship between the two. This makes sense, given the more flexible criteria of the *OECD* classification, which likely captures a broader range of exports as green, leading to a stronger link between total export values and green exports.

The **correlation between BLS and OECD green exports** is 0.7375, indicating a moderate relationship between the two classifications. This suggests that while there is some overlap in what both systems classify as green, the differences in their criteria still lead to distinct categorizations of trade flows. The broader scope of the *OECD* classification results in higher green export values, which is reflected in the stronger correlations between *OECD* green exports and both total exports and *BLS* green exports.

In conclusion, the analysis of export values and green classifications shows that while green exports under the *BLS* system are relatively stable and small, those under the *OECD* classification are larger and more closely tied to overall export trends. The correlation analysis further highlights the differing impacts of these classification systems on how green trade is quantified and understood in the context of international trade. The Stata code used for this analysis underscores the importance of methodological rigor when interpreting green trade data, as different classification systems can lead to significantly different conclusions.

Algorithm 18: Stata code: Export and Green Export correlation matrix

Data: Final Dataset

```
begin
    * Open the final table dataset;
    clear;
    use final dataset.dta;
    gen exp_BLS = export_val if GGS_Green == 1;
    gen exp_OECD = export_val if HS_Green == "yes";
    collapse (sum) export_val exp_BLS exp_OECD, by(year);
    corr export_val exp_BLS exp_OECD;
```

4.2.10 Correlation between Green values

The Stata outputs display **correlation** matrices for **green import** and **export** values under the *BLS* and *OECD* classifications, offering a comparative look at how green imports relate to green exports within each framework. Each matrix, detailed in the accompanying Stata code, provides insight into the dynamics of green trade.

Table 23: Import & Export BLS correlation matrix from Stata

	Import BLS	**Export BLS**
Import BLS	1.0000	
Export BLS	0.5309	1.0000

Under the **BLS classification**, the correlation coefficient between green imports and green exports is recorded at 0.5309. This indicates a moderate positive relationship, suggesting that changes in green exports tend to be somewhat mirrored by changes in green imports under this strict classification system. However, this correlation is not particularly strong, implying that other factors may influence green imports and exports independently.

Table 24: Export & Import OECD correlation matrix from Stata

	Import OECD	**Export OECD**
Import OECD	1.0000	
Export OECD	0.7747	1.0000

Contrastingly, the **OECD classification** shows a stronger correlation of 0.7747 between green imports and green exports. This higher figure suggests a more robust connection under the $OECD$'s criteria, which are broader and potentially include a wider range of products deemed environmentally friendly. This stronger correlation could indicate that green imports and exports under the $OECD$ classification are more consistently influenced by similar factors, perhaps due to a more uniform global understanding or application of what constitutes a green product under these less stringent guidelines.

When compared to the previous analysis which examined overall import and export correlations, it's clear that the general trade relationship is stronger (correlation of 0.9137) than within the subset of green trade. This suggests that broader trade flows, which include both green and non-green products, are more synchronized compared to the more specialized and variably defined green trade sector.

The variation in correlations between the BLS and $OECD$ classifications reflects the impact of their respective definitions of green goods. The stricter BLS criteria may result in a narrower selection of goods classified as green, possibly leading to the more varied factors driving imports and exports. On the other hand, the broader *OECD* standards capture a wider variety of goods as green, likely leading to a stronger and more uniform relationship between green imports and exports as these goods are influenced by global trends affecting the green market more homogeneously.

This analysis underscores the significance of classification standards in shaping trade dynamics, with broader criteria potentially facilitating stronger and more coherent relationships between green imports and exports due to a more inclusive definition of what constitutes a green product.

Algorithm 19: Stata code: Green values correlation matrix

Data: Final Dataset

```
begin
    * Open the final table dataset;
    clear;
    use final dataset.dta;
    gen exp_BLS = export_val if GGS_Green == 1;
    gen exp_OECD = export_val if HS_Green == "yes";
    gen imp_green_BLS = import_val if GGS_Green == 1;
    gen imp_green_OECD = import_val if HS_Green == "yes";
    collapse (sum) imp_green_BLS imp_green_OECD exp_BLS exp_OECD, by (year);
    corr imp_green_BLS exp_BLS;
    corr imp_green_OECD exp_OECD;
```

4.2.11 Export and Import decomposition using the HDI and OECD classification

The analysis has been repeated using the same framework as in Section 4.2.4, but with an important update: the division of countries has been based on the **Human Development Index (HDI) from the United Nations**. This classification provides a more comprehensive and modern approach to categorizing countries, reflecting not just economic output but also broader dimensions of human development, such as life expectancy and education. Additionally, the division of products into green and non-green categories has been done according to the OECD classification, which identifies goods and services that contribute to environmental sustainability and the green economy. This dual classification allows for a clearer and more accurate reflection of the current state of global trade.

Figures 9 and 10 illustrate the **stacked export and import volumes** for developed

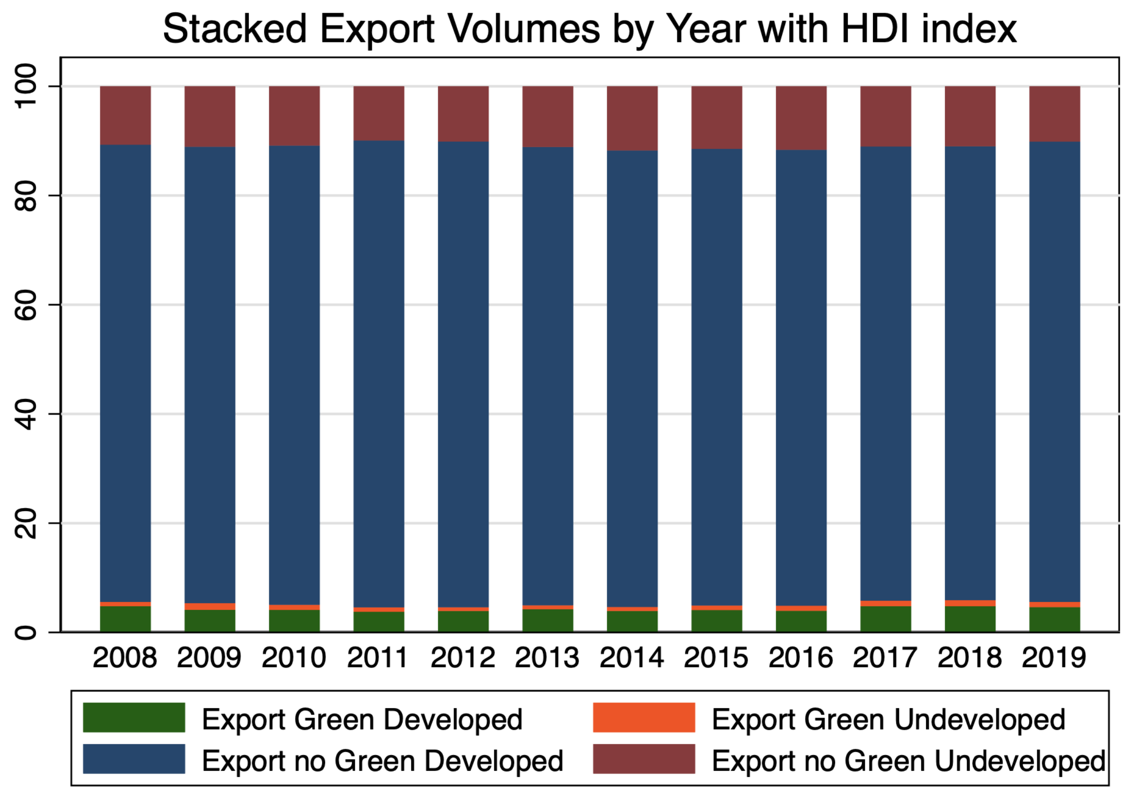

Figure 9: Stacked Export Volumes by Year with HDI index and OECD

and undeveloped countries, categorized by green and non-green products, over the period from 2008 to 2019. The graphs reveal a strong consistency in the dominance of non-green exports and imports from developed countries, as represented by the large blue segments. This pattern shows that, despite growing global interest in sustainable products, non-green trade still represents the bulk of international exchange, particularly in developed nations.

Green exports and imports from developed countries (green segments) are present, but they account for a much smaller share of total trade. However, their presence indicates that developed nations are slowly increasing their participation in green trade, likely due to stronger environmental policies and growing demand for sustainable products. On the other hand, undeveloped countries, as categorized by the HDI, contribute relatively small volumes to both green and non-green trade, as shown by the thin red and brown segments. This suggests that these countries face structural barriers that limit their participation in global trade, particularly in the green sector.

Compared to the previous analysis, this classification offers results that are more

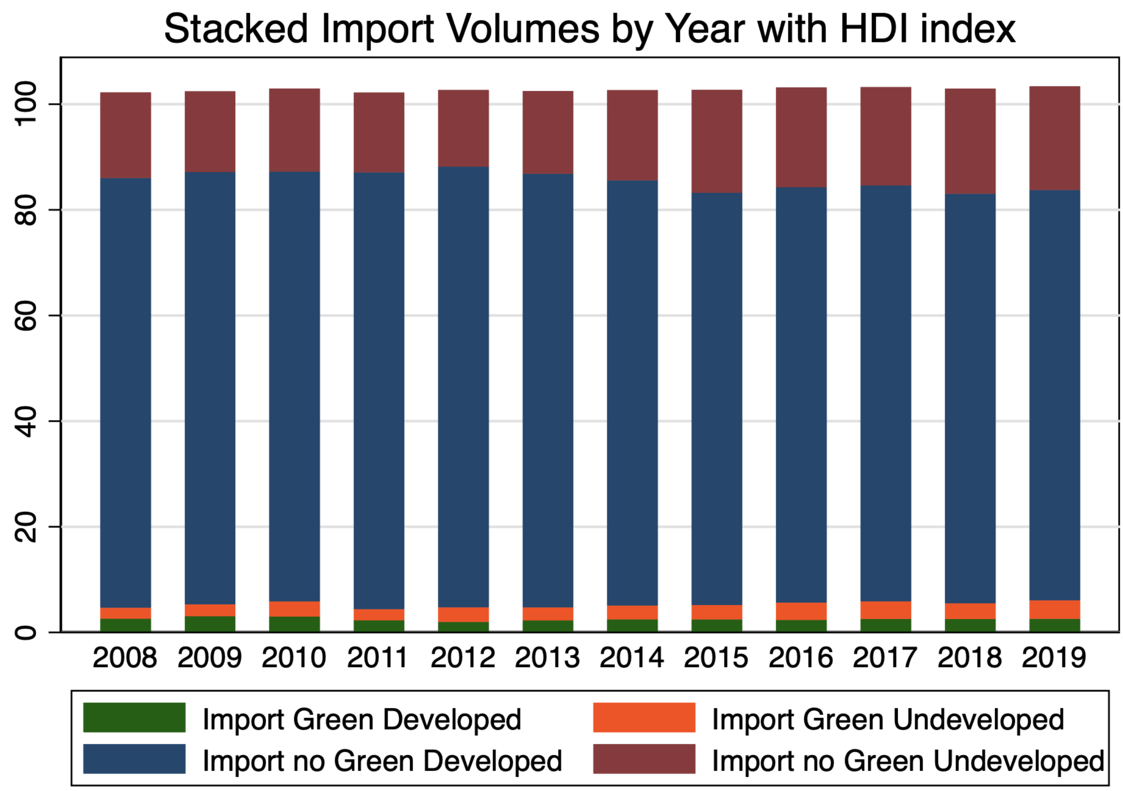

Figure 10: Stacked Import Volumes by Year with HDI index and OECD

aligned with contemporary realities. The HDI-based division of countries provides a clearer view of their development status beyond economic measures alone, while the OECD classification of products helps to identify the growing, though still limited, role of green products in trade. The results of this updated analysis, therefore, offer a more accurate and nuanced understanding of the relationship between development levels and participation in green and non-green trade across the world.

Algorithm 20: Stata code: Graph Import and Export volumes by Year using HDI index and OECD Part 1

Data: Final Dataset, Country Table, HDR2022_Country_Table

```
begin
    clear;
    * Load your dataset;
    use final dataset.dta;
    merge m:m country using Country Table;
    drop if _merge==2;
    drop _merge;
    merge m:m country using HDR2022_Country_Table.dta;
    drop if _merge==2;
    drop _merge;
```

Algorithm 21: Stata code: Graph Import and Export volumes by Year using HDI index and OECD Part 2

Data: Final Dataset, Country Table, HDR2022_Country_Table

```
begin
    label values HDIdeveloped dev;
    replace HDIdeveloped = 2 if HDIdeveloped == . ;
    * Step 1: Create new variables with conditional values;
    gen exp_dev = export_val if HDIdeveloped == 1  HS_Green == "no";
    gen exp_undev = export_val if (HDIdeveloped == 0 | HDIdeveloped == 2)  HS_Green == "no";
    gen exp_dev_HS_Green = export_val if HDIdeveloped == 1  HS_Green == "yes";
    gen exp_undev_HS_Green = export_val if (HDIdeveloped == 0 | HDIdeveloped == 2)  HS_Green ==
      "yes";
    gen imp_dev = import_val if HDIdeveloped == 1  HS_Green == "no";
    gen imp_undev = import_val if (HDIdeveloped == 0 | HDIdeveloped == 2)  HS_Green == "no";
    gen imp_dev_HS_Green = import_val if HDIdeveloped == 1  HS_Green == "yes";
    gen imp_undev_HS_Green = import_val if (HDIdeveloped == 0 | HDIdeveloped == 2)  HS_Green ==
      "yes";
    * Step 2: Collapse the dataset to get the sum of the desired variables by year;
    collapse (sum) export_val exp_dev exp_undev exp_dev_HS_Green exp_undev_HS_Green import_val
      imp_dev imp_undev imp_dev_HS_Green imp_undev_HS_Green, by(year);
    * Step 3: ;
    gen perc_exp_dev_HS_Green = (exp_dev_HS_Green/export_val)*100;
    gen perc_exp_undev_HS_Green = (exp_undev_HS_Green/export_val)*100;
    gen perc_exp_dev = (exp_dev/export_val)*100;
    gen perc_exp_undev = (exp_undev/export_val)*100;
    gen perc_imp_dev_HS_Green = (imp_dev_HS_Green/imp_dev)*100;
    gen perc_imp_undev_HS_Green = (imp_undev_HS_Green/imp_undev)*100;
    gen perc_imp_dev = (imp_dev/import_val)*100;
    gen perc_imp_undev = (imp_undev/import_val)*100;
    drop exp_dev exp_undev exp_dev_HS_Green exp_undev_HS_Green imp_dev imp_undev
      imp_dev_HS_Green imp_undev_HS_Green;
    * Export HS graph;
    graph bar (sum) perc_exp_dev_HS_Green perc_exp_undev_HS_Green perc_exp_dev perc_exp_dev
      perc_exp_undev, /// ;
    over(year) /// ;
    stack /// ;
    legend(order(1 "Export Green Developed" 2 "Export Green Undeveloped" 3 "Export no Green Developed" 4
      "Export no Green Undeveloped")) /// ;
    title("Stacked Export Volumes by Year with HDI index");
    graph export "Export volumes HDI.png", as(png) replace;
    * Import HS graph;
    graph bar (sum) perc_imp_dev_HS_Green perc_imp_undev_HS_Green perc_imp_dev perc_imp_undev,
      /// ;
    over(year) /// ;
    stack /// ;
    legend(order(1 "Import Green Developed" 2 "Import Green Undeveloped" 3 "Import no Green Developed" 4
      "Import no Green Undeveloped")) /// ;
    title("Stacked Import Volumes by Year with HDI index");
    graph export "Import volumes HDI.png", as(png) replace;
```

4.2.12 Most important Export Countries using the HDI classification

The analysis presented in Tables 25 and 26 offers a comprehensive comparison of the top 15 exporting countries, divided into developed and undeveloped categories according to the Human Development Index (HDI). The tables provide data on the total export volumes (in millions) for both developed and undeveloped countries, as well as the percentage of these exports classified as green under two different classification systems: the OECD green classification and the Bureau of Labor Statistics (BLS) green classification.

Table 25: Export HDI Developed Countries

State	Export (Millions)	Percentage OECD Green	Percentage BLS Green
Austria	6,720	3.049%	0.141%
Belgium	5,960	5.363%	0.234%
Czech Republic	2,840	8.875%	1.244%
France	29,300	3.814%	0.426%
Germany	35,400	4.947%	0.854%
Netherlands	6,100	5.409%	0.361%
Poland	5,630	4.141%	1.579%
Romania	2,760	5.771%	0.611%
Russian Federation	3,910	10.594%	0.319%
Spain	10,200	4.420%	0.599%
Sweden	3,710	5.457%	0.101%
Switzerland	13,500	2.331%	0.073%
Turkey	3,640	5.379%	0.565%
United Kindom	14,300	3.268%	0.244%
United States	16,200	4.664%	0.228%
Total	**160,170**	**5.165%**	**0.505%**

For the **developed countries** listed in Table 25, the total export volume reaches 160,170 million. Of this, an average of 5.165% is classified as green according to the OECD classification, while only 0.505% falls under the BLS green classification. Countries such as the Russian Federation and the Czech Republic stand out, with green exports under the OECD classification making up 10.594% and 8.875% of their total exports, respectively. However, it is notable that, across all developed countries, the proportion of green exports is considerably lower when classified according to the BLS standard. This suggests that the definition of green products under the BLS is more restrictive or narrower compared to the OECD, which might account for the variation in green export shares.

Table 26: Export HDI Undeveloped Countries

State	Export (Millions)	Percentage OECD Green	Percentage BLS Green
Algeria	2,150	6.101%	0.126%
Brazil	1,540	8.810%	1.172%
Bulgaria	939	5.786%	0.824%
China	4,760	7.247%	0.646%
Egypt	1,100	12.458%	0.193%
India	2,000	7.713%	1.392%
Indonesia	487	6.141%	0.354%
Iran, Islamic Republic of	639	21.367%	1.417%
Libyan Arab Jamahiriya	870	3.528%	0.095%
Mexico	1,460	5.987%	0.420%
Morocco	618	9.699%	1.148%
South Africa	852	6.792%	0.330%
Taiwan	592	10.109%	0.231%
Tunisia	1,330	4.041%	0.806%
Ukraine	621	5.581%	1.661%
Total	**19,958**	**8.091%**	**0.721%**

Table 26 highlights the export volumes for **undeveloped countries**, which total 19,958 million. Interestingly, these countries exhibit a higher percentage of green exports when measured using the OECD classification, with an average of 8.091%. This contrasts with the lower overall export volumes of undeveloped countries but indicates a relatively stronger share of green exports, particularly in countries like the Islamic Republic of Iran (21.367%) and Ukraine (5.581%). The BLS classification shows a smaller percentage of green exports for these countries, though still higher than for developed countries, averaging 0.721%. This discrepancy between classifications underscores the challenges in defining and categorizing green products, as different frameworks yield significantly different results.

The comparison between the developed and undeveloped country groups reveals several key insights. While developed countries export substantially larger volumes overall, undeveloped countries demonstrate a higher proportion of green exports according to the OECD classification. This could be indicative of a growing focus on sustainable trade practices in these emerging economies, although the relatively low BLS classification percentages for both groups highlight the complexity and variability in assessing the green economy. These findings suggest that the framework used for classifying green exports plays a crucial role in shaping our understanding of global trade dynamics, especially in the context of sustainable development.

Algorithm 22: Stata code: Most important HDI Export Countries Part 1

Data: Final Dataset, Country Table, HDR2022_Country_Table

```
begin
    *** DEVELOPED ****;
    clear;
    use final dataset.dta;
    merge m:m country using HDR2022_Country_Table.dta;
    drop if _merge==2;
    drop _merge;
    label values HDIdeveloped dev;
    replace HDIdeveloped = 2 if HDIdeveloped == . ;
    * To view the total import and export for each of the developed country;
    keep if HDIdeveloped == 1;
    gen exp_green_LBS = export_val if HS_Green=="yes";
    gen imp_green_LBS = import_val if HS_Green=="yes";
    gen exp_green_OECD = export_val if GGS_Green==1;
    gen imp_green_OECD = import_val if GGS_Green==1;
    drop firmid id year developed HDIdeveloped GGS_perc_2011 import offshoring_4d offshoring_3d
      ateco2007_3d HScode;
    collapse (sum) export_val import_val exp_green_LBS exp_green_OECD imp_green_LBS
      imp_green_OECD, by(country);
    gen perc_exp_green_LBS= exp_green_LBS / export_val * 100;
    gen perc_imp_green_LBS= imp_green_LBS / import_val * 100;
    gen perc_exp_green_OECD= exp_green_OECD / export_val * 100;
    gen perc_imp_green_OECD= imp_green_OECD / import_val * 100;
    * Add country lable according to the Eurostat system;
    merge m:m country using Country Table.dta;
    drop if _merge==2;
    drop _merge ISO;
    drop exp_green_LBS exp_green_OECD imp_green_LBS imp_green_OECD;
    gsort -export_val;
    keep in 1/15;
    estpost tabstat export_val perc_exp_green_LBS perc_exp_green_OECD, by(State) stats(sum);
    *** UNDEVELOPED ***;
    clear;
    use final dataset.dta;
    merge m:m country using HDR2022_Country_Table.dta;
    drop if _merge==2;
    drop _merge;
```

Algorithm 23: Stata code: Most important HDI Export Countries Part 2

Data: Final Dataset, Country Table, HDR2022_Country_Table

```
begin
    label values HDIdeveloped dev replace HDIdeveloped = 2 if HDIdeveloped == . ;
    * To view the total import and export for each of the developed country;
    keep if (HDIdeveloped == 0 | HDIdeveloped == 2);
    gen exp_green_LBS = export_val if HS_Green=="yes";
    gen imp_green_LBS = import_val if HS_Green=="yes";
    gen exp_green_OECD = export_val if GGS_Green==1;
    gen imp_green_OECD = import_val if GGS_Green==1;
    drop firmid id year developed HDIdeveloped GGS_perc_2011 import offshoring_4d offshoring_3d
      ateco2007_3d HScode;
    collapse (sum) export_val import_val exp_green_LBS exp_green_OECD imp_green_LBS
      imp_green_OECD, by(country);
    gen perc_exp_green_LBS= exp_green_LBS / export_val * 100;
    gen perc_imp_green_LBS= imp_green_LBS / import_val * 100;
    gen perc_exp_green_OECD= exp_green_OECD / export_val * 100;
    gen perc_imp_green_OECD= imp_green_OECD / import_val * 100;
    * Add country lable according to the Eurostat system;
    merge m:m country using Country Table.dta;
    drop if _merge==2;
    drop _merge ISO;
    drop exp_green_LBS exp_green_OECD imp_green_LBS imp_green_OECD;
    gsort -export_val;
    keep in 1/15;
    estpost tabstat export_val perc_exp_green_LBS perc_exp_green_OECD, by(State) stats(sum);
```

4.2.13 Most important Importing Countries using the HDI classification

The analysis in Tables 27 and 28 provides a detailed overview of the top 15 import source countries for Italy, categorized into developed and undeveloped countries based on the Human Development Index (HDI). Each table presents the total import volumes (in millions), along with the percentage of imports classified as green according to the OECD and BLS green classifications.

Table 27: Import Developed HDI Countries

State	Import (Millions)	Percentage OECD Green	Percentage BLS Green
Austria	6,530	1.548%	0.420%
Belgium	4,120	1.624%	0.617%
Czech Republic	2,150	1.680%	0.515%
France	13,000	2.124%	0.268%
Germany	17,800	3.528%	0.448%
Hungary	2,620	0.868%	0.100%

Continued on next page

Table 27 – Continued from previous page

State	Import (Millions)	Percentage OECD Green	Percentage BLS Green
Japan	1,630	8.182%	0.033%
Netherlands	4,270	0.929%	0.126%
Poland	2,050	5.419%	0.550%
Romania	1,560	3.468%	1.430%
Spain	6,490	1.336%	0.141%
Switzerland	4,120	2.715%	0.171%
Turkey	1,980	2.387%	0.233%
United Kindom	2,900	2.052%	1.936%
United States	7,180	0.782%	0.054%
Total	**78,400**	**2.576%**	**0.469%**

Table 27 focuses on **developed countries**, where the total import volume reaches 78,400 million. Of these imports, 2.576% are classified as green under the OECD green classification, while 0.469% are classified as green under the BLS system. Among these developed countries, Japan stands out with the highest proportion of green imports according to the OECD classification (8.182%), although the BLS classification for Japan's green imports is significantly lower at 0.033%. Germany, Poland, and Switzerland also show relatively higher shares of green imports under the OECD classification, with 3.528%, 5.419%, and 2.715%, respectively. However, the overall percentage of green imports remains modest, reflecting that non-green imports still dominate trade flows from these countries.

Table 28: Import Undeveloped HDI Countries

State	Import (Millions)	Percentage OECD Green	Percentage BLS Green
Albania	208	0.451%	0.003%
Bosnia and Herzegovina	432	0.283%	0.012%
Brazil	1,830	0.075%	0.166%
Bulgaria	701	5.085%	0.587%
China	8,630	4.152%	0.799%
Egypt	264	1.918%	0.000%
India	1,210	3.127%	0.891%
Indonesia	452	0.034%	0.223%
Mexico	540	0.435%	0.095%
Morocco	253	0.008%	0.001%

Continued on next page

Table 28 – Continued from previous page

State	Import (Millions)	Percentage OECD Green	Percentage BLS Green
Pakistan	208	0.027%	0.000%
Taiwan	403	5.352%	0.535%
Tunisia	771	1.756%	0.099%
Ukraine	721	0.010%	0.001%
Viet-Nam	812	5.152%	0.292%
Total	**1,162**	**1.858%**	**0.247%**

Table 28 presents data on **undeveloped countries**, with a total import volume of 1,162 million. The average percentage of OECD green imports from these countries is 1.858%, while the BLS classification shows a significantly lower average of 0.247%. China leads the undeveloped group in terms of green imports according to the OECD classification, with 4.152%, although it also exhibits a much lower percentage under the BLS classification at 0.799%. Other notable contributors to green imports from undeveloped countries include Taiwan (5.352% OECD green), Viet-Nam (5.152% OECD green), and Bulgaria (5.085% OECD green). However, many of these countries show very low shares of green imports according to the BLS classification, illustrating once again the variation between the two classification systems.

The **comparison between developed and undeveloped countries** in terms of green imports reveals several important patterns. Developed countries contribute a higher absolute volume of imports, but undeveloped countries show a relatively higher percentage of green imports under the OECD classification. However, as with the export data, the BLS classification reflects a much narrower definition of green products, leading to significantly lower percentages across both groups. This variation highlights the importance of classification frameworks in assessing the role of green trade and suggests that while there is some movement towards green imports, particularly from select undeveloped countries, the overall trend remains dominated by non-green trade.

Algorithm 24: Stata code: Most important HDI Import Countries Part 1

Data: Final Dataset, Country Table, HDR2022_Country_Table

```
begin
    *** Developed *** clear;
    use "/Volumes/ESD-USB/TESI/final dataset.dta";
    merge m:m country using HDR2022_Country_Table.dta;
    drop if _merge==2;
    drop _merge;
    label values HDIdeveloped dev;
    replace HDIdeveloped = 2 if HDIdeveloped == . ;
    * To view the total import and export for each of the developed country;
    keep if HDIdeveloped == 1;
    gen exp_green_LBS = export_val if HS_Green=="yes";
    gen imp_green_LBS = import_val if HS_Green=="yes";
    gen exp_green_OECD = export_val if GGS_Green==1;
    gen imp_green_OECD = import_val if GGS_Green==1;
    drop firmid id year developed HDIdeveloped GGS_perc_2011 import offshoring_4d offshoring_3d
      ateco2007_3d HScode;
    collapse (sum) export_val import_val exp_green_LBS exp_green_OECD imp_green_LBS
      imp_green_OECD, by(country);
    gen perc_exp_green_LBS= exp_green_LBS / export_val * 100;
    gen perc_imp_green_LBS= imp_green_LBS / import_val * 100;
    gen perc_exp_green_OECD= exp_green_OECD / export_val * 100;
    gen perc_imp_green_OECD= imp_green_OECD / import_val * 100;
    * Add country lable according to the Eurostat system merge m:m country using Country Table.dta;
    drop if _merge==2;
    drop _merge ISO;
    drop exp_green_LBS exp_green_OECD imp_green_LBS imp_green_OECD;
    gsort -import_val;
    keep in 1/15;
    estpost tabstat import_val perc_imp_green_LBS perc_imp_green_OECD, by(State) stats(sum);
    *** Undeveloped ***;
    clear;
    use final dataset.dta;
    merge m:m country using HDR2022_Country_Table.dta;
    drop if _merge==2;
    drop _merge;
    label values HDIdeveloped dev replace HDIdeveloped = 2 if HDIdeveloped == . ;
    * To view the total import and export for each of the developed country;
    keep if (HDIdeveloped == 0 | HDIdeveloped == 2);
    gen exp_green_LBS = export_val if HS_Green=="yes";
    gen imp_green_LBS = import_val if HS_Green=="yes";
    gen exp_green_OECD = export_val if GGS_Green==1;
    gen imp_green_OECD = import_val if GGS_Green==1;
```

Algorithm 25: Stata code: Most important HDI Import Countries Part 2

Data: Final Dataset, Country Table, HDR2022_Country_Table

```
begin
    drop firmid id year developed HDIdeveloped GGS_perc_2011 import offshoring_4d offshoring_3d
      ateco2007_3d HScode;
    collapse (sum) export_val import_val exp_green_LBS exp_green_OECD imp_green_LBS
      imp_green_OECD, by(country);
    gen perc_exp_green_LBS= exp_green_LBS / export_val * 100;
    gen perc_imp_green_LBS= imp_green_LBS / import_val * 100;
    gen perc_exp_green_OECD= exp_green_OECD / export_val * 100;
    gen perc_imp_green_OECD= imp_green_OECD / import_val * 100;
    * Add country lable according to the Eurostat system merge m:m country using Country Table.dta"; drop if
      _merge==2;
    drop _merge ISO;
    drop exp_green_LBS exp_green_OECD imp_green_LBS imp_green_OECD;
    gsort -import_val;
    keep in 1/15;
    estpost tabstat import_val perc_imp_green_LBS perc_imp_green_OECD, by(State) stats(sum);
```

4.2.14 Offshoring overview

Offshore transactions represent an integral aspect of modern global trade, involving the production and exchange of goods and services between domestic firms and foreign entities, typically through subsidiaries or affiliates located outside the national borders. These transactions often arise when firms seek to capitalize on cost advantages, favorable regulatory environments, or strategic market access. Offshore exports refer to goods produced in foreign countries by domestic firms and exported from these foreign locations, whereas offshore imports involve goods produced abroad and brought into the domestic market, often through foreign affiliates or partners of domestic companies. Understanding the dynamics of offshore transactions is essential for analyzing a country's international trade patterns, as it highlights the growing importance of global supply chains in shaping both exports and imports.

The analysis of export and offshore export volumes from 2008 to 2019 reveals a clear upward trend in both categories. Initially, there is a substantial difference between total export volumes and offshore export volumes, with offshore exports contributing a smaller share to overall export activities. Over time, total exports increase steadily, rising from approximately 15,000 million in 2008 to nearly 22,500 million by 2019. Offshore exports also show a consistent increase during this period, growing from around 12,500 million to 16,000 million. Although offshore exports represent a significant

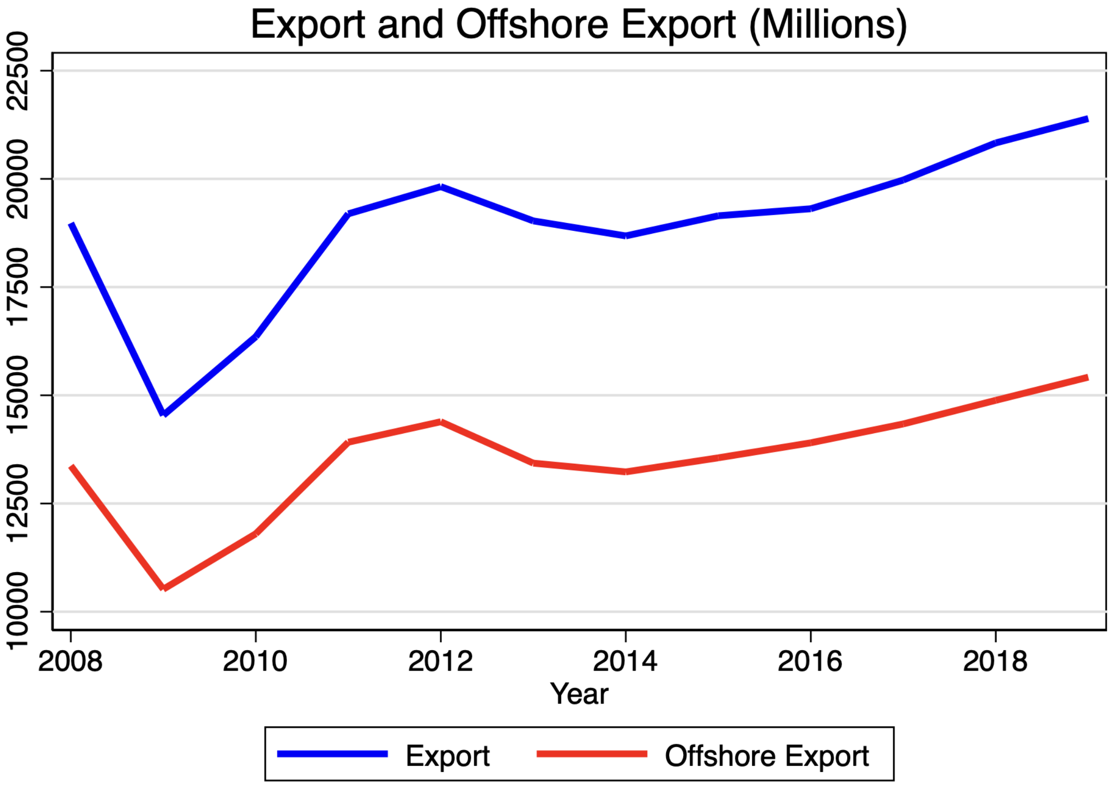

Figure 11: Export and Offshore Export over the years (Millions)

portion of the country's export activities, they consistently remain lower than total exports. This indicates that while offshore production and exportation have gained importance over the years, a large share of the country's export activities continues to be conducted through traditional channels or domestic production.

A similar trend is observed in the analysis of import and offshore import volumes over the same period. Total imports exhibit fluctuations, particularly between 2008 and 2012, but overall they increase from approximately 9,500 million in 2008 to nearly 10,500 million by 2019. Offshore imports, while lower in absolute terms than total imports, also experience steady growth, increasing from 4,000 million to about 5,500 million over the period. The gap between total imports and offshore imports indicates that a substantial proportion of the country's imports continues to be generated through conventional trade mechanisms, with offshore imports representing a smaller, though growing, segment.

Comparing the trends in offshore exports and offshore imports reveals several important insights. Offshore exports consistently outpace offshore imports in terms of volume,

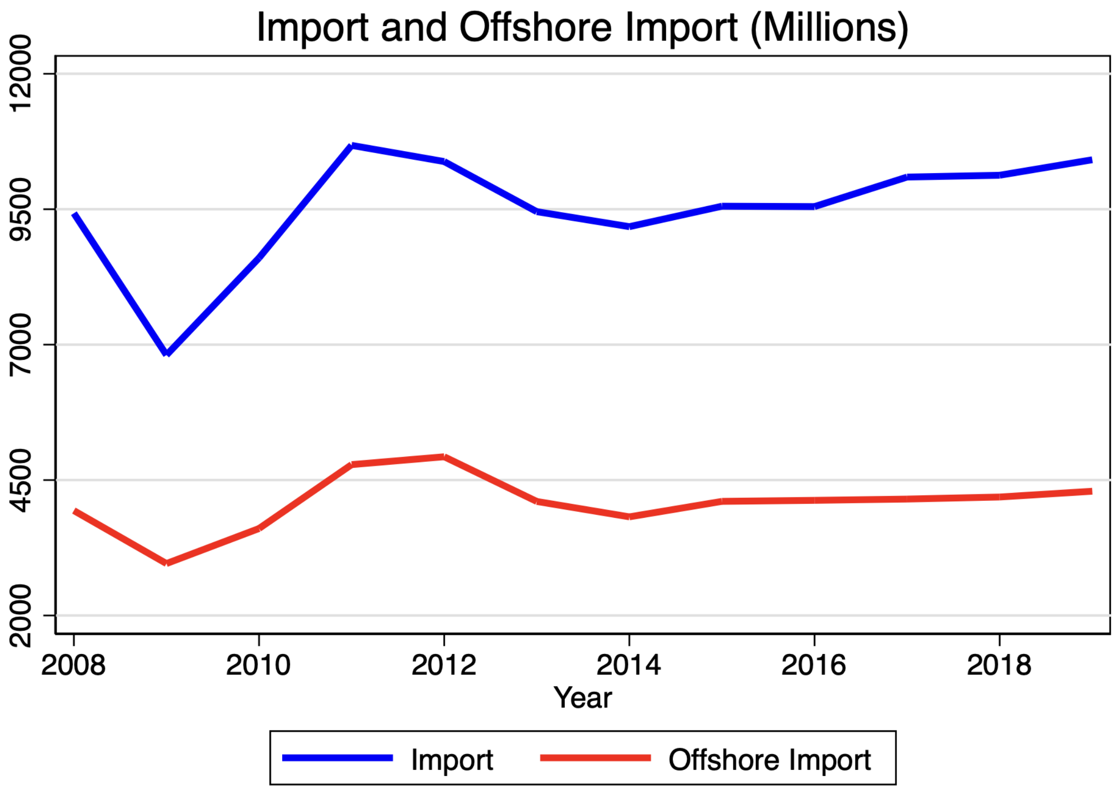

Figure 12: Import and Offshore Import over the years (Millions)

indicating a stronger reliance on offshore production for international markets than for supplying the domestic market. This suggests that domestic firms are increasingly turning to offshore production as a means of enhancing their competitiveness in foreign markets, leveraging lower production costs or accessing strategic resources. On the other hand, the lower volume of offshore imports relative to total imports suggests that the domestic market remains less dependent on goods produced offshore, despite the steady growth in offshore import activities.

Algorithm 26: Stata code: Import and Export offshoring graphs Part 1

Data: Final Dataset

```
begin
    * Open file;
    clear;
    use final dataset.dta;
    * Step 1: Create new variables with conditional values;
    gen exp_offshore = export_val/1000000 if offshoring_3d == 1;
    gen imp_offshore = import_val/1000000 if offshoring_3d == 1;
    gen exp_norm = export_val/1000000;
    gen imp_norm = import_val/1000000;
```

Algorithm 27: Stata code: Import and Export offshoring graphs Part 2

Data: Final Dataset

```
begin
    * Step 2: Collapse the dataset to get the sum of the desired variables by year;
    collapse (sum) exp_norm exp_offshore imp_norm imp_offshore, by(year);
    * Generate graph for Export and Offshoring Export:;
    twoway (line exp_norm year, lcolor(blue) lpattern(solid) lwidth(thick)) /// ;
    (line exp_offshore year, lcolor(red) lpattern(solid) lwidth(thick)), /// ;
    legend(label(1 "Export") label(2 "Offshore Export")) /// ;
    title("Export and Offshore Export (Millions)") /// ;
    xtitle("Year") /// ;
    xlabel(2008(2)2019) /// ;
    ylabel(10000(2500)22500, grid);
    graph export "graph export+export offshoring.png", as(png) replace;
    * Generate graph for Export and Offshoring Export: ;
    twoway (line imp_norm year, lcolor(blue) lpattern(solid) lwidth(thick)) /// ;
    (line imp_offshore year, lcolor(red) lpattern(solid) lwidth(thick)), /// ;
    legend(label(1 "Import") label(2 "Offshore Import")) /// ;
    title("Import and Offshore Import (Millions)") /// ;
    xtitle("Year") /// ;
    xlabel(2008(2)2019) /// ;
    ylabel(2000(2500)12000, grid);
    graph export "graph import+import offshoring.png", as(png) replace;
```

4.2.15 Green Offshoring using OECD classification

The analysis of offshore exports, as presented in Figure 13, distinguishes between sustainable (green) and non-sustainable (no green) products using the OECD's sustainable product list. The data reveals that, over the period from 2008 to 2019, the vast majority of offshore exports are classified as non-sustainable (no green), represented by the large blue area in the graph. Although the volume of sustainable (green) offshore exports shows a slight increase over the years, indicated by the growing green section at the top of the chart, it remains a small proportion of total offshore exports. The trend indicates that, while there is a gradual rise in sustainable exports, the overall composition of offshore export activities remains dominated by non-sustainable goods. This suggests that despite some efforts toward sustainability in production, a significant portion of offshore export activities continue to rely on traditional, non-green sectors.

Similarly, the analysis of offshore imports in Figure 14 follows the same distinction between sustainable and non-sustainable products. The graph shows a similar pattern,

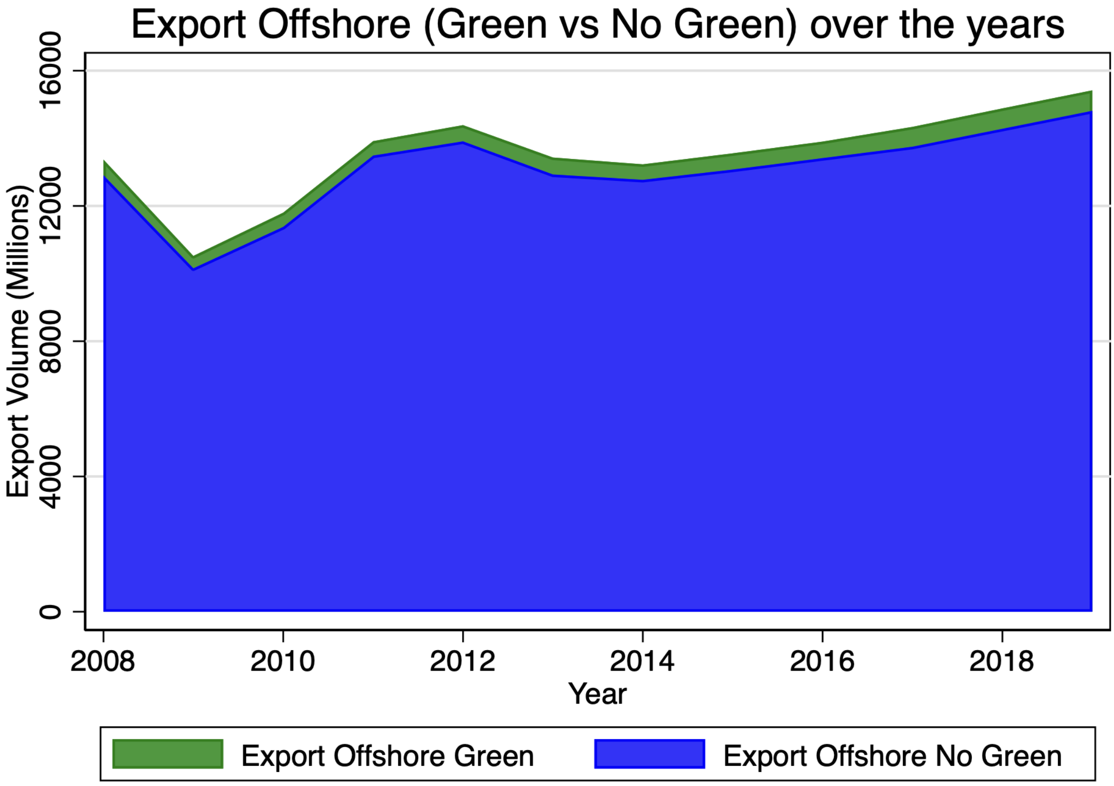

Figure 13: Export Offshore (Green vs No Green) over the years

where the majority of offshore imports are non-sustainable (no green), with the blue area representing most of the import volume. The green portion, representing sustainable offshore imports, remains small throughout the period, although there is a slight upward trend. In contrast to offshore exports, offshore imports appear to have a more stable trend without the fluctuations seen in exports, particularly in the years leading up to 2012. The data suggests that, like exports, offshore imports remain primarily non-sustainable, though there is a small but steady increase in the volume of green products.

When comparing the results of offshore exports and imports, several observations emerge. In both cases, non-sustainable products represent the overwhelming majority of offshore transactions, with sustainable products accounting for a small and relatively stable share. However, offshore exports display slightly more volatility, particularly in the years 2010 to 2012, whereas offshore imports show a more consistent pattern over time. The increasing trend of green products in both imports and exports, though modest, indicates a gradual shift toward sustainability, though it remains insufficient

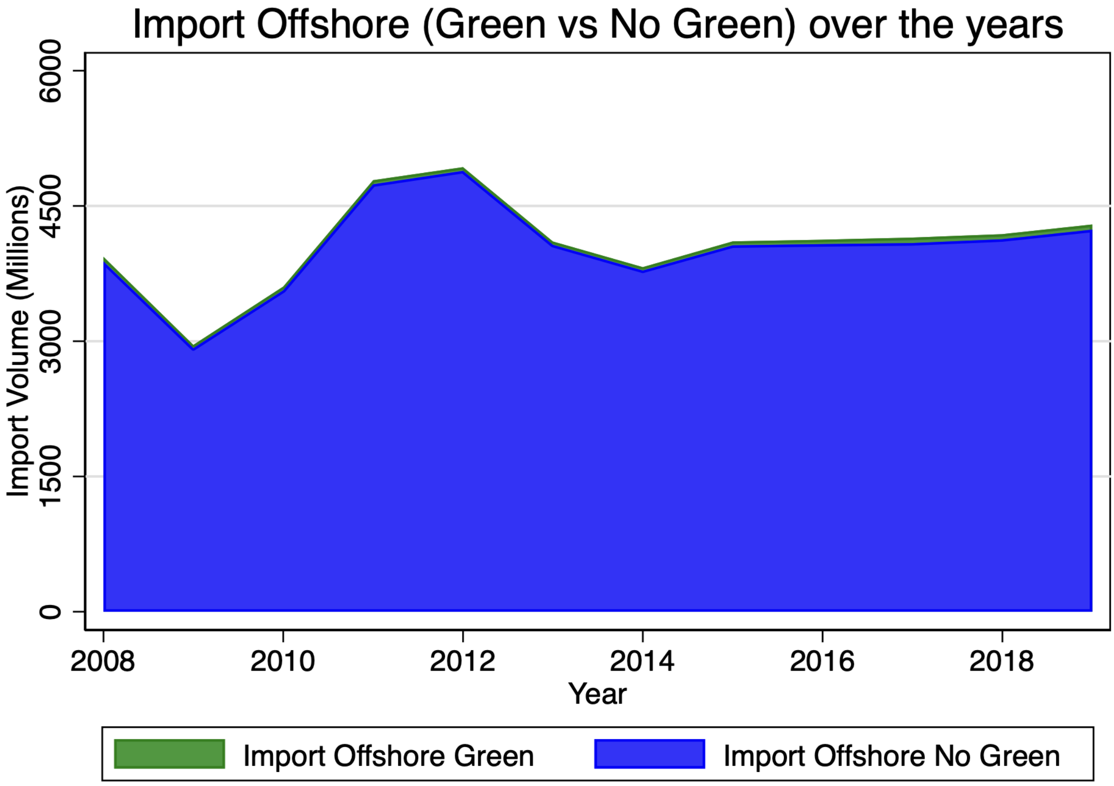

Figure 14: Import Offshore (Green vs No Green) over the years

to significantly alter the overall structure of offshore trade.

The dominance of non-sustainable products in offshore transactions raises questions related to the pollution haven hypothesis, which suggests that countries with less stringent environmental regulations may become attractive destinations for industries looking to produce goods in a cost-effective but environmentally harmful manner. The data shows that despite some growth in green products, offshore trade is still heavily reliant on non-green goods, lending support to the pollution haven hypothesis. This imbalance between sustainable and non-sustainable offshore trade suggests that while some progress has been made toward incorporating sustainable practices, the reliance on non-green products continues to play a significant role in offshore transactions, potentially exacerbating environmental concerns associated with global trade.

Algorithm 28: Stata code: Green Import and Export offshoring graphs

Data: Final Dataset

```
begin
    * Open file;
    clear;
    use final dataset.dta;
    drop if offshoring_3d != 1;
    * Step 1: Create new variables with conditional values;
    gen exp = export_val/1000000 if HS_Green == "no";
    gen exp_HS_Green = export_val/1000000 if HS_Green == "yes";
    gen imp = import_val/1000000 if HS_Green == "no";
    gen imp_HS_Green = import_val/1000000 if HS_Green == "yes";
    * Step 2: Collapse the dataset to get the sum of the desired variables by year;
    collapse (sum) exp exp_HS_Green imp imp_HS_Green, by(year);
    * Comulative variable for area graph;
    gen Total_Offshore_Export = exp + exp_HS_Green;
    gen Total_Offshore_Import = imp + imp_HS_Green;
    * Graph Export Offshore (Green vs No Green) over the years;
    twoway (area Total_Offshore_Export year, lcolor(green) fcolor(green)) /// ;
    (area exp year, lcolor(blue) fcolor(blue)), /// ;
    legend(label(2 "Export Offshore No Green") label(1 "Export Offshore Green")) /// ;
    title("Export Offshore (Green vs No Green) over the years") /// ;
    xtitle("Year") ytitle("Export Volume (Millions)") /// xlabel(2008(2)2018) /// ;
    ylabel(0(4000)16000, grid);
    graph export "graph export offshoring green vs no green.png", as(png) replace;
    * Graph Import Offshore (Green vs No Green) over the years;
    twoway (area Total_Offshore_Import year, lcolor(green) fcolor(green)) /// ;
    (area imp year, lcolor(blue) fcolor(blue)), /// ;
    legend(label(2 "Import Offshore No Green") label(1 "Import Offshore Green")) /// ;
    title("Import Offshore (Green vs No Green) over the years") /// ;
    xtitle("Year") ytitle("Import Volume (Millions)") /// ;
    xlabel(2008(2)2018) /// ;
    ylabel(0(1500)6000, grid);
    graph export "graph import offshoring green vs no green.png", as(png) replace;
```

5 Conclusion

This study underscores the significant impact that **classification assumptions** have on the analysis of sustainability in international trade. The findings illustrate how the choice of classification systems, both for categorizing sustainable transactions and for dividing countries into developed and undeveloped groups, profoundly affects the results. As evidenced in the comparative analysis of data from the OECD and the Bureau of Labor Statistics (BLS), the definitions of what constitutes a **"green" product** yield strikingly different outcomes. The OECD's broader classification captures a larger volume of goods as sustainable, which suggests that trade in green goods is more substantial than what the BLS's more restrictive criteria reveal. This indicates that the scope and inclusiveness of the criteria used to identify green products are essential to understanding the real scale of sustainability in global trade flows. The broader the definition, the more substantial the volume of green transactions appears, while stricter standards result in lower recorded volumes, thus giving the impression of a smaller green economy.

Similarly, the **classification of countries** into developed and undeveloped groups also plays a critical role in shaping our understanding of sustainability in trade. By comparing the IMF's economic-based classification with the ONU's Human Development Index (HDI), the study highlights important differences in how global trade patterns are understood. The IMF's classification, focused on economic indicators, tends to overlook broader human welfare dimensions, whereas the HDI provides a more comprehensive measure of development by integrating factors such as education, health, and standard of living. This more holistic approach allows for a nuanced analysis of trade relationships and sustainability patterns. Countries previously considered undeveloped under economic measures may demonstrate significant development progress when viewed through the HDI lens, influencing their role and contribution in global sustainable trade. The data shows that applying the HDI provides a clearer understanding of which nations are advancing toward sustainable development, even if they remain classified as "developing" by traditional economic metrics.

The analysis also highlights **key trends** related to green and non-green exports and imports. While non-green trade remains dominant, there is a discernible increase in the volume of green products, particularly in developed countries. This indicates a shift, albeit gradual, toward more sustainable trade practices. The trend suggests that countries with higher development indices, particularly those classified as developed, are increasingly integrating green products into their trade activities. In contrast, undeveloped or developing countries, though also participating in green trade, continue to rely heavily on non-green goods. This trend points to the need for greater support and investment in sustainable production in developing economies to encourage a faster transition toward green trade.

Furthermore, the results of the **offshoring analysis** provide valuable insights into the sustainability of international business practices. The offshoring trends for both imports and exports show that non-green offshoring remains predominant, reflecting the continuing reliance on traditional, non-sustainable production methods in offshore transactions. However, there is a small but steady increase in the offshoring of green products, indicating that some sectors are beginning to adopt more sustainable practices abroad. This suggests a growing awareness of sustainability in offshoring strategies, particularly in industries subject to international scrutiny regarding their environmental impact. However, the volume of green offshoring remains relatively low compared to non-green offshoring, highlighting the ongoing challenges in making sustainability a core component of international production strategies.

The comparison of offshore export and import trends reveals important correlations that further inform the study's conclusions. Offshore exports show greater volatility than offshore imports, suggesting that firms may be using offshoring more strategically for exports, potentially to take advantage of cost efficiencies or to meet foreign market demand. In contrast, offshore imports display a more stable trend, indicating a consistent reliance on foreign-produced goods, particularly in non-green sectors. The rising trend of green offshoring, though limited, suggests that firms are beginning to integrate sustainable practices into their global supply chains, but more robust policy frameworks and incentives are needed to accelerate this shift.

One key implication of these findings is the relevance of the **pollution haven hypothesis**, which posits that firms may relocate production to countries with less stringent environmental regulations, contributing to global pollution. The data shows that despite some increase in green trade, offshore activities remain dominated by non-sustainable practices, potentially supporting the hypothesis that firms are seeking lower-cost, less regulated environments for their operations. This calls for stronger international regulatory cooperation and harmonization of environmental standards to prevent the exploitation of regulatory gaps that allow for environmentally harmful offshoring.

In conclusion, the study demonstrates that the classifications and assumptions used in assessing sustainable trade have a profound impact on the results. The choice of the OECD product list for classifying green products proves to be more effective and accurate than relying on sector-level codes like ATECO, as it provides a clearer and broader understanding of what constitutes sustainable trade. Moreover, combining the OECD product classification with the ONU's HDI-based country classification provides a more comprehensive framework for understanding the role of different nations in global sustainable trade. This integrated approach reveals that while developed countries are leading the shift toward green trade, developing nations remain heavily reliant on non-sustainable exports and imports.

Lastly, the offshoring analysis points to the growing but still limited role of sustainability in offshore production and trade. While the rise in green offshoring is encouraging, it is clear that much more needs to be done to promote sustainable practices in international trade. Policymakers and industry leaders must focus on creating incentives for sustainable offshoring and harmonizing environmental regulations globally to ensure that offshoring contributes positively to both economic growth and environmental protection.

References

Adefarati, T. & Bansal, R. (2019), 'Reliability, economic and environmental analysis of a microgrid system in the presence of renewable energy resources', *Applied Energy* **236**, 1089–1114.

Andreoni, J. & Levinson, A. (1998), 'The simple analytics of the environmental kuznets curve', *National Bureau of Economic Research Working Paper 6739* .

Antweiler, W., Copeland, B. & Taylor, M. (2001), 'Is free trade good for the environment?', *American Economic Review* **91**, 877–908.

Balsalobre-Lorente, D., Driha, O. & Bekun, F. (2021), 'Green trade and growth: the environmental impact of green trade openness on economic growth and energy demand', *Economic Analysis and Policy* **69**, 318–332.

Becker, R. & Henderson, J. V. (2000), 'Effects of air quality regulations on polluting industries', *Journal of Political Economy* **108**(2), 379–421.

Beckerman, W. (1992), 'Economic growth and the environment: Whose growth? whose environment?', *World Development* **20**, 481–496.

Beghin, J., Roland-Holst, D. & van der Mensbrugghe, D. (1994), 'A survey of the trade and environment nexus: Global dimensions', *OECD Economic Studies* **23**, 167–192.

Brunel, C. (2019), 'Green innovation and green imports: Links between environmental policies, innovation, and production', *Journal of Environmental Management* . `https://www.researchgate.net/publication/334974235`.

Brunnermeier, S. B. & Levinson, A. (2004), 'Examining the evidence on environmental regulations and industry location', *Journal of Environment & Development* **13**(1), 6–41.

Cole, M. & Elliott, R. (2003), 'Determining the trade-environment composition effect: The role of capital, labor, and environmental regulations', *Journal of Environmental Economics and Management* **46**, 363–383.

Copeland, B. R. (1994), 'International trade and the environment: Policy reform in a polluted small open economy', *Journal of Environmental Economics and Management* **26**(1), 44–65.

Copeland, B. R. & Taylor, M. S. (2004*a*), 'Trade, growth, and the environment', *Journal of Economic Literature* **42**(1), 7–71.

Copeland, B. & Taylor, M. (1994), 'North-south trade and the environment', *Quarterly Journal of Economics* **109**, 755–787.

Copeland, B. & Taylor, M. (2004*b*), 'Trade, growth, and the environment', *Journal of Economic Literature* **42**, 7–71.

Costantini, V. & Crespi, F. (2008), 'Environmental regulation and the export dynamics of energy technologies', *Ecological Economics* **66**, 447–460.

Costantini, V., Crespi, F. & Palma, A. (2017), 'Characterizing the policy mix and its impact on eco-innovation: A patent analysis of energy-efficient technologies', *Research Policy* **46**, 799–819.

Costantini, V. & Mazzanti, M. (2012*a*), 'Green exports and the role of environmental innovation in the eu: A dynamic econometric analysis', *Environment and Development Economics* **17**(4), 409–433.

Costantini, V. & Mazzanti, M. (2012*b*), 'On the green and innovative side of trade competitiveness? the impact of environmental policies and innovation on eu exports', *Research Policy* **41**, 132–153.

Dasgupta, S., Laplante, B., Wang, H. & Wheeler, D. (2002), 'Confronting the environmental kuznets curve', *Journal of Economic Perspectives* **16**, 147–168.

Day, K. & Grafton, R. (2003), 'Growth and the environment in canada: An empirical analysis', *Canadian Journal of Agricultural Economics* **51**, 197–216.

De Bruyn, S. M., van den Bergh, J. C. & Opschoor, H. J. (1998), 'Economic growth and emissions: reconsidering the empirical basis of environmental kuznets curves', *Ecological Economics* **25**(2), 161–175.

Dechezlepretre, A. & Glachant, M. (2014), 'Does foreign environmental policy influence domestic innovation?evidence from the wind industry', *Environmental and Resource Economics* **58**, 391–413.

Dechezlepretre, A., Glachant, M., Haščič, I., Johnstone, N. & Ménière, Y. (2013), ‘Invention and transfer of climate change mitigation technologies: A global analysis’, *Review of Environmental Economics and Policy* **7**, 109–130.

Di Pietro, E. (2005), ‘Le statistiche del commercio estero dell’istat: Rilevazione intrastat’, *Servizio Statistiche del Commercio Estero, ISTAT* **1**(13), 2–92. Document on foreign trade statistics methodologies.

Ederington, J. & Minier, J. (2003), ‘Footloose and pollution-free’, *The Review of Economics and Statistics* **85**(1), 92–99.

Etsy, D. & Porter, M. (2005), ‘National environmental performance: An empirical analysis of policy results and determinants’, *Environmental Development Economics* **10**, 391–434.

European Commission (2010), ‘Geonomenclature 2010: Nomenclature of countries and territories for the international trade of goods statistics’, *EUROSTAT* . Published by EUROSTAT, Unit G4 International Transactions.
URL: *https://ec.europa.eu/eurostat/documents/*

Grossman, G. & Krueger, A. (1995*a*), ‘Economic growth and the environment’, *Quarterly Journal of Economics* **110**, 353–377.

Grossman, G. M. & Krueger, A. B. (1993), ‘Environmental impacts of a north american free trade agreement’, *The US-Mexico Free Trade Agreement* pp. 13–56.

Grossman, G. M. & Krueger, A. B. (1995*b*), ‘Economic growth and the environment’, *The Quarterly Journal of Economics* **110**(2), 353–377.

Harris, M. N., Konya, L. & Matyas, L. (2002), ‘Modelling the impact of environmental regulations on bilateral trade flows: Oecd, 1990-1996’, *The World Economy* **25**, 387–405.

Hettige, H., Mani, M. & Wheeler, D. (1992), ‘The toxic intensity of industrial production: global patterns, trends, and trade policy’, *The American Economic Review* **82**(2), 478–481.

Hibiki, A. & Managi, S. (2010), ‘Does the japanese prtr program reduce emissions?’, *Environmental Economics and Policy Studies* **12**(2), 151–173.

Huang, L. & Zhao, W. (2022), 'The impact of green trade and green growth on natural resources', *Resources Policy* **77**, 102749.

International Monetary Fund (2023), 'World economic outlook database: April 2023 - groups and aggregates', *IMF World Economic Outlook* . Accessed: 16 October 2024. **URL:** *https://www.imf.org/en/Publications/WEO/weo-database/2023/April/groups-and-aggregatesae*

ISTAT (2023), 'The economic importance of intrastat data collection for italy', *ISTAT Economic Reports* **25**(3), 15–30. Annual review of Italy's trade within the EU.

Jaffe, A. B., Peterson, S. R., Portney, P. R. & Stavins, R. N. (1995), 'Environmental regulation and the competitiveness of us manufacturing: what does the evidence tell us?', *Journal of Economic Literature* **33**(1), 132–163.

Jaffe, A. & Palmer, K. (1997), 'Environmental regulation and innovation: a panel data study', *Review of Economics and Statistics* **79**, 610–619.

Jayadevappa, R. & Chhatre, S. (2000), 'International trade and environmental quality: a survey', *Ecological Economics* **32**(2), 175–194.

Jug, J. & Mirza, D. (2005), 'Environmental regulations in gravity equations: Evidence from europe', *The World Economy* **28**, 1591–1615.

Kang, S. J. & Lee, S. (2021), 'Impacts of environmental policies on global green trade', *Sustainability* **13**(3), 1517.

Kolstad, A. & Krautkraemer, V. (1993), 'Natural resource use and the environment', *Handbook of Natural Resource and Energy Economics* **3**, 1219–1265.

Kuik, O., Branger, F. & Quirion, P. (2019), 'Competitive advantage in the renewable energy industry: Evidence from a gravity model', *Renewable Energy* **131**, 472–481.

Lantz, V. & Feng, Q. (2006), 'Assessing income, population, and technology impacts on co2 emissions in canada: Where's the ekc?', *Ecological Economics* **57**, 229–238.

Levinson, A. & Taylor, M. S. (2008), 'Trade policy and international trade in waste products', *American Economic Review* **98**(2), 421–426.

Lopez, R. (1994), 'The environment as a factor of production: The effects of economic growth and trade liberalization', *Journal of Environmental Economics and Management* **27**, 163–184.

Lucas, R. E., Wheeler, D. & Hettige, H. (1992), 'Economic development, environmental regulation, and the international migration of toxic industrial pollution: 1960–1988', *International Trade and the Environment, World Bank Discussion Paper* **159**, 67–86.

Mohapatra, S., Adamowicz, W. & Boxall, P. (2016), 'Dynamic technique and scale effects of economic growth on the environment', *Energy Economics* **57**, 256–264.

Oladosu, G. & Rose, A. (2007), 'Income distribution impacts of climate change mitigation policy in the susquehanna river basin economy', *Energy Economics* **29**, 520–544.

Pao, H. & Tsai, C. (2011), 'Modeling and forecasting the co2 emissions, energy consumption, and economic growth in brazil', *Energy* **36**(5), 2450–2458.

Parliament, E. & Council (2004), 'Regulation (ec) no 638/2004 on intrastat data collection', *Official Journal of the European Union* **638**(1), 2–10. EU regulations on statistical data collection for intra-EU trade.

Pearce, D. W. & Turner, R. K. (1990), *Economics of Natural Resources and the Environment*, Johns Hopkins University Press, Baltimore, MD, USA.

Peters, M., Schneider, M., Griesshaber, T. & Hoffmann, V. (2012), 'The impact of technology-push and demand-pull policies on technical change – does the locus of policies matter?', *Research Policy* **41**, 1296–1308.

Pethig, R. (1976), 'Pollution, welfare, and environmental policy in the theory of comparative advantage', *Journal of Environmental Economics and Management* **2**(3), 160–169.

Pollin, R. (2019), 'Advancing a viable global climate stabilization project: Degrowth versus the green new deal', *Review of Radical Political Economics* **51**, 311–319.

Popp, D. (2002), 'Induced innovation and energy prices', *American Economic Review* **92**, 160–180.

Porter, M. E. & Van der Linde, C. (1995), 'Toward a new conception of the environment-competitiveness relationship', *Journal of Economic Perspectives* **9**(4), 97–118.

Sandberg, M. & et al. (2019), 'The role of green trade in reducing environmental impacts', *Ecological Economics* **164**, 106367.

Shahbaz, M., Rehman, I. & Amir, N. (2016), 'Does renewable energy consumption add in economic growth? an application of auto-regressive distributed lag model in pakistan', *Renewable and Sustainable Energy Reviews* **60**, 1072–1080.

Siebert, H. (1992), 'The economics of the environment: Theory and policy', *Springer-Verlag* .

Steenblik, R. (2005), 'Environmental goods: A comparison of the apec and oecd lists', *OECD Trade and Environment Working Papers* (2005/04).

Stern, D. I. (2004), 'The rise and fall of the environmental kuznets curve', *World Development* **32**(8), 1419–1439.

Stern, D. I., Common, M. S. & Barbier, E. B. (1996), 'Economic growth and environmental degradation: The environmental kuznets curve and sustainable development', *World Development* **24**(7), 1151–1160.

Tang, J. P. (2015), 'Pollution havens and the trade in toxic chemicals: Evidence from u.s. trade flows', *Ecological Economics* **112**, 150–160.

Tang, M. (2011), 'Carbon pricing, fairness and fiscal federalism: A cost-sharing proposal for canada', *Queens Policy Review* **2**, 17–36.

Tsurumi, T., Managi, S. & Hibiki, A. (2015), 'Do environmental regulations increase bilateral trade flows?', *The B.E. Journal of Economic Analysis & Policy* **15**(3), 1549–1577.

United Nations (1987), 'Report of the World Commission on Environment and Development: Our Common Future', *United Nations, New York* .
URL: *https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf*

United Nations Development Programme (2024), 'Human development report: Country insights', *UNDP Human Development Data Center* . Accessed: 16 October 2024.
URL: *https://hdr.undp.org/data-center/country-insights/ranks*

United States, B. o. L. S. (2012), 'Employment in green goods and services in 2010', *U.S. Bureau of Labor Statistics* . `https://www.bls.gov/opub/ted/2012/ted_20120327.htm?view_full` (Accessed 2 November 2020).

Verdolini, E. & Bosetti, V. (2017), 'Environmental policy and the international diffusion of cleaner energy technologies', *Environmental and Resource Economics* **68**, 735–758.

Zafar, M. W., Zaidi, S. A. H., Khan, I. & Mirza, F. (2020), 'The impact of renewable energy consumption and environmental sustainability on economic growth in the middle east and north africa region', *Journal of environmental management* **243**, 247–260.

List of Abbreviations

EKC Environmental Kuznets Curve.

PHH Pollution haven hypothesis.

U.S. United States of America.

TRI Toxics Release Inventory.

PRTR Pollutant Release and Transfer Register.

OECD Organization for Economic Co-operation and Development.

SITC Standard International Trade Classification.

BLS U.S. Bureau of Labor Statistics.

GVC Global value chain.

GGS Green Goods and Services.

NAICS North American Industry Classification System.

QCEW Quarterly Census of Employment and Wages.

ATECO (ATtività ECOnomiche) is a class of activity assigned by ISTAT and identify the macro-category of economic activity.

EU European Union.

ISTAT Italian National Institute of Statistics.

HS Harmonized System.

CN8 Combined Nomenclature.

Intrastat Data collection system for compiling statistics on international trade in goods between the European Union Member States.

Eurostat The statistical office of the European Union, based in Luxembourg. It publishes official, harmonised statistics on the European Union and the euro area, offering a comparable, reliable and objective portrayal of Europe's society and economy.

NACE Nomenclature statistique des activités économiques dans la Communauté européenne. Statistical classification of economic activities in the European Community.

HDI Human Development Index.

A Annex

A.1 Table 3 (United States 2012)

Table 29: Green Goods and Services (GGS) private sector employment by detailed industry, annual averages

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Total, all industries		**2.342.562**	**2.515.200**	**2,2**	**2,3**	**172.638**
Natural resources and mining	**11,21**	**63.344**	**64.689**	**3,5**	**3,4**	**1.345**
Crop production	111	36.703	36.796	6,9	6,9	93
Oilseed and grain farming	1111	3.934	4.775	9,3	10,6	841
Vegetable and melon farming	1112	10.045	10.701	10,7	11,3	656
Fruit and tree nut farming	1113	12.954	11.669	7,1	6,3	-1.285
Greenhouse and nursery production	1114	5.627	5.631	3,9	3,9	4
Other crop farming	1119	4.143	4.020	6,5	6,5	-123
Animal production	112	6.626	6.196	2,9	2,7	-430
Cattle ranching and farming	1121	3.800	3.421	2,9	2,5	-379
Hog and pig farming	1122	536	–[4]	1,9	–[4]	–
Poultry and egg production	1123	1.787	1.798	4,6	4,6	11
Sheep and goat farming	1124	–[4]	–[4]	–[4]	–[4]	–
Aquaculture	1125	382	426	6,5	7,5	44
Other animal production	1129	–[4]	–[4]	–[4]	–[4]	–
Forestry and logging	113	9.432	10.564	16,8	19,0	1.132
Timber tract operations	1131	1.061	1.292	29,7	35,6	231

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Forest nursery and gathering forest products	1132	528	434	17,9	14,1	-94
Logging	1133	7.844	8.837	15,8	18,1	993
Agriculture and forestry support activities	115	10.583	11.133	3,2	3,3	550
Support activities for crop production	1151	5.395	5.761	1,9	2,0	366
Support activities for animal production	1152	–[4]	–[4]	–[4]	–[4]	–
Support activities for forestry	1153	–[4]	–[4]	–[4]	–[4]	–
Utilities	**22**	**69.031**	**71.129**	**12,5**	**12,9**	**2.098**
Utilities	221	69.031	71.129	12,5	12,9	2.098
Electric power generation, transmission, and distribution	2211	49.973	53.787	12,6	13,6	3.814
Electric power generation	22111	49.973	53.787	29,5	32,4	3.814
Hydroelectric power generation	221111	5.124	3.780	72,7	64,8	-1.344
Nuclear electric power generation	221113	39.818	44.054	75,7	83,6	4.236
Solar electric power generation	221114	–[5]	522	–[5]	97,9	–
Wind electric power generation	221115	–[5]	2.724	–[5]	91,7	–
Geothermal electric power generation	221116	–[5]	1.017	–[5]	96,9	–
Biomass electric power generation	221117	–[5]	1.166	–[5]	92,3	–
Other electric power generation	221118	–[5]	525	–[5]	65,8	–
Water, sewage, and other systems	2213	19.058	17.342	40,8	37,0	-1.716
Water supply and irrigation systems	22131	11.995	10.248	32,0	27,2	-1.747
Sewage treatment facilities	22132	6.439	6.448	87,7	88,1	9
Steam and air-conditioning supply	22133	624	646	32,2	34,6	22

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Construction	**23**	**385.777**	**487.709**	**7,0**	**8,9**	**101.932**
Construction of buildings	236	78.113	117.263	6,4	9,7	39.150
Residential building construction	2361	31.498	57.016	5,5	10,1	25.518
Nonresidential building construction	2362	46.615	60.247	7,2	9,3	13.632
Heavy and civil engineering construction	237	44.560	49.613	5,5	6,0	5.053
Utility system construction	2371	34.642	39.330	9,1	9,9	4.688
Land subdivision	2372	1.889	1.664	3,7	3,7	-225
Other heavy construction	2379	8.028	8.618	8,5	9,1	590
Specialty trade contractors	238	263.105	320.833	7,6	9,3	57.728
Building foundation and exterior contractors	2381	39.585	51.190	5,9	7,7	11.605
Building equipment contractors	2382	164.809	194.476	10,1	11,9	29.667
Building finishing contractors	2383	38.185	49.119	6,0	7,9	10.934
Other specialty trade contractors	2389	20.526	26.049	4,0	5,0	5.523
Manufacturing	**31-33**	**492.985**	**507.168**	**4,3**	**4,3**	**14.183**
Textile product mills	314	10.484	10.131	8,8	8,6	-353
Textile furnishings mills	3141	9.461[6]	9.271	16,5[6]	17,0	-190[6]
Other textile product mills	3149	1.023	859	1,7	1,4	-164
Wood product mfg.	321	33.838	33.052	10,0	9,8	-786
Sawmills and wood preservation	3211	498	323	0,6	0,4	-175
Veneer, plywood, and engineered wood product mfg.	3212	6.545	6.840	10,4	11,2	295
Veneer, plywood, and engineered wood product mfg.	32121	6.545	6.840	10,4	11,2	295

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Hardwood veneer and plywood mfg.	321211	1.516	1.992	10,3	13,2	476
Softwood veneer and plywood mfg.	321212	–[4]	658	–[4]	4,9	–
Engineered wood member mfg.	321213	–[4]	345	–[4]	8,6	–
Truss mfg.	321214	997	1.158	5,5	6,8	161
Reconstituted wood product mfg.	321219	2.929	2.687	23,8	22,8	-242
Other wood product mfg.	3219	26.795	25.888	13,8	13,5	-907
Millwork	32191	20.839	21.970	22,7	24,9	1.131
Wood window and door mfg.	321911	18.055	19.041	40,1	44,8	986
Other millwork, including flooring	321918	2.783	2.928	7,9	8,6	145
All other wood product mfg.	32199	5.956	3.919	11,6	7,7	-2.037
Manufactured home, mobile home, mfg.	321991	3.803	2.114	19,9	11,7	-1.689
Prefabricated wood building mfg.	321992	2.154	1.805	16,1	14,2	-349
Paper mfg.	322	33.853	32.032	8,6	8,3	-1.821
Pulp, paper, and paperboard mills	3221	33.853	32.032	30,3	29,3	-1.821
Pulp mills	32211	1.208	1.078	20,3	18,0	-130
Paper mills	32212	19.669	18.167	25,9	24,5	-1.502
Paper, except newsprint, mills	322121	17.052	15.552	25,0	23,3	-1.500
Newsprint mills	322122	2.617	2.615	33,6	34,8	-2
Paperboard mills	32213	12.976	12.787	43,6	43,7	-189
Petroleum and coal products mfg.	324	3.244	3.278	2,9	3,0	34
Petroleum and coal products mfg.	3241	3.244	3.278	2,9	3,0	34

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Chemical mfg.	325	23.124	24.733	2,9	3,2	1.609
Basic chemical mfg.	3251	10.600	10.842	7,5	7,6	242
Agricultural chemical mfg.	3253	639	518	1,8	1,4	-121
Paint, coating, and adhesive mfg.	3255	3.674	4.131	6,6	7,2	457
Paint and coating mfg.	32551	2.731	3.078	7,5	8,2	347
Adhesive mfg.	32552	943	1.053	4,9	5,3	110
Soap, cleaning compound, and toilet preparation mfg.	3256	2.228	2.601	2,2	2,6	373
Soap and cleaning compound mfg.	32561	2.228	2.601	4,3	5,0	373
Soap and other detergent mfg.	325611	674	806	2,8	3,4	132
Polish and other sanitation good mfg.	325612	1.553	1.795	6,8	7,7	242
Other chemical product and preparation mfg.	3259	5.983	6.641	7,1	7,8	658
Printing ink mfg.	32591	1.357	1.400	14,3	14,9	43
All other chemical product and preparation mfg.	32599	4.626	5.241	6,8	7,7	615
Custom compounding of purchased resins	325991	1.597	1.968	10,5	12,7	371
Other miscellaneous chemical product mfg.	325998	3.029	3.273	8,9	9,3	244
Plastics and rubber products mfg.	326	32.407	33.421	5,2	5,3	1.014
Plastics product mfg.	3261	27.768	28.660	5,5	5,7	892
Other plastics product mfg.	32619	27.768	28.660	10,2	10,5	892
Plastics plumbing fixture mfg.	326191	409	801	3,3	6,7	392
Resilient floor covering mfg.	326199	27.359[6]	27.860	10,6[6]	10,6	501[6]
Rubber product mfg.	3262	4.639	4.760	3,8	3,8	121

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Tire mfg.	32621	3.008	3.221	5,8	6,0	213
Tire retreading	326212	3.008	3.221	45,4	46,4	213
Other rubber product mfg.	32629	1.631	1.539	3,4	3,0	-92
All other rubber product mfg.	326299	1.631	1.539	7,0	6,2	-92
Nonmetallic mineral product mfg.	327	29.710	29.885	8,1	8,2	175
Clay product and refractory mfg.	3271	4.878[6]	4.706	12,1[6]	11,6	-172[6]
Glass and glass product mfg.	3272	7.991	9.079	10,1	11,4	1.088
Cement and concrete product mfg.	3273	9.963	9.495	5,9	5,8	-468
Lime and gypsum product mfg.	3274	2.397	2.433	17,8	18,3	36
Other nonmetallic mineral product mfg.	3279	4.481	4.172	6,9	6,3	-309
All other nonmetallic mineral product mfg.	32799	4.481	4.172	8,0	7,4	-309
Mineral wool mfg.	327993	3.597	3.311	22,3	20,8	-286
Miscellaneous nonmetallic mineral products	327999	884	861	8,1	7,8	-23
Primary metal mfg.	331	64.859	63.292	18,0	16,3	-1.567
Iron and steel mills and ferroalloy mfg.	3311	37.831[6]	33.812	44,1[6]	36,9	-4.019[6]
Alumina and aluminum production	3313	8.316[6]	8.200	15,4[6]	14,4	-116[6]
Other nonferrous metal production	3314	9.788[6]	10.493	16,9[6]	17,2	705[6]
Foundries	3315	8.925	10.787	8,0	8,9	1.862
Fabricated metal product mfg.	332	31.476	30.310	2,5	2,3	-1.166
Forging and stamping	3321	1.565	1.527	1,8	1,6	-38
Architectural and structural metals mfg.	3323	21.720	21.792	6,8	6,6	72

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Plate work and fabricated structural product mfg.	33231	9.508	9.124	6,5	6,0	-384
Fabricated structural metal mfg.	332312	9.508	9.124	12,4	11,5	-384
Ornamental and architectural metal products mfg.	33232	12.213	12.668	7,1	7,2	455
Metal window and door mfg.	332321	12.213	12.668	24,1	25,5	455
Other fabricated metal product mfg.	3329	8.190	6.991	3,3	2,8	-1.199
Metal valve mfg.	33291	7.201	6.273	9,0	7,6	-928
Industrial valve mfg.	332911	3.597	3.579	15,5	14,8	-18
Plumbing fixture fitting and trim mfg.	332913	1.716	1.608	17,8	17,2	-108
Other metal valve and pipe fitting mfg.	332919	1.888	1.085	11,6	6,9	-803
All other fabricated metal product mfg.	33299	989	718	0,6	0,4	-271
Fabricated pipe and pipe fitting mfg.	332996	989	718	3,6	2,4	-271
Machinery mfg.	333	67.057	69.097	6,8	6,6	2.040
Ag, construction, and mining machinery mfg.	3331	–[4]	–[4]	–[4]	–[4]	–
Commercial and service industry machinery	3333	10.618[6]	10.577	11,5[6]	11,5	-41[6]
Ventilation, heating, AC, and commercial refrigeration equipment mfg.	3334	41.412	42.242	32,9	32,7	830
Ventilation, heating, AC, and commercial refrigeration equipment mfg.	33341	41.412	42.242	32,9	32,7	830
Air purification, fan and blower equip. mfg.	333413	8.502	9.000	32,5	32,9	498
Heating equipment, except warm air furnaces mfg.	333414	5.550	5.736	34,8	33,3	186
AC, refrigeration, and forced air heating mfg.	333415	27.360	27.507	32,7	32,5	147
Metalworking machinery mfg.	3335	–[4]	–[4]	–[4]	–[4]	–

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Turbine and power transmission equipment mfg.	3336	14.328	15.540	15,7	15,7	1.212
Engine, turbine, and power transmission mfg.	33361	14.328	15.540	15,7	15,7	1.212
Turbine and turbine generator set units mfg.	333611	13.400	14.439	50,3	49,7	1.039
Engine and power transmission equipment mfg., excl. turbine mfg.	333612,3	928	1.100	3,8	4,1	172
Computer and electronic product mfg.	334	65.759	74.105	6,0	6,7	8.346
Computer and peripheral equipment mfg.	3341	23.706	24.723	14,9	15,7	1.017
Communications equipment mfg.	3342	2.827	2.688	2,4	2,3	-139
Audio and video equipment mfg.	3343	628	770	3,1	3,9	142
Semiconductor and electronic component mfg.	3344	22.491	27.454	6,1	7,2	4.963
Navigational, measuring, electromedical, and control instruments mfg.	3345	16.107	18.470	4,0	4,6	2.363
Navigational, measuring, electromedical, and control instruments mfg.	33451	16.107	18.470	4,0	4,6	2.363
Automatic environmental control mfg.	334512	2.310	2.515	12,7	14,0	205
Industrial process variable instruments	334513	4.584	5.528	8,2	9,5	944
Totalizing fluid meters and counting devices	334514	2.488	3.302	23,0	30,0	814
Electricity and signal testing instruments	334515	2.736	3.015	6,8	7,2	279
Analytical laboratory instrument mfg.	334516	1.813	1.764	5,9	5,6	-49
Other measuring and controlling device mfg.	334519	2.176[6]	2.346	6,6[6]	7,1	170[6]
Electrical equipment and appliance mfg.	335	41.865	45.998	11,8	12,6	4.133
Electric lighting equipment mfg.	3351	11.214	13.030	24,8	28,9	1.816
Electric lamp bulb and part mfg.	33511	3.844	4.058	42,4	45,5	214

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Lighting fixture mfg.	33512	7.371	8.971	20,4	24,7	1.600
Residential electric lighting fixture mfg.	335121	885	956	10,8	11,9	71
Nonresidential electric lighting fixture mfg.	335122	4.618	5.726	24,2	29,7	1.108
Other lighting equipment mfg.	335129	1.868	2.289	21,0	25,8	421
Household appliance mfg.	3352	13.879	14.859	23,7	26,4	980
Small electrical appliance mfg.	33521	–[4]	–[4]	–[4]	–[4]	–
Major appliance mfg.	33522	–[4]	–[4]	–[4]	–[4]	–
Household cooking appliance mfg.	335221	–[4]	–[4]	–[4]	–[4]	–
Household refrigerator and home freezer mfg.	335222	–[4]	3.443	–[4]	25,8	–
Household laundry equipment mfg.	335224	–[4]	–[4]	–[4]	–[4]	–
Other major household appliance mfg.	335228	–[4]	–[4]	–[4]	–[4]	–
Electrical equipment mfg.	3353	8.036	9.222	6,0	6,7	1.186
Electrical equipment mfg.	33531	8.036	9.222	6,0	6,7	1.186
Electric power and specialty transformer mfg.	335311	3.979	4.328	16,6	18,0	349
Motor and generator mfg.	335312	4.057	4.894	10,5	12,3	837
Other electrical equipment and component mfg.	3359	8.736	8.887	7,4	7,1	151
Battery mfg.	33591	4.590	4.642	19,1	17,7	52
Storage battery mfg.	335911	–[4]	–[4]	–[4]	–[4]	–
Primary battery mfg.	335912	–[4]	–[4]	–[4]	–[4]	–
All other electrical equipment and component mfg.	33599	4.147	4.245	12,5	12,0	98
Miscellaneous electrical equipment mfg.	335999	4.147	4.245	15,7	15,2	98

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Transportation equipment mfg.	336	43.243	45.367	3,3	3,3	2.124
Motor vehicle mfg.	3361	12.740	11.888	8,3	7,4	-852
Motor vehicle parts mfg.	3363	22.615[6]	25.490	5,4[6]	5,7	2.875[6]
Railroad rolling stock mfg.	3365	–[4]	–[4]	–[4]	–[4]	–
Ship and boat building	3366	–[4]	–[4]	–[4]	–[4]	–
Furniture and related product mfg.	337	12.066	12.469	3,4	3,6	403
Office furniture and fixtures mfg.	3372	9.585	9.779	10,0	10,0	194
Other furniture related product mfg.	3379	2.481	2.690	6,8	7,6	209
Trade	**42,44-45**	**205.567**	**223.079**	**1,0**	**1,1**	**17.512**
Merchant wholesalers, durable goods	423	94.916	104.913	3,5	3,8	9.997
Misc. durable goods merchant wholesalers	4239	94.916	104.913	34,4	36,1	9.997
Miscellaneous store retailers	453	110.651	118.166	14,3	15,2	7.515
Used merchandise stores	4533	110.651	118.166	88,2	88,7	7.515
Transportation and warehousing	**48-49**	**242.137**	**238.755**	**6,1**	**5,9**	**-3.382**
Water transportation	483	2.393	2.180	3,8	3,4	-213
Sea, coastal, and Great Lakes transportation	4831	1.751	1.586	4,7	4,1	-165
Inland water transportation	4832	642	595	2,6	2,4	-47
Transit and ground passenger transportation	485	239.744	236.574	57,2	55,0	-3.170
Urban transit systems	4851	34.935	34.956	84,7	84,5	21
Interurban and rural bus transportation	4852	11.528	11.494	62,7	62,5	-34
School and employee bus transportation	4854	167.924	166.916	91,9	90,9	-1.008

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Charter bus industry	4855	17.326	15.194	58,4	50,2	-2.132
Other ground passenger transportation	4859	8.030	8.014	10,1	9,5	-16
Information	**51**	**33.321**	**29.412**	**1,2**	**1,1**	**-3.909**
Publishing industries, except Internet	511	22.355	21.160	3,0	2,8	-1.195
Newspaper, book, and directory publishers	5111	12.118	11.025	2,4	2,3	-1.093
Software publishers	5112	10.237	10.135	4,0	3,8	-102
Motion picture and sound recording industries	512	–[4]	–[4]	–[4]	–[4]	–
Motion picture and video industries	5121	–[4]	–[4]	–[4]	–[4]	–
Broadcasting, except Internet	515	7.525	5.352	2,6	1,9	-2.173
Radio and television broadcasting	5151	–[4]	–[4]	–[4]	–[4]	–
Cable and other subscription programming	5152	–[4]	–[4]	–[4]	–[4]	–
Other information services	519	–[4]	–[4]	–[4]	–[4]	–
Other information services	5191	–[4]	–[4]	–[4]	–[4]	–
Financial activities	**52,53**	**462**	**475**	**0,0**	**0,0**	**13**
Securities, commodity contracts, investments	523	462	475	0,1	0,1	13
Professional, scientific, and technical services	**54**	**355.386**	**381.981**	**4,8**	**5,0**	**26.595**
Professional and technical services	541	355.386	381.981	4,8	5,0	26.595
Legal services	5411	–[4]	–[4]	–[4]	–[4]	–
Architectural and engineering services	5413	184.628	192.393	14,4	14,9	7.765
Engineering services	54133	113.031	122.619	13,0	14,0	9.588
Architectural and related services excl. engineering services	54131,2,5,6,7,8	71.597	69.774	17,7	17,0	-1.823

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Specialized design services	5414	3.088	3.077	2,7	2,7	-11
Computer systems design and related services	5415	54.792	67.348	3,8	4,4	12.556
Management and technical consulting services	5416	68.476	72.121	6,8	6,7	3.645
Scientific research and development services	5417	36.949	39.590	6,0	6,3	2.641
Research and development in the physical, engineering, and life sciences	54171	36.949	39.590	6,6	6,9	2.641
Research and development in biotechnology	541711	3.680	3.884	2,7	2,8	204
Other physical and biological research	541712	33.268	35.706	7,8	8,2	2.438
Advertising, PR, and related services	5418	–[4]	–[4]	–[4]	–[4]	–
Other professional and technical services	5419	–[4]	–[4]	–[4]	–[4]	–
Management of companies and enterprises	**55**	**62.630**	**69.310**	**3,4**	**3,6**	**6.680**
Management of companies and enterprises	551	62.630	69.310	3,4	3,6	6.680
Management of companies and enterprises	5511	62.630	69.310	3,4	3,6	6.680
Administrative and waste services	**56**	**330.650**	**335.417**	**4,5**	**4,3**	**4.767**
Administrative and support services	561	24.963	20.440	0,4	0,3	-4.523
Travel arrangement and reservation services	5615	405	537	0,2	0,3	132
Services to buildings and dwellings	5617	24.557	19.903	1,4	1,1	-4.654
Waste management and remediation services	562	305.688	314.977	85,9	86,6	9.289
Waste collection	5621	124.712	131.048	89,8	90,1	6.336
Waste treatment and disposal	5622	89.090	87.951	93,2	93,1	-1.139
Waste treatment and disposal	56221	89.090	87.951	93,2	93,1	-1.139
Hazardous waste treatment and disposal	562211	35.287	34.211	94,6	93,4	-1.076

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Solid waste landfill	562212	35.485	35.039	94,0	93,2	-446
Solid waste combustors and incinerators	562213	5.854	5.555	95,2	96,8	-299
Other nonhazardous waste disposal	562219	12.465	13.146	86,7	90,6	681
Remediation and other waste management services	5629	91.886	95.979	75,6	77,6	4.093
Remediation services	56291	57.474	58.251	75,5	75,9	777
Materials recovery facilities	56292	11.219	12.474	90,6	93,0	1.255
All other waste management services	56299	23.193	25.254	70,3	75,3	2.061
Septic tank and related services	562991	14.395	15.994	73,6	81,0	1.599
Miscellaneous waste management services	562998	8.798	9.260	65,5	67,2	462
Education and health services	**61,62**	**28.789**	**26.123**	**0,2**	**0,1**	**-2.666**
Educational services	611	28.789	26.123	1,2	1,0	-2.666
Leisure and hospitality	**71,72**	**20.642**	**23.696**	**0,2**	**0,2**	**3.054**
Museums, historical sites, zoos, and parks	712	20.642	23.696	16,2	18,1	3.054
Museums, historical sites, zoos, and parks	7121	20.642	23.696	16,2	18,1	3.054
Other services, except public administration	**81**	**51.841**	**56.257**	**1,2**	**1,3**	**4.416**
Repair and maintenance	811	21.134	22.100	1,9	1,9	966
Automotive repair and maintenance	8111	7.757	6.652	1,0	0,8	-1.105
Electronic equipment repair and maintenance	8112	5.247	4.857	5,4	4,9	-390
Commercial machinery repair and maintenance	8113	5.319	7.200	3,1	3,9	1.881
Household goods repair and maintenance	8114	2.811	3.391	4,2	5,0	580
Membership associations and organizations	813	30.707	34.157	2,3	2,6	3.450

Continued on next page

Table 29 – Continued from previous page

Industry	NAICS[1]	GGS Employment[2]		GGS Percent[3]		GGS change
		2010	2011	2010	2011	
Grantmaking and giving services	8132	2.817	3.662	2,3	2,9	845
Social advocacy organizations	8133	20.277	20.800	10,6	10,7	523
Professional and similar organizations	8139	7.613	9.695	1,8	2,3	2.082

[1]North American Industry Classification System, 2012.

[2]GGS employment is the number of jobs related to the production of Green Goods and Services. This table reflects private ownership only.

[3]GGS percent is the percentage of the GGS employment compared to the total employment. This value is derived by dividing the GGS employment by the total employment.

[4]Data do not meet BLS disclosure standards.

[5]Estimate cannot be created due to the conversion from NAICS 2007 to NAICS 2012.

[6]The 2012 NAICS conversion changed the GGS scope for this industry. BLS utilized backcasting to make the 2010 and 2011 estimates comparable. See the extended technical note for more detail.

[0]NOTE: GGS data for 2010 have been revised to incorporate methodological changes explained in the Technical Note. Please also note data may not add to total or subtotal due to rounding.

A.2 Table Country (European Commission 2010)

Table 30: Geonomenclature

Code		Text
ISO	GEO	
AD	(043)	Andorra
AE	(647)	United Arab Emirates
AF	(660)	Afghanistan
AG	(459)	Antigua and Barbuda
AI	(446)	Anguilla
AL	(070)	Albania
AM	(077)	Armenia
AN	(478)	Netherlands Antilles
AO	(330)	Angola
AQ	(891)	Antarctica
AR	(528)	Argentina
AS	(830)	American Samoa
AT	(038)	Austria
AU	(800)	Australia
AW	(474)	Aruba
AZ	(078)	Azerbaijan
BA	(093)	Bosnia and Herzegovina
BB	(469)	Barbados
BD	(666)	Bangladesh
BE	(017)	Belgium
BF	(236)	Burkina Faso
BG	(068)	Bulgaria
BH	(640)	Bahrain
BI	(328)	Burundi
BJ	(284)	Benin
BM	(413)	Bermuda
BN	(703)	Brunei Darussalam
BO	(516)	Bolivia
BR	(508)	Brazil
BS	(453)	Bahamas
BT	(675)	Bhutan
BV	(892)	Bouvet Island
BW	(391)	Botswana
BY	(073)	Belarus
BZ	(421)	Belize

Continued on next page

Table 30 – Continued from previous page

ISO	GEO	Text
CA	(404)	Canada
CC	(833)	Cocos (Keeling), Islands
CD	(322)	Congo, Democratic Republic of
CF	(306)	Central African Republic
CG	(318)	Congo
CH	(039)	Switzerland
CI	(272)	Côte d'Ivoire
CK	(837)	Cook Islands
CL	(512)	Chile
CM	(302)	Cameroon
CN	(720)	China
CO	(480)	Colombia
CR	(436)	Costa Rica
CU	(448)	Cuba
CV	(247)	Cape Verde
CX	(834)	Christmas Island
CY	(600)	Cyprus
CZ	(061)	Czech Republic
DE	(004)	Germany
DJ	(338)	Djibouti
DK	(008)	Denmark
DM	(460)	Dominica
DO	(456)	Dominican Republic
DZ	(208)	Algeria
EC	(500)	Ecuador
EE	(053)	Estonia
EG	(220)	Egypt
ER	(336)	Eritrea
ES	(011)	Spain
ET	(334)	Ethiopia
EU	(999)	European Community
FI	(032)	Finland
FJ	(815)	Fiji
FK	(529)	Falkland Islands (Malvinas)
FM	(823)	Micronesia, Federated States of
FO	(041)	Faroe Islands
FR	(001)	France
GA	(314)	Gabon

Continued on next page

Table 30 – Continued from previous page

ISO	GEO	Text
GB	(006)	United Kingdom
GD	(473)	Grenada
GE	(076)	Georgia
GH	(276)	Ghana
GI	(044)	Gibraltar
GL	(406)	Greenland
GM	(252)	Gambia
GN	(260)	Guinea
GQ	(310)	Equatorial Guinea
GR	(009)	Greece
GS	(893)	South Georgia and South Sandwich Islands
GT	(416)	Guatemala
GU	(831)	Guam
GW	(257)	Guinea-Bissau
GY	(488)	Guyana
HK	(740)	Hong Kong
HM	(835)	Heard Island and McDonald Islands
HN	(424)	Honduras
HR	(092)	Croatia
HT	(452)	Haiti
HU	(064)	Hungary
ID	(700)	Indonesia
IE	(007)	Ireland
IL	(624)	Israel
IN	(664)	India
IO	(357)	British Indian Ocean Territory
IQ	(612)	Iraq
IR	(616)	Iran, Islamic Republic of
IS	(024)	Iceland
IT	(005)	Italy
JM	(464)	Jamaica
JO	(628)	Jordan
JP	(732)	Japan
KE	(346)	Kenya
KG	(083)	Kyrgyz, Republic
KH	(696)	Cambodia
KI	(812)	Kiribati
KM	(375)	Comoros

Continued on next page

Table 30 – Continued from previous page

ISO	GEO	Text
KN	(449)	St Kitts and Nevis
KP	(724)	Korea, Democratic People's Republic of
KR	(728)	Korea, Republic of
KW	(636)	Kuwait
KY	(463)	Cayman Islands
KZ	(079)	Kazakhstan
LA	(684)	Lao People's Democratic Republic
LB	(604)	Lebanon
LC	(465)	Saint Lucia
LI	(037)	Liechtenstein
LK	(669)	Sri Lanka
LR	(268)	Liberia
LS	(395)	Lesotho
LT	(055)	Lithuania
LU	(018)	Luxembourg
LV	(054)	Latvia
LY	(216)	Libyan Arab Jamahiriya
MA	(204)	Morocco
MD	(074)	Moldova, Republic of
ME	(097)	Montenegro
MG	(370)	Madagascar
MH	(824)	Marshall Islands
MK1	(096)	Macedonia, Former Yugoslav Republic of
ML	(232)	Mali
MM	(676)	Myanmar
MN	(716)	Mongolia
MO	(743)	Macao
MP	(820)	Northern Mariana Islands
MR	(228)	Mauritania
MS	(470)	Montserrat
MT	(046)	Malta
MU	(373)	Mauritius
MV	(667)	Maldives
MW	(386)	Malawi
MX	(412)	Mexico
MY	(701)	Malaysia
MZ	(366)	Mozambique
NA	(389)	Namibia

Continued on next page

Table 30 – Continued from previous page

ISO	GEO	Text
NC	(809)	New Caledonia
NE	(240)	Niger
NF	(836)	Norfolk Island
NG	(288)	Nigeria
NI	(432)	Nicaragua
NL	(003)	Netherlands
NO	(028)	Norway
NP	(672)	Nepal
NR	(803)	Nauru
NU	(838)	Niue
NZ	(804)	New Zealand
OM	(649)	Oman
PA	(442)	Panama
PE	(504)	Peru
PF	(822)	French Polynesia
PG	(801)	Papua New Guinea
PH	(708)	Philippines
PK	(662)	Pakistan
PL	(060)	Poland
PM	(408)	Saint Pierre and Miquelon
PN	(813)	Pitcairn
PS	(625)	Palestinian Territory, Occupied
PT	(010)	Portugal
PW	(825)	Palau
PY	(520)	Paraguay
QA	(644)	Qatar
QQ	(950)	Stores and provisions
QR	(951)	Stores and provisions within the framework of intra-Community trade
QS	(952)	Stores and provisions within the framework of trade with third countries
QU	(958)	Countries and territories not specified
QV	(959)	Countries and territories not specified in the framework of intra-Community trade
QW	(960)	Countries and territories not specified within the framework of trade with third countries
QX	(977)	Countries and territories not specified for commercial or military reasons
QY	(978)	Countries and territories not specified for commercial or military reasons in the framework of intra- Community trade
QZ	(979)	Countries and territories not specified for commercial or military reasons in the framework of trade with third countries
RO	(066)	Romania

Continued on next page

Table 30 – Continued from previous page

ISO	GEO	Text
RU	(075)	Russian Federation
RW	(324)	Rwanda
SA	(632)	Saudi Arabia
SB	(806)	Solomon Islands
SC	(355)	Seychelles
SD	(224)	Sudan
SE	(030)	Sweden
SG	(706)	Singapore
SH	(329)	Saint Helena
SI	(091)	Slovenia
SK	(063)	Slovakia
SL	(264)	Sierra Leone
SM	(047)	San Marino
SN	(248)	Senegal
SO	(342)	Somalia
SR	(492)	Suriname
ST	(311)	Sao Tome and Principe
SV	(428)	El Salvador
SY	(608)	Syrian Arab Republic
SZ	(393)	Swaziland
TC	(454)	Turks and Caicos Islands
TD	(244)	Chad
TF	(894)	French Southern Territories
TG	(280)	Togo
TH	(680)	Thailand
TJ	(082)	Tajikistan
TK	(839)	Tokelau
TL	(626)	Timor-Leste
TM	(080)	Turkmenistan
TN	(212)	Tunisia
TO	(817)	Tonga
TR	(052)	Turkey
TT	(472)	Trinidad and Tobago
TV	(807)	Tuvalu
TW	(736)	Taiwan
TZ	(352)	Tanzania, United Republic of
UA	(072)	Ukraine
UG	(350)	Uganda

Continued on next page

Table 30 – Continued from previous page

ISO	GEO	Text
UM	(832)	United States Minor Outlying Islands
US	(400)	United States
UY	(524)	Uruguay
UZ	(081)	Uzbekistan
VA	(045)	Holy See (Vatican City State)
VC	(467)	St Vincent and the Grenadines
VE	(484)	Venezuela
VG	(468)	Virgin Islands, British
VI	(457)	Virgin Islands (US)
VN	(690)	Viet-Nam
VU	(816)	Vanuatu
WF	(811)	Wallis and Futuna
WS	(819)	Samoa
XC	(021)	Ceuta
XK	(095)	Kosovo
XL	(023)	Melilla
XS	(098)	Serbia
YE	(653)	Yemen
YT	(377)	Mayotte
ZA	(388)	South Africa
ZM	(378)	Zambia
ZW	(382)	Zimbabwe

A.3 Table Human Development Index and its components (United Nations Development Programme 2024)

Rank	Country	HDI Value (value)	Life Expectancy (years)	Expected Years Schooling (years)	Mean Years Schooling (years)	GNI[0] per Capita (2017 PPP $)
VERY HIGH HUMAN DEVELOPMENT						
1	Switzerland	0.967	84.255	16.6	13.9[3]	69432.8
2	Norway	0.966	83.393	18.6[4]	13.1[3]	69189.8
3	Iceland	0.959	82.815	19.1[4]	13.8	54688.4
4	Hong Kong, China (SAR)	0.956	84.315	17.8	12.3	62485.5
5	Denmark	0.952	81.882	18.8[4]	13	62019
5	Sweden	0.952	83.505	19[4]	12.7[3]	56995.8
7	Germany	0.95	80.989	17.3	14.3	55340.2
7	Ireland	0.95	82.716	19.1[4]	11.7[3]	87467.5[5]
9	Singapore	0.949	84.133	16.9	11.9	88761.1[5]
10	Australia	0.946	83.579	21.1[4]	12.7	49257.1
10	Netherlands	0.946	82.451	18.6[4]	12.6	57278.3
12	Belgium	0.942	82.293	18.9[4]	12.5[3]	53644
12	Finland	0.942	82.351	19.2[4]	12.9[3]	49522.1
12	Liechtenstein	0.942	84.656	15.5	12.4[6]	146673.2[5,7]
15	United Kingdom	0.94	82.156	17.6	13.4	46623.9
16	New Zealand	0.939	83.006	19.7[4]	12.9	43665.5

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
17	United Arab Emirates	0.937	79.196	17.2	12.8	74103.7
18	Canada	0.935	82.847	16	13.9[3]	48444.4
19	Korea (Republic of)	0.929	84.024	16.5	12.6[3]	46026.5
20	Luxembourg	0.927	82.591	14.2	13[8]	78554.2[5]
20	United States	0.927	78.203	16.4	13.6	65564.9
22	Austria	0.926	82.412	16.4	12.3[3]	56529.7
22	Slovenia	0.926	82.133	17.4	12.9[3]	41586.9
24	Japan	0.92	84.82	15.5	12.7	43643.9
25	Israel	0.915	82.601	15	13.4[3]	43588.3
25	Malta	0.915	83.704	15.9	12.2	44464
27	Spain	0.911	83.912	17.8	10.6	40043.3
28	France	0.91	83.229	16	11.7[3]	47378.7
29	Cyprus	0.907	81.889	16.2	12.4	40136.9
30	Italy	0.906	84.057	16.7	10.7	44284.2
31	Estonia	0.899	79.155	15.9	13.5	37151.6
32	Czechia	0.895	78.129	16.3	12.9[3]	39944.7
33	Greece	0.893	80.614	20[4]	11.4	31381.7
34	Bahrain	0.888	79.246	16.3	11	48731.4
35	Andorra	0.884	83.552	12.8	11.6	54233.4[9]
36	Poland	0.881	76.996	15.9	13.2	35151
37	Latvia	0.879	75.927	16.6	13.3[3]	32083

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
37	Lithuania	0.879	74.293	16.4	13.5	38131.2
39	Croatia	0.878	79.236	15.6	12.3[3]	34323.8
40	Qatar	0.875	81.559	13.3	10.1[3]	95944.4[5]
40	Saudi Arabia	0.875	77.905	15.2[10]	11.3	50620.4
42	Portugal	0.874	82.24	16.8	9.6	35315
43	San Marino	0.867	83.433	12.4	10.5[11]	57686.5[12]
44	Chile	0.86	79.519	16.8	11.1[3]	24431
45	Slovakia	0.855	75.33	14.7	13[3]	32171.2
45	Türkiye	0.855	78.475	19.7[4]	8.8[3]	32833.5
47	Hungary	0.851	74.958	15.1	12.2	34195.5
48	Argentina	0.849	76.064	19[4]	11.1	22048
49	Kuwait	0.847	80.264	15.7[3]	7.4[3]	56729.2
50	Montenegro	0.844	76.845	15.1	12.6[3]	22513.3
51	Saint Kitts and Nevis	0.838	72.027	18.4[4,12]	10.8[13]	28441.7
52	Uruguay	0.83	78	17.4	9.1[3]	22207
53	Romania	0.827	74.117	14.5	11.4[3]	31641.4
54	Antigua and Barbuda	0.826	79.236	15.5[3]	10.5[10]	18784
55	Brunei Darussalam	0.823	74.551	13.7	9.2	59245.6
56	Russian Federation	0.821	70.116	15.7[3]	12.4	26991.8
57	Bahamas	0.82	74.358	11.9[11]	12.7[3]	32534.9
57	Panama	0.82	76.826	13.2[3]	10.7[3]	32029.4

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
59	Oman	0.819	73.935	13	11.9	32967.4
60	Georgia	0.814	71.587	16.7	12.7	15952
60	Trinidad and Tobago	0.814	74.708	14.1[13]	11.7[3]	22473
62	Barbados	0.809	77.706	16.5[3]	9.9[16]	14810.2
63	Malaysia	0.807	76.26	12.9	10.7[3]	27295.4
64	[3]osta Rica	0.806	77.32	16.1[3]	8.8	20248.4
65	Serbia	0.805	74.137	14.5	11.5[3]	19494
66	Thailand	0.803	79.68	15.6	8.8[3]	16886.5
67	Kazakhstan	0.802	69.489	14.8	12.4[3]	22586.8
67	Seychelles	0.802	71.738	13.9	11.2	28385.7
69	Belarus	0.801	73.246	14	12.2[3]	18425
HIGH HUMAN DEVELOPMENT						
70	Bulgaria	0.799	71.528	13.9	11.4	25920.8
71	Palau	0.797	65.362	17.2[11]	13[11]	19343.8[12]
72	Mauritius	0.796	73.975	14.6	10[16]	23251.6
73	Grenada	0.793	75.335	16.6[3]	9.9[10]	13593.2
74	Albania	0.789	76.833	14.5	10.1[16]	15293.3
75	China	0.788	78.587	15.2[3]	8.1[3]	18024.9
76	Armenia	0.786	73.372	14.4	11.3	15388.3
77	Mexico	0.781	74.832	14.5	9.2	19138
78	Iran (Islamic Republic of)	0.78	74.556	14.1	10.7[3]	14770.3

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
78	Sri Lanka	0.78	76.61	13.6[3]	11.2	11899.5
80	Bosnia and Herzegovina	0.779	75.293	13.3	10.5	16571.4
81	Saint Vincent and the Grenadines	0.772	68.972	16.3[3]	11[11]	14049.1
82	Dominican Republic	0.766	74.17	13.6	9.2[3]	18653.3
83	Ecuador	0.765	77.894	14.9	9	10693.2
83	North Macedonia	0.765	73.888	13	10.2	16395.8
85	Cuba	0.764	78.155	14.5	10.5[3]	7953.4[17]
86	Moldova (Republic of)	0.763	68.621	14.9	11.8[3]	12963.6
87	Maldives	0.762	80.839	12.2[3]	7.8[3]	18846.8
87	Peru	0.762	73.385	14.8[3]	10[3]	11916.4
89	Azerbaijan	0.76	73.488	12.7	10.6[3]	15018.1
89	Brazil	0.76	73.425	15.6	8.3[3]	14615.9
91	Colombia	0.758	73.659	14.4	8.9	15013.9
92	Libya	0.746	72.151	14[10]	7.8[18]	19751.6
93	Algeria	0.745	77.129	15.5	7[3]	10978.4
94	Turkmenistan	0.744	69.41	13.2	11.1[3]	12859.9[12]
95	Guyana	0.742	65.989	13[13]	8.6[16]	35782.9
96	Mongolia	0.741	72.667	14.5[3]	9.4	10350.9
97	Dominica	0.74	72.981	13.6[3]	9.2[10]	12467.9
98	Tonga	0.739	71.27	16.3	10.9[16]	6360.2[12]
99	Jordan	0.736	74.215	12.6[3]	10.4	9294.8

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
100	Ukraine	0.734	68.564	13.3	11.1[16]	11416.2
101	Tunisia	0.732	74.263	14.6[3]	8[3]	10296.6
102	Marshall Islands	0.731	65.146	16.4	12.8[11]	6855.2
102	Paraguay	0.731	70.475	13.9[19]	8.9	13161.1
104	Fiji	0.729	68.312	13.8	10.4	11233.7
105	Egypt	0.728	70.159	12.9	9.8[3]	12360.8
106	Uzbekistan	0.727	71.674	12	11.9	8055.9
107	Viet Nam	0.726	74.58	13.1[20]	8.5[3]	10814
108	Saint Lucia	0.725	71.294	12.7	8.6[3]	14778.3
109	Lebanon	0.723	74.416	12.1[21]	8.6[11]	12313.4[22]
110	South Africa	0.717	61.48	14.3	11.6	13185.6
111	Palestine, State of	0.716	73.444	13.2	9.9	6936.3
112	Indonesia	0.713	68.25	14[3]	8.6	12045.6
113	Philippines	0.71	72.187	12.8	9[3]	9058.8
114	Botswana	0.708	65.913	11.4	10.4	14841.6
115	Jamaica	0.706	70.629	12.5[3]	9.2[3]	9694.5
116	Samoa	0.702	72.598	12.4	11.4[3]	4970.2
117	Kyrgyzstan	0.701	70.484	13	12[3]	4781.7
118	Belize	0.7	70.962	12.4	8.8	9242.1
MEDIUM HUMAN DEVELOPMENT						
119	Venezuela (Bolivarian Republic of)	0.699	71.105	13.5[11]	9.6[11]	6184.1[23]

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
120	Bolivia (Plurinational State of)	0.698	64.928	15	9.8	7987.8
120	Morocco	0.698	74.973	14.6	6.1	7954.5
122	Nauru	0.696	64.014	12.6[3]	9.2[10]	14938.6
123	Gabon	0.693	65.694	12.4[3]	9.6	11194.2
124	Suriname	0.69	70.289	11	8.4[3]	12310
125	Bhutan	0.681	72.229	13.1[3]	5.8[3]	10624.9[22]
126	Tajikistan	0.679	71.288	10.9[3]	11.3[16]	4807.2
127	El Salvador	0.674	71.475	11.9 s	7.2	8886.2
128	Iraq	0.673	71.336	12.2[20]	6.8[16]	9091.9
129	Bangladesh	0.67	73.698	11.9	7.4	6511.1
130	Nicaragua	0.669	74.615	12.6[19]	7.3	5426.5
131	Cabo Verde	0.661	74.722	11.5[3]	6.1[11]	7601.1
132	Tuvalu	0.653	64.854	12.1[3]	10.6[3]	4754.5
133	Equatorial Guinea	0.65	61.19	12.1[10]	8.3[10]	10662.7
134	India	0.644	67.744	12.6	6.6	6950.5
135	Micronesia (Federated States of)	0.634	70.925	12.6[10]	7.3[10]	3709.2
136	Guatemala	0.629	68.674	10.8[3]	5.7[3]	8996.4
137	Kiribati	0.628	67.661	11.8	9.1[11]	3440.4
138	Honduras	0.624	70.728	10[19]	7.3[3]	5271.6
139	Lao People's Democratic Republic	0.62	68.999	10.2	5.9[16]	7744.8

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
140	Vanuatu	0.614	70.492	11.8[3]	7.2[10]	3244
141	Sao Tome and Principe	0.613	68.794	12.7[13]	5.9[3]	4054.1
142	Eswatini (Kingdom of)	0.61	56.36	14.9[3]	5.7	8391.9
142	Namibia	0.61	58.059	11.8[24]	7.2[16]	9200
144	Myanmar	0.608	67.256	12.1[3]	6.5[16]	4037.7
145	Ghana	0.602	63.945	11.6	6.4[16]	5380.3
146	Kenya	0.601	62.055	11.4[24]	7.7	4807.7
146	Nepal	0.601	70.484	12.6	4.5[3]	4025.6
148	Cambodia	0.6	69.896	11.6[11]	5.2	4291.1
149	Congo	0.593	63.053	12.4[3]	8.3[16]	2902.8
150	Angola	0.591	61.929	12.2	5.8[24]	5327.8
151	Cameroon	0.587	60.958	13.4[3]	6.5[16]	3681.5
152	Comoros	0.586	63.68	13[3]	6.2[25]	3260.6
153	Zambia	0.569	61.803	11[25]	7.3[16]	3157.4
154	Papua New Guinea	0.568	65.958	11.1[24]	4.9[16]	3710.3
155	Timor-Leste	0.566	69.056	13.2[24]	6[24]	1629.2
156	Solomon Islands	0.562	70.742	10.3[3]	5.9[10]	2273.3
157	Syrian Arab Republic	0.557	72.3	7.4[11]	5.7[11]	3594.1[26]
158	Haiti	0.552	63.728	11.1[10]	5.6[16]	2801.7
159	Uganda	0.55	63.638	11.5[24]	6.2[3]	2240.6
159	Zimbabwe	0.55	59.391	11[3]	8.8[3]	2078.9

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
LOW HUMAN DEVELOPMENT						
160	Nigeria	0.548	53.633	10.5	7.6	4754.8
161	Rwanda	0.548	67.129	11.4	4.9	2316.8
163	Togo	0.547	61.588	13[3]	5.6[3]	2214.2
164	Mauritania	0.54	64.691	8.1	4.8[16]	5343.6
164	Pakistan	0.54	66.431	7.9[3]	4.4[3]	5374.3
166	Côte d'Ivoire	0.534	58.916	10.1	4.2[16]	5376.4
167	Tanzania (United Republic of)	0.532	66.782	8.6	5.6[3]	2578.2
168	Lesotho	0.521	53.036	11.1[3]	7.5[3]	2708.7
169	Senegal	0.517	67.913	9.1	2.9[3]	3463.8
170	Sudan	0.516	65.578	8.5[3]	3.9	3514.8
171	Djibouti	0.515	62.859	8[3]	3.9[11]	4874.5
172	Malawi	0.508	62.898	11.5[3]	5.2	1432.5
173	Benin	0.504	59.954	10.3	3.1[16]	3406.1
174	Gambia	0.495	62.906	9[24]	4.5	2089.6
175	Eritrea	0.493	66.604	7.3[3]	5.1[10]	1957[26]
176	Ethiopia	0.492	65.645	9.9[3]	2.4[3]	2368.8
177	Liberia	0.487	61.1	10.5	5.3[16]	1330.4
177	Madagascar	0.487	65.23	9.2[3]	4.6	1463.5
179	Guinea-Bissau	0.483	59.861	10.5[13]	3.7	1879.9
180	Congo (Democratic Republic of the)	0.481	59.743	9.6[3]	7.2[16]	1080.1

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
181	Guinea	0.471	58.985	10.2[3]	2.4[3]	2404.2
182	Afghanistan	0.462	62.879	10.7[3]	2.5	1335.2[26]
183	Mozambique	0.461	59.625	10.7[3]	3.9	1219.2
184	Sierra Leone	0.458	60.411	9[13]	3.5[3]	1612.7
185	Burkina Faso	0.438	59.766	8.1	2.3[3]	2037
186	Yemen	0.424	63.72	7.9[11]	2.8[18]	1105.8[12]
187	Burundi	0.42	61.977	10[3]	3.3[3]	712
188	Mali	0.41	59.417	7[3]	1.6	2043.7
189	Chad	0.394	52.997	8.2[3]	2.3[3]	1388.9
189	Niger	0.394	62.08	7.2[3]	1.3[16]	1283.3
191	Central African Republic	0.387	54.477	7.3[3]	4[16]	869.1
192	South Sudan	0.381	55.567	5.6[3]	5.7[27]	690.7[12]
193	Somalia	0.38	56.107	7.6[10]	1.9	1072.2
OTHER COUNTRIES OR TERRITORIES						
	Korea (Democratic People's Rep. of)	..	73.578	..	..	..
	Monaco	..	86.895[28]	18.7[34]	..	..
Human development groups						
	Very high human development	0.902	79.309367	16.6	12.3	44957.6
	High human development	0.764	75.20368	14.5	8.6	15483.8
	Medium human development	0.64	67.95257	12.3	6.7	6444.3

Continued on next page

Rank	Country	HDI Value	Life Expectancy	Expected Years Schooling	Mean Years Schooling	GNI per Capita
	Low human development	0.517	61.647365	9.3	4.7	3185.9
	Developing countries	0.694	70.512348	12.5	7.6	11125.4
Regions						
	Arab States	0.704	71.309417	11.9	7.8	14390.9
	East Asia and the Pacific	0.766	76.215491	14.5	8.2	16137.7
	Europe and Central Asia	0.802	73.564575	15.5	10.6	19763
	Latin America and the Caribbean	0.763	73.715085	14.8	9	15109.4
	South Asia	0.641	68.441543	11.9	6.6	6971.6
	Sub-Saharan Africa	0.549	60.6397	10.3	6	3666.2
	Least developed countries	0.542	64.922579	10.1	5	3005.7
	Small island developing states	0.73	71.577062	12.6	8.6	16379.4
	Organisation for Economic Co-operation and Development	0.906	80.129907	16.6	12.2	46318.3
	World	0.739	72.00407	13	8.7	17254.4

[0]Gross national income

[1]Data refer to 2022 or the most recent year available.

[2]Based on countries for which a Human Development Index value is calculated.

[3]Updated by HDRO based on data from UNESCO Institute for Statistics (2023).

[4]In calculating the HDI value, expected years of schooling is capped at 18 years.

[5]In calculating the HDI value, GNI per capita is capped at $75,000.

[6]Updated by HDRO using mean years of schooling trend of Austria and data from UNESCO Institute for Statistics (2023)

[7]Estimated using the purchasing power parity (PPP) rate and projected growth rate of Switzerland.

[8]Updated by HDRO based on data from UNESCO Institute for Statistics (2023) and OECD (2023).

[9]Estimated using the PPP rate of Spain.

[10]Based on HDRO estimates using cross-country regression.

[11]Updated by HDRO based on data from UNESCO Institute for Statistics (2023) and estimates using cross-country regression.

[12]HDRO estimate based on data from World Bank (2023), United Nations Statistics Division (2023) and IMF (2023).

[13]Refers to 2015 based on UNESCO Institute for Statistics (2023).

[14]Refers to 2015 based on HDRO estimates using cross-country regression.

[15]Updated by HDRO based on data from UNESCO Institute for Statistics (2023) and United Nations Children's Fund (UNICEF) Multiple Indicator Cluster Surveys for various years.

[16]Updated by HDRO based on data from UNESCO Institute for Statistics (2023) and Barro and Lee (2018).

[17]HDRO estimate based on cross-country regression and the projected growth rate from United Nations Statistics Division (2023) and UN DESA (2023).

[18]Updated by HDRO based on data from Barro and Lee (2018) and estimates using cross-country regression.

[19]Updated by HDRO based on data from UNESCO Institute for Statistics (2023) and SEDLAC (CEDLAS and The World Bank) (2023).

[20]Updated by HDRO based on data from United Nations Children's Fund (UNICEF) Multiple Indicator Cluster Surveys for various years.

[21]Updated by HDRO based on data from United Nations Children's Fund (UNICEF) Multiple Indicator Cluster Surveys for various years and estimates using cross-country regression.

[22]HDRO estimate based on data from World Bank (2023) and IMF (2023).

[23]IMF (2023).

[24]Updated by HDRO based on data from UNESCO Institute for Statistics (2023) and ICF Macro Demographic and Health Surveys for various years.

[25]Updated by HDRO based on data from ICF Macro Demographic and Health Surveys for various years.

[26]HDRO estimate based on data from World Bank (2023), United Nations Statistics Division (2023) and UN DESA (2023).

[27]Refers to 2008 based on UNESCO Institute for Statistics (2023).

[28]In calculating the HDI value, life expectancy is capped at 85 years.

Definitions:

Human Development Index (HDI): A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living. See Technical note 1 at `http://hdr.undp.org/sites/default/files/hdr2023_technical_notes.pdf` for details on how the HDI is calculated.

Life expectancy at birth: Number of years a newborn infant could expect to live if prevailing patterns of age-specific mortality rates at the time of birth stay the same throughout the infant's life.

Expected years of schooling: Number of years of schooling that a child of school entrance age can expect to receive if prevailing patterns of age-specific enrolment rates persist throughout the child's life.

Mean years of schooling: Average number of years of education received by people ages 25 and older, converted from education attainment levels using official durations of each level.

Gross national income (GNI) per capita: Aggregate income of an economy generated by its production and its ownership of factors of production, less the incomes paid for the use of factors of production owned by the rest of the world, converted to international dollars using PPP rates, divided by midyear population.

GNI per capita rank minus HDI rank: Difference in ranking by GNI per capita and by HDI value. A negative value means that the country is better ranked by GNI than by HDI value.

HDI rank for 2021: Ranking by HDI value for 2021, calculated using the same most recently revised data available in 2023 that were used to calculate HDI values for 2021.

To my colleagues Gaia and Samuele, to my parents and to JEToP's family and friends - your presence on this journey has meant everything.