Hacettepe University Graduate School Of Social Sciences

Department of Economics

THE RELATIONSHIP BETWEEN INCOME INEQUALITY AND ENVIRONMENTAL DEGRADATION: A STUDY ON THE EUROPEAN UNION COUNTRIES

Dora Ege KAYACAN

Master's Thesis

Ankara, 2022

THE RELATIONSHIP BETWEEN INCOME INEQUALITY AND ENVIRONMENTAL DEGRADATION: A STUDY ON THE EUROPEAN UNION COUNTRIES

Dora Ege KAYACAN

Hacettepe University Graduate School of Social Sciences

Department of Economics

Master's Thesis

Ankara, 2022

ACCEPTANCE AND APPROVAL

The jury finds that Dora Ege Kayacan has on the date of 26.05.2022 successfully passed the defense examination and approves his master's thesis titled "The Relationship Between Income Inequality And Environmental Degradation: A Study on the European Union Countries".

Prof. Dr. Aytekin GÜVEN (Jury President)

Asst. Prof. Dr. Onur YENİ (Main Adviser)

Assoc. Prof. Dr. Selcen ÖZTÜRK

I agree that the signatures above belong to the faculty members listed.

Prof. Dr. Uğur ÖMÜRGÖNÜLŞEN

Graduate School Director

YAYIMLAMA VE FİKRİ MÜLKİYET HAKLARI BEYANI

Enstitü tarafından onaylanan lisansüstü tezimin/raporumun tamamını veya herhangi bir kısmını, basılı (kağıt) ve elektronik formatta arşivleme ve aşağıda verilen koşullarla kullanıma açma iznini Hacettepe Üniversitesine verdiğimi bildiririm. Bu izinle Üniversiteye verilen kullanım hakları dışındaki tüm fikri mülkiyet haklarım bende kalacak, tezimin tamamının ya da bir bölümünün gelecekteki çalışmalarda (makale, kitap, lisans ve patent vb.) kullanım hakları bana ait olacaktır.

Tezin kendi orijinal çalışmam olduğunu, başkalarının haklarını ihlal etmediğimi ve tezimin tek yetkili sahibi olduğumu beyan ve taahhüt ederim. Tezimde yer alan telif hakkı bulunan ve sahiplerinden yazılı izin alınarak kullanılması zorunlu metinlerin yazılı izin alınarak kullandığımı ve istenildiğinde suretlerini Üniversiteye teslim etmeyi taahhüt ederim.

Yükseköğretim Kurulu tarafından yayınlanan ***"Lisansüstü Tezlerin Elektronik Ortamda Toplanması, Düzenlenmesi ve Erişime Açılmasına İlişkin Yönerge"*** kapsamında tezim aşağıda belirtilen koşullar haricince YÖK Ulusal Tez Merkezi / H.Ü. Kütüphaneleri Açık Erişim Sisteminde erişime açılır.

- o Enstitü / Fakülte yönetim kurulu kararı ile tezimin erişime açılması mezuniyet tarihimden itibaren 2 yıl ertelenmiştir. (1)
- o Enstitü / Fakülte yönetim kurulunun gerekçeli kararı ile tezimin erişime açılması mezuniyet tarihimden itibaren ... ay ertelenmiştir. (2)
- o Tezimle ilgili gizlilik kararı verilmiştir. (3)

26/05/2022

Dora Ege KAYACAN

[1] *"Lisansüstü Tezlerin Elektronik Ortamda Toplanması, Düzenlenmesi ve Erişime Açılmasına İlişkin Yönerge"*

(1) *Madde 6. 1. Lisansüstü tezle ilgili patent başvurusu yapılması veya patent alma sürecinin devam etmesi durumunda, tez* ***danışmanının*** *önerisi ve* ***enstitü anabilim dalının*** *uygun görüşü üzerine* ***enstitü*** *veya* ***fakülte yönetim kurulu*** *iki yıl süre ile tezin erişime açılmasının ertelenmesine karar verebilir.*

(2) *Madde 6. 2. Yeni teknik, materyal ve metotların kullanıldığı, henüz makaleye dönüşmemiş veya patent gibi yöntemlerle korunmamış ve internetten paylaşılması durumunda 3. şahıslara veya kurumlara haksız kazanç imkanı oluşturabilecek bilgi ve bulguları içeren tezler hakkında tez* ***danışmanının*** *önerisi ve* ***enstitü anabilim dalının*** *uygun görüşü üzerine* ***enstitü*** *veya* ***fakülte yönetim kurulunun*** *gerekçeli kararı ile altı ayı aşmamak üzere tezin erişime açılması engellenebilir.*

(3) *Madde 7. 1. Ulusal çıkarları veya güvenliği ilgilendiren, emniyet, istihbarat, savunma ve güvenlik, sağlık vb. konulara ilişkin lisansüstü tezlerle ilgili gizlilik kararı,* ***tezin yapıldığı kurum*** *tarafından verilir *. Kurum ve kuruluşlarla yapılan işbirliği protokolü çerçevesinde hazırlanan lisansüstü tezlere ilişkin gizlilik kararı ise,* ***ilgili kurum ve kuruluşun önerisi*** *ile* ***enstitü*** *veya* ***fakültenin*** *uygun görüşü üzerine* ***üniversite yönetim kurulu*** *tarafından verilir. Gizlilik kararı verilen tezler Yükseköğretim Kuruluna bildirilir.*
Madde 7.2. Gizlilik kararı verilen tezler gizlilik süresince enstitü veya fakülte tarafından gizlilik kuralları çerçevesinde muhafaza edilir, gizlilik kararının kaldırılması halinde Tez Otomasyon Sistemine yüklenir

**** Tez*** ***danışmanının*** *önerisi ve* ***enstitü anabilim dalının*** *uygun görüşü üzerine* ***enstitü*** *veya* ***fakülte yönetim kurulu tarafından karar verilir.***

ETİK BEYAN

Bu çalışmadaki bütün bilgi ve belgeleri akademik kurallar çerçevesinde elde ettiğimi, görsel, işitsel ve yazılı tüm bilgi ve sonuçları bilimsel ahlak kurallarına uygun olarak sunduğumu, kullandığım verilerde herhangi bir tahrifat yapmadığımı, yararlandığım kaynaklara bilimsel normlara uygun olarak atıfta bulunduğumu, tezimin kaynak gösterilen durumlar dışında özgün olduğunu, **Dr.Öğr.Üyesi Onur YENİ** danışmanlığında tarafımdan üretildiğini ve Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü Tez Yazım Yönergesine göre yazıldığını beyan ederim.

Dora Ege KAYACAN

ACKNOWLEDGEMENTS

First of all, I would like to express my deep and sincere gratitude to my supervisor Asst. Prof. Onur YENİ for his guidance and support throughout the whole process.

I want to express my gratitude to the committee members, Prof. Dr. Aytekin GÜVEN and Assoc. Prof. Selcen ÖZTÜRK, for their valuable contributions and comments on my thesis.

I would also thank all my family members for encouraging me and supporting me from the very beginning to the end.

ABSTRACT

KAYACAN, Dora Ege. *The Relationship Between Income Inequality And Environmental Degradation: A Study on the European Union Countries*, Master's Thesis, Ankara, 2022.

The relationship between income levels and environmental indicators has been studied in the literature by various scholars. However, lesser attention has been paid to the relationship between income inequality and environmental degradation. This thesis aims to identify the relationship between income inequality and environmental degradation using the data between 2005 and 2018 for EU member countries. Panel data analysis has been applied for 28 countries to analyze the relationship. Alternative income inequality indicators such as Gini coefficient, income share of the top 10%, S80/S20 ratio, income share of the bottom 40%, and the Palma ratio have been used for the income inequality as key independent variables along with the other independent variables. The dependent variables of this thesis that have been used mainly for the different base models are greenhouse gas emissions per capita and ecological footprint per capita. This thesis focused on determining whether there is a robust relationship between income inequality and environmental degradation while examining the relationship between. As a result of Driscoll Kraay's robust error estimator, a negative relationship between income inequality and environmental degradation has been found. Accordingly, for the greenhouse gas emissions and ecological footprint, there was a negative relationship between the Gini coefficient, Palma ratio, and income share of the top 10%, while a positive relationship was observed for the bottom 40%. Although, S80/S20 ratio was insignificant for greenhouse gas emission, there was a negative relationship between ecological footprint. Additionally, real GDP per capita positively affected both indicators, while urbanization and human capital negatively. A positive relationship between the manufacturing ratio, final energy consumption, and energy intensity has been shown with the greenhouse gas emissions. Only energy intensity positively affected the ecological footprint per capita apart from manufacturing ratio and final energy consumption.

Keywords

Income inequality , environmental degradation , greenhouse gas emissions per capita , ecological footprint per capita , panel data analysis , Driscoll & Kraay

ÖZET

KAYACAN, Dora Ege. *The Relationship Between Income Inequality And Environmental Degradation: A Study on the European Union Countries*, Master's Thesis, Ankara, 2022.

Gelir düzeyleri ile çevresel göstergeler arasındaki ilişki literatürde çeşitli bilim insanları tarafından incelenmiştir. Gelir ve çevresel bozulma arasındaki ilişki incelenirken, hem gelir eşitsizliğine hem de sera gazı emisyonları ve ekolojik ayak izi açısından çevresel bozulmaya daha az dikkat edilmiştir. Bu tez, AB üyesi ülkelerde 2005-2018 yılları arasındaki verileri kullanarak gelir eşitsizliği ve çevresel bozulma arasındaki ilişkiyi belirlemeyi amaçlamaktadır. İlişkiyi gözlemlemek için 28 ülke için panel veri analizi uygulanmıştır. Gelir eşitsizliği için diğer bağımsız değişkenlerle birlikte temel bağımsız değişken olarak Gini katsayısı, en üst %10'un gelir payı, S80/S20 oranı, en alt %40'ın gelir payı ve Palma oranı kullanılmıştır. Gini katsayısı, en üst %10'un gelir payı, S80/S20 oranı, en alttaki %40'ın gelir payı ve Palma oranı, diğer bağımsız değişkenlerle birlikte temel bağımsız değişkenler olarak gelir eşitsizliği için kullanılmıştır. Temelde farklı ana modeller için kullanılan bu tezin bağımlı değişkenleri, kişi başına düşen sera gazı emisyonları ve kişi başına düşen ekolojik ayak izidir. Bu tez, arasındaki ilişkiyi incelerken, gelir eşitsizliği ile çevresel bozulma arasında sağlam bir ilişki olup olmadığını belirlemeye odaklanmıştır. Driscoll Kraay'ın güçlü hata tahmincisi sonucunda, gelir eşitsizliği ile çevresel bozulma arasında negatif bir ilişki bulunmuştur. Buna göre sera gazı emisyonları ve ekolojik ayak izi için Gini katsayısı, Palma oranı ve en üst %10'un gelir payı arasında negatif, en alttaki %40 için pozitif bir ilişki gözlemlenmiştir. Sera gazı emisyonu için S80/S20 oranı anlamsız olmasına rağmen, ekolojik ayak izi arasında negatif bir ilişki bulunmuştur. Ayrıca, kişi başına düşen reel gelir her iki göstergeyi de pozitif, kentleşme ve beşeri sermayeyi negatif yönde etkilemiştir. Sera gazı emisyonları ile sanayileşme oranı, nihai enerji tüketimi ve enerji yoğunluğu arasında pozitif bir ilişki gösterilmiştir. Sanayileşme oranı ve nihai enerji tüketimi dışında kişi başına düşen ekolojik ayak izini yalnızca enerji yoğunluğu pozitif yönde etkilemiştir.

Anahtar Sözcükler

Gelir eşitsizliği , çevresel bozulma , kişi başı sera gazı emisyonu , kişi başı ekolojik ayak izi , panel veri analizi , Driscoll & Kraay

TABLE OF CONTENTS

ACCEPTANCE AND APPROVAL……………………………………………….….….i

YAYIMLAMA VE FİKRİ MÜLKİYET HAKLARI BEYANI………….........…ii

ETİK BEYAN…………………………………………………………………….iii

ACKNOWLEDGEMENTS …………………..………………………….….…......iv

ABSTRACT...…………………………………………………………....……........v

TURKISH ABSTRACT ……………………..……………………………………..vi

TABLE OF CONTENTS……………………………………………………......vii

LIST OF TABLES............……………..……………………………….……........ix

LIST OF FIGURES…………………………………………….………...….........x

INTRODUCTION……………………………………………..…….….…………1

CHAPTER 1: LITERATURE REVIEW……….…………………………………….9

1.1. ENVIRONMENTAL KUZNETS CURVE…………….……..…...……….11

1.2. THE POLITICAL ECONOMY OF ENVIRONMENTAL DEGRADATION AND INCOME INEQUALITY ………………………………...14

1.2.1. Demand for the Environmental Protection……………….............16

1.3. INDIVIDUAL ECONOMIC BEHAVIOUR……………….……...…21

1.3.1. Marginal Propensity To Emit………………..…..…………….......21

1.3.2. Veblen Effect…………………………………..…...………25

CHAPTER 2: DATA AND METHODOLOGY……………………..……...……....37

CHAPTER 3: RESULTS AND DISCUSSION……………….…………....…….48

3.1. ROLE OF INCOME INEQUALITY………………..…........................49

3.2. ROLE OF INCOME ……………………..…...56

3.3. ROLE OF ENERGY AND MANUFACTURING………………….........57

3.4. ROLE OF HUMAN CAPITAL……………………………….…...........58

3.5. ROLE OF URBANIZATION…………………………………….........60

CONCLUSION…………………..…………………………....……………………….61

BIBLIOGRAPHY………………………..…………………...…………………….66

APPENDIX 1. ....…...….73

APPENDIX 2. ……........………………………………………………....……..….……74

APPENDIX 3. ………………………………………….…………...…….…….…...75

APPENDIX 4. ………………..……………...………………………………...…….……...76

APPENDIX 5. ……………………………………………………….………...……80

APPENDIX 6. …………………………………………………………..……….…….82

LIST OF TABLES

Table 1: Literature Review Table (Overview of the reviewed studies)…….……….30

Table 2: Variables of the Thesis …………………………………..……….............…38

Table 3: Summary Statistics …………………...…………………….......…………….43

Table 4: Tests - Greenhouse Gas Emissions Per Capita – Base Model (1)…......……...45

Table 5: Tests - Ecological Footprint Per Capita – Base Model (2)..………….............46

Table 6: First Model Regression Table (1) Greenhouse Gas Emissions Per Capita Results ...48

Table 7: Second Model Regression Table (2) Ecological Footprint Per Capita Results..........49

LIST OF FIGURES

Figure 1: Environmental Kuznets Curve Shape ……………………………………...….12

Figure 2: Relationships Between Individual Income and Environmental Pressure...…22

INTRODUCTION

What exactly defines life? This question has been asked many times by different people in various time periods and is still being asked. Although all answers differ, life for humanity began in nature. So much so that in our long journey from homo erectus to homo sapiens and from there to homo economicus, humankind invariably lives as a part of nature. Humans have always had a close relationship with nature, relying on it for survival and production (Keniger et al., 2013). According to environmental ethics, most fundamentally, human well-being is a whole with the environment (Boyce, 2010).

However, this situation is about to change today because now homo economicus is in a mess in the order they created. Nature, that is, the environment, attracts the echoes of this confusion. So much so that the elements of pressure for nature are increasing day by day in every field, and the limits of nature are being pushed more and more. It is possible to show climate change as the most significant outcome of this situation. Humans have tended to move away from nature and even harm it for their benefit since the beginning of industrialization. Namely, industrialization has resulted in economic welfare and massive production. Nevertheless, due to more population, the possible pressures for nature have been created (Patnaik, 2018). Modern society increased the human population, and urbanization has carried the ability to continue from simple production and vital activities to another dimension and has led people to consume at the expense of the environment. As we get closer to the present, it is possible to say that this situation has turned into a significant environmental degradation.

Besides, humans are experiencing significant issues not only with nature but also within themselves at the social and economic levels. Humans struggle with many problems in the newly globalized world and are moving away from a livable world day by day. Such as trade wars, poverty, inequality, insecurity, unemployment, growth, hunger, and migration, are being experienced by various people and countries both globally and regionally (Banerjee and Duflo, 2019). One of the critical factors that trigger these problems can be stated as inequalities. Inequalities manifest themselves in different ways and areas. Undoubtedly, one of the areas where these inequalities are clearly seen is income distribution. How income inequality emerged and how it persists over time is one of the important issues discussed by social scientists for years (Gönel, 2016). The literature on the role of economic growth and country-specific features in income inequality is still controversial. Yet, economic activities basically emerge as the main factor that creates income inequality. The same economic activities are also one of the leading causes of environmental degradation. As the literature on the Environmental Kuznets Curve (EKC) shows, increases in climate change have been reported and are expected due to economic activity (Grunewald et al., 2017). It is also known that economic growth is highly associated with higher carbon and greenhouse gas emissions (Ravallion et al., 2000). So that, for both income inequality and environmental degradation, there is a linkage between economic activities.

Another key situation is EKC emphasizes that higher economic growth positively impacts environmental degradation. Yet, there is a strict positive relationship between income levels and environmental pollution in the early stages of development. However, this effect on the environmental degradation due to economic growth differs among countries with high income and low income (De Bruyn et al., 1998; Magnani, 2001). This situation shows that other possible factors can affect environmental quality besides economic growth and economic activity. In the political economy of environmental degradation theory, unequal power distribution between the poor and rich is considered a potential feature is influencing environmental degradation (Boyce, 1994; Li et al., 2020; Magnani, 2000; M. Ravallion et al., 2000; Scruggs, 1998). In line with the unequal power distribution, the political economy point of view constitutes another pillar of the theoretical infrastructure which directly affects the income inequality-related demand for the environmental policies that can prevent environmental degradation (Borghesi, 2005; Boyce, 2010; Destek, 2019; Kashwan, 2017; Kempf & Rossignol, 2007; Magnani, 2001; Ridzuan, 2019).

Another perspective can be drawn with the latest research. For instance, in compliance with the Oxfam research, it has been shown that the richest 10% is solely responsible for 52% of the aggregate emissions while 40% of the middle-income group is 41% and only 7% of aggregate emissions are bonded to 50% of the poorest.[1] This situation indicates that the contribution of the poor and the rich to environmental pollution is not equal. The difference in the balance of power and economic behaviour of the individuals may underlie this difference (Liu et al., 2020). The economic behaviour of the individual theory plays a significant role while examining the possible nexus between income inequality and environmental degradation. More specifically, the consumption patterns that can change due to income redistribution or possible income inequality changes emerges as one of the main reasons discussed in the literature for the environmental outcomes. Marginal propensity to emit (MPE) and Veblen effect theories which can be classified under the economic behaviour of the individuals are one of the significant mechanisms for income inequality and environmental degradation nexus. (Baležentis et al., 2020; Heerink et al., 2001; Jorgenson et al., 2017; Mader, 2018; M. Ravallion et al., 2000; Scruggs, 1998).

As it has been known, in the post-industrial era, greenhouse gas emissions have been increasing rapidly. Human activities have been the most significant factor in these rising emission levels. Climate change has been triggered in line with the increased greenhouse gas emissions since the mid-twentieth century (WMO,2020). It is also important to note that human activities are directly associated with economic activities. Greenhouse gas emissions resulting from human activities emerge as the primary driver of climate change. The latest IPCC 6 report underlined that human impact has warmed and affected the atmosphere, ocean, and land leading to vulnerable effects on the complete earth systems (IPCC, 2021). Change in the global temperature and "greenhouse effect" has incrementally increased since the pre-industrial era; these temperature anomalies attributed to greenhouse emissions, primarily CO2 emissions, have severe outcomes. These changes in the climate and temperature rises due to greenhouse gas emissions have significant potential ecological, physical, and health consequences. Additionally, it triggered unusual weather events, leading to floods, droughts, storms, sea-level rises, disrupted water systems, and altered crop growth (Ritchie & Roser, 2020).

[1] https://www.oxfam.org/en/press-releases/carbon-emissions-richest-1-percent-more-double-emissions-poorest-half-humanity

It is possible to see environmental warnings from other indicators as well. One of the most important of these is the ecological footprint, which will be another concern of this thesis with greenhouse gas emissions. Briefly, there is a relationship between ecological footprint and biocapacity. Biocapacity per capita is determined by how many hectares of productive land are being used, how productive the land is, and how many people share this biocapacity. On the other hand, the ecological footprint shows how much of this capacity is used, in other words, the level of environmental pressure caused by human activities. As specified by the latest calculated ecological footprint data, since 1961, the world's entire ecological footprint has been increasing at a rate of 2.1% each year on average. The most significant increase can be observed in the carbon footprint (Lin et al., 2018).

In the 21st century, humankind is faced with many problems that need to be resolved to maintain a livable and sustainable world in line with the sustainable development concept. In its broadest sense, the concept of sustainable development encompasses environmental degradation, poverty, and an economic growth model that does not increase income disparity. Three essential characteristics of sustainable development are defined and pointed in this direction, which can be stated as economic, social, and environmental (Destek, 2019). Undoubtedly, maintaining sustainable development and the solution of income inequality and climate change, which are two of the biggest problems humankind faces, is to reduce income inequalities and diminish climate change.

Moreover, in line with the sustainable development goals (SDGs), climate change and income inequality are the most critical concerns in achieving long-term development goals (Liobikienė & Rimkuvienė, 2020). The Sustainable Development Goals emphasize that rising inequality and environmental deterioration are severe risks to human well-being. Besides, income inequality and sustainable development are inextricably linked. As a result, addressing environmental concerns while ignoring income disparity may result in inadequate outcomes (Masud et al., 2018).

Hence, considering the possible outcomes of income inequality and environmental degradation is crucial for the environment and humanity, which gives us the definition of 'our earth' in the simplest sense. With this motive -which is also the starting point of this thesis-, understanding the link between income inequality and environmental degradation has become even more pivotal in our era. As an outcome, sustaining and improving humanity's living standards is directly related to environmental degradation. Ecology and the economy have a vital role to play in society's efforts to improve the quality of life throughout the world.

Therefore, the question discussed in this thesis is, "Is there a relationship between income inequality and environmental degradation?" We will investigate the relationship between income inequality and environmental degradation and show whether there is a trade-off (negative relationship) between these two concepts. We focus on the European Union (EU) member countries to this end. The main reason for selecting these countries is that the EU has specific targets for both reducing greenhouse gas emissions and inequalities. Namely, the EU countries have set forth to decrease greenhouse gas emissions by 40% in 2030 and 80% in 2050 compared to 1990's emission rates and massive energy consumption levels (Sterpu et al., 2018). A climate-neutral economy is desired to be achieved by 2050 by the EU. The European Climate Law has been adopted for this purpose, and the last measurements showed there is a decrease of 24% in 2019 compared to the rates in 1990[2] (see Appendix-1) It is also known that reducing income inequality is one of the priorities of the EU (European Commission, 2017). However, income inequality has been rising in European countries at all different income levels (Blanchet et al., 2019). So while environmental degradation is decreasing, a rise in income inequality can be seen. This situation enables the investigation of different dynamics observed in EU member countries regarding income inequality and environmental degradation. The robustness of the relationship between income inequality and environmental degradation is another issue investigated in this thesis. Additionally, data availability has been also considered while selecting the country coverage.

In the literature on income inequality and environmental degradation, most of the studies used carbon emissions as an indicator for environmental degradation. So, it can be said that less attention has been paid to other environmental indicators such as

[2] https://www.eea.europa.eu/themes/climate/eu-greenhouse-gas-inventory/is-europe-reducing-its-greenhouse

ecological footprint and greenhouse gas emissions. Although, it is worth noting that carbon dioxide is the largest contributor to greenhouse gas emissions but not the strongest one (Brander, 2012). In this study, we use greenhouse gas emissions per capita and ecological footprint per capita as environmental indicators. In order to capture the different dimensions of the inequality, S80/S20 ratio, the income share of the bottom 40%, the income share of top 10%, and Palma ratio -which is calculated by dividing the richest 10% of the population by the poorest 40%'s share- have been used. Another reason for using various income measurements is that the political effects and consumption behaviours of different income groups -known as the Veblen effect and MPE theories that will be discussed in detail in the following sections- can be interpreted from these variables is possible. Taking into account different indicators of income inequality and environmental degradation is important to provide a multidimensional perspective, and to check robustness.

The first contribution of this thesis, therefore is to examine the relationship between environmental degradation and income inequality with different income inequality and degradation indicators, which have been relatively under-studied in the literature. While investigating this relationship, possible connections between various inequality indicators and environmental degradation are revealed. At the same time, findings of this study can provide valuable insights in the search for solutions to environmental degradation and income inequality problems. It should be pointed out that providing a robustness check with different income share and distribution measurements while using especially greenhouse gas emissions per capita and ecological footprint per capita, which are significant climate change indicators, is another intended contribution to the growing literature on this nexus. Our findings of this study indicate that there is a trade-off exists between environmental degradation and income inequality. Decision-makers may consider this relationship in policy adjustments and consider environmental deterioration in income distribution. As our findings showed, the accumulation of the income in the bottom 20% and %40 has increased the environmental degradation while the reverse is observed for the top 10% and 20% in the EU countries. By focusing on individual environmental awareness, it is possible to overcome this trade-off resulting from a rising MPE and Veblen effect for the relatively low-income segment. Increasing the number of individuals with high environmental awareness in society can be effective in their consumption behaviors, motivations and environmental policy demands. Increasing the level of education, which is one of the human capital elements, in lower-income groups is a step that can be applied for this purpose. The negative relationship found as a result of this study between education level and environmental degradation also supports this aim. Therefore, policymakers can consider a possible relationship between environmental degradation and income inequality in their environmental and income inequality-reducing policy practices. This is seen as a significant contribution to the literature.

Firstly, a base model with the different income inequality indicators has been conducted for the greenhouse gas emissions per capita while it is the dependent variable. For instance, Jorgenson et al. (2017) have emphasized that the Gini coefficient can't be solely enough to represent the direct position in the income distribution; possible variation differences due to differences in low and middle income have been stated as the main reason. Additionally, the coefficient has limitations, which are discussed in the upcoming sections. If we take the income share of the top 10%, for example, it is an indicator that can reflect and determine the economic and political power as well as the wealthy's emulative pull (Jorgenson et al., 2017). 40% income share of the bottom, on the other hand, provided a two-sided perspective correspondingly while observing the possible relationship between environmental degradation and income inequality. Covering countries with different income inequality measurements provided a robustness check for the relationship found as a result of this thesis.

For the other alternative base model, the ecological footprint per capita was used as a dependent variable with the same independent variables, including the income inequality measurements mentioned above, to make a multidimensional analysis and show environmental outcomes from a broader perspective in terms of environmental degradation. A large amount of studies has been constructed for CO2 emissions in the literature on income inequality and environmental degradation. However, CO2 emissions show partial environmental pollution resulting from energy consumption (Al-Mulali et al., 2015) and using CO2 emissions as an only indicator won't result insufficient results, unlike ecological footprint, which set forth a broader perspective (Destek, 2019).

Other independent variables were added to both models in accordance with the literature to increase the established models' reliability and explain the possible relationship between income inequality and environmental degradation with different aspects. These independent variables are real GDP per capita, manufacturing ratio to GDP (% of GDP), the proportion of the urban population, energy intensity, human capital, and final household energy consumption.

Annual data of each variable in years between 2005 to 2018 has been used for the EU-28 countries. In order to examine the linkage between income inequality and environmental degradation, panel data analysis has been applied. In concluson, as a result of our estimations, a negative relationship was found between income inequality and environmental degradation, which is represented by greenhouse gas emission per capita and ecological footprint per capita. Our results indicate, Gini coefficient, Palma ratio, S80/S20, has a negative effect on environmental degradation and a positive impact on the income share of the bottom 40%, that is, an improvement in the income of the low-income group can be observed. As a consequence of the accumulation of the income in the top 10% compared to the income share of the bottom 40%, environmental degradation, which is denoted by greenhouse gas emissions per capita and ecological footprint per capita, has reduced. Additionally, as the S80/S20, which represents the ratio of the 20% population with the highest household income in total household disposable income to 20% of the population with the lowest household disposable income (Kolluru & Semenenko, 2021), increases the ecological footprint per capita similarly has decreased. This result is supported by the signs of the Palma ratio, the income share of the top 10%, and the income share of the bottom 40%. As the income share of the top 10% increases, which can be identified as the affluent group that holds the political power (Boyce, 2010; Jorgenson et al., 2017; Knight et al., 2017; Mader, 2018; Winters & Page, 2009), under the assumption of purchasing power and political power go hand to hand, greenhouse gas emission per capita and ecological footprint per capita decreases. On the contrary, as the income share of the bottom 40% rises, the environmental degradation denoted by these two degradation indicators increases. Hence, for the EU member countries in line with the result, the higher income group has a lower MPE than the relatively poorer. As the income share of the top 10% increases, less environmental degradation will occur. Due to the Veblen effect, a higher MPE for the low-income group can be seen. The results also showed that there is a negative effect of human capital and urbanization on environmental degradation. There is a positive relationship between real GDP per capita and both indicators. Similarly, a positive relationship between the manufacturing ratio, final energy consumption, and energy intensity has been shown with the greenhouse gas emissions. On the other hand, energy intensity positively affected the ecological footprint per capita, while manufacturing ratio and final energy consumption was insignificant.

The study is organized as follows: **Chapter 1** presents the literature review, this section discusses in greater detail the relationship between income inequality and environmental degradation, After reviewing the relevant literature, **Chapter 2** presents data and methodology and gives the details of the empirical strategy used. **Chapter 3** presents our results and discusses them, and the final section concludes.

CHAPTER 1

LITERATURE REVIEW

This section covers the relevant literature on the nexus between income inequality and environmental degradation. Several studies conducted on this issue from various perspectives. A growing literature can be observed on this relationship. Most of these studies have used the Gini coefficient for income inequality and carbon emissions for environmental degradation. The direct effect of income inequality on emission levels emerges as the main subject of these empirical studies.

As the findings of these studies are examined, it can be clearly said that there is no exact consensus on the natüre of the relationship between income inequality and environmental degradation. It is possible to classify the studies investigating the relationship in terms of their results which are positive, negative, and insignificant (see table 1). The reason behind this conflict is that; there are some limitations and differences in these studies.

Findings vary from each other and they are considered to be mixed due to time preferences and constructed models (Borghesi, 2005). Additionally, the conclusions derived from the empirical studies result from models designed for entirely different indicators of environmental degradation for different country groups. Besides, these countries' structural, economic, and political characteristics potentially impact the relationship between income inequality and environmental degradation (Lutz Sager, 2017). Considering the variables, samples, and time period differences, there is a variation in the studies in terms of methodology in the literature. For instance, Duro (2016) stated that as a result of a study, the relationship between income inequality and environmental degradation in different gas measurements, varies for different indexes. Thus, the observed relationship between income inequality and environmental degradation can be different as the indicators and model specifications change.

Specifically, to observe the relationship between income inequality and environmental degradation, panel data analysis (Alatas & Akın, 2021; Liobikienė & Rimkuvienė, 2020; Ravallion et al., 2000; Yang et al., 2011; Zhang & Zhao, 2014; Liu et al., 2020; Magnani,2000; Liu et al., 2020; Magnani, 2000; Grunewald et al., 2017; Danish et al., 2020) ARDL (Destek, 2019; Ghosh, 2019; Kusumawardani & Dewi, 2020) time series and cross-section analysis (Scuggs, 1998; Heerink et al., 2001; Jorgenson et al., 2017; Boyce et al., 2010) has been used with different independent and dependent variables. (see table 1) As the empirical models revealed, there are various possible ways of examining the relationship between inequality and degradation. (Jorgenson et al., 2017) The casual relationship discussed in the studies can not fully cover the theoretical mechanisms (Berthe & Elie, 2015).

Besides these differences, theoretical differences and perspectives leading to different interpretations are the reasons lying behind different results concerning the relationship between income inequality and environmental degradation. The EKC hypothesis provides a primary foundation for the theoretical background. Therefore, as a start, it would be appropriate to define the EKC hypothesis explain its role in the analysis of the relationship between income inequality and environmental degradation.

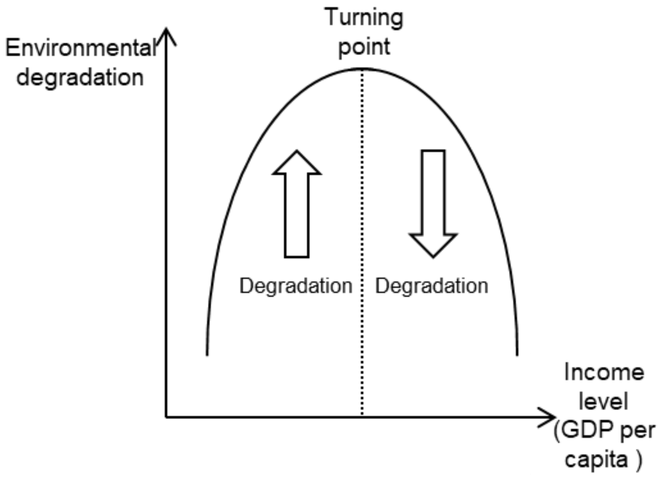
1.1. ENVIRONMENTAL KUZNETS CURVE

The Environmental Kuznets Curve (EKC) hypothesis, examines the relationship between income growth and environmental quality.

This relationship basically emerges from S. Kuznets' (1955) theory that there is an inverted-U-shaped relationship between income growth and income inequality. Accordingly, at the early stages of development, income inequality increases with the rising per capita income. After a critical level of income, as the income level increases, income inequality decrease.

Grossman and Krueger's (1991) study was the first study that identified what was later called the "Environmental Kuznets Curve." According to their findings, there is an inverted-U-shaped relationship between income growth and environmental degradation. As the income level increases, environmental degradation increases in the early stages of economic development before a threshold level is reached. After the threshold income level, higher levels of income will create a positive impact on the environment and environmental degradation decreases. As a result, an increase in income has a long-term negative effect on environmental degradation (Ghosh, 2019). The EKC relationship is shown in the figure below.

Figure 1: Environmental Kuznets Curve Shape



Source: Grossman and Krueger (1991)

Nevertheless, De Bruyn et al. (1998) have shown that the impact of economic growth on emissions can differ among high and poor-income groups. Magnani (2001) has also emphasized that when a shift from low-income to high-income countries occurs, the explanatory power of the coefficient for the GDP per capita that affects environmental conditions decreases substantially. Another key situation regarding the EKC is that the relative threshold point -a turning point- and curve of the EKC do not occur spontaneously (Yang et al., 2011).

Hence, these views have demonstrated that there are other possible features that can affect environmental degradation apart from economic activity and income level (Magnani, 2000). In other words, the investigation of other possible causes of deviations in environmental degradation impacts across country groups in the EKC theory has led scholars in the literature to recognize and examine significant differences that may have an impact on environmental pollution, such as income inequality. Income distribution has emerged as an important variable that will affect environmental degradation. For instance, Heerink et al. (2001) have empirically shown that inequality affects environmental degradation in line with the EKC theory.

From this point of departure, there have been some studies that observed income distribution is also one of the determinants of environmental degradation. Thus, this particular study has found that environmental pollution can depend on income distribution. According to some studies, income inequality can also influence the rise in the environmental pollution in the early stages of EKC; increasing inequality after reaching a threshold can lead to a decrease in environmental pollution (Grunewald et. al., 2017; Demir et al., 2019; Huang & Duan, 2020).

Hence in other words, when we combine EKC and KC theories, an increase in income inequality in the early stages of development can lead to an increase in environmental degradation. At the same time, a certain threshold has been reached. After this threshold level, as the income inequality decreases (according to Kuznets Curve), the environmental degradation also decreases. (according to EKC) Nonetheless, the EKC theory provides a foundation in the income inequality and environmental degradation literature, but it is important to show the mechanism behind this nexus.

As it is mentioned earlier, conducted empirical studies have various methods, samples, results, and different points of view while examining the relationship between income inequality and environmental degradation (Jorgenson et al., 2017). Regarded studies can be evaluated under several main titles. Different theoretical mechanisms in line with the EKC theory postulate the linkage between income inequality and environmental degradation. These mechanisms, in other words, main points can be stated as a political economy point of view, environmental policy demand, marginal propensity to emit, and Veblen effect, which can be evaluated under the individual economic behaviour. Based on different mechanisms, country-level and regional-level studies have been constructed. Country-level studies can be referred to as aggregated levels, while regional or state-level studies can be considered as disaggregated level studies (Alatas & Akın, 2021). In this section of the thesis, studies with both of these two different samples have been considered.

1.2. THE POLITICAL ECONOMY OF ENVIRONMENTAL DEGRADATION AND INCOME INEQUALITY

From the mid-1990's beginning with Boyce's (1994) pioneer study that emphasized a political-economy perspective on the relationship between income inequality and environmental degradation, a possible linkage has started to be shown between these two crucial concepts. In regard to the study, environmental degradation is identified as an external cost as a result of economic activities. Boyce has specified the "power-weighted social decision rule," which basically says that the relatively powerful -in this case richer- have higher social advantages in the way of politics and wealth so that they can easily impose the environmental outcomes on relatively poorer groups (Boyce, 1994).

Boyce (1994) has underlined that there are winners and losers of economic activities that create negative impacts on the environment, and possible losers/winners of this equation may belong to the future in line with the sustainable perspective or aware of they are on the losing/winning side but not aware of the costs of environmental outcomes (Boyce, 1994). Namely, greater power and wealth inequalities when the winner group is relatively more powerful than the loser group, environmental degradation will rise. This situation is due to imposed costs on poorer groups who are not able to prevent the outcomes of environmental degradation (Boyce, 1994). The empirical state-level study was conducted later by Boyce et al., (1999) for 50 US states by using the environmental stress index, environmental policy index that was introduced by Hall band Kerr and Gini coefficient. As a result of this study, in compliance with the earlier hypothesis advocated by Boyce, it has been found that higher power disparities result in more enervated environmental policies resulting in increased environmental deterioration; in other words, a positive relationship has been observed. This result has also highlighted the assumption of Boyce that higher democracy in economies can lead to a more positive impact on the environment than the other political regimes due to the more even distribution of power.

On the other hand, Scruggs (1998) investigated the impact of inequality on environmental degradation based on Boyce's work with a political economy point of view on environmental degradation. According to this study, equality does not necessarily generate environmental degradation, and distributional problems do not explain variations in environmental quality (Scruggs, 1998). Contrary to Boyce's suggestion, as a rise in income level occurs, individuals with a higher income will tend to consume eco-friendly goods, lowering environmental degradation, yet no significant relationship has been found in the regarded study.

Later on, this view was subjected to a study and was discussed by Zhang & Zhao (2014). Namely, panel data analysis has been constructed for the regions of China in the years between 1955 to 2010 to find out the nexus between income inequality and CO_2 emissions while considering regional differences. As a result of this study, as the EKC research in the literature emphasizes, economic growth (income) increases have increased China's CO_2 emissions for all the regions. Another significant result is that income inequality impacted CO_2 emissions greater in the Eastern region than in the Western. If we put it another way, equally distributed income improves the control of CO_2 emissions in developing regions, a positive relationship has been seen as the income, and income inequality rises. Accordingly, this result coincides with the idea put forward by Scruggs (1998). The result indicates that under the assumption of environmental goods demand is flexible, as a rise in income occurs, environmentally friendly products will be more in the market, and the composition of the goods will become more eco-friendly. The rise in income level goes on; the income distribution will also come closer to an equal position; this situation will lead the other relative group to increase their income levels and become able to use eco-friendly goods, which will eventually lead to an improvement in the environmental conditions (Zhang & Zhao, 2014). This situation also is known as the go-between theory, as the authors highlighted.

However, in line with the go-between theory Magnani (2000) has shown earlier that income inequality eventually creates a positive impact on environmental degradation due to the relative go-between's income level and capability to pay for eco-friendly products. Namely, as the income distribution gap continues to widen, the relative income of the others will fall, and they will pay less for eco-friendly goods, and the

EKC's turning point will be delayed (Yang et al., 2011). This will cause a positive impact on environmental degradation.

Magnani (2000) also emphasizes that policy decisions are one of the crucial features that can create a downslope on the EKC, also indicates that, If we consider the capacity of environmental protection for each country, possible income disparity will create a difference between this capacity and capability to implement environmental protection (Magnani, 2000). This situation will lead to environmental pollution. The regarded relationship has been shown for the 19 OECD countries for the years between 1980 and 1991. As a result, a positive relationship between income inequality and environmental degradation has been demonstrated in Magnani's study as well as Boyce's study. Another important outcome of this study is that income inequality creates a decrease in the public expenditures that are used for environmental protection, which opens the path to environmental degradation. This situation leads us to examine the demand for environmental protection and how it is connected with income inequality thus environmental degradation.

1.2.1. Demand for the Environmental Protection

Environmental protection mainly addresses the possible prevention of the environmental outcomes resulting from economic activities. In income inequality and environmental degradation nexus, the literature suggests that demand for environmental protections and policies are connected with income inequality and degradation.

Ridzuan (2019) has noticed an important detail in his work, which he prepared based on the EKC theory. Accordingly, the negative or positive impact of income inequality on environmental degradation can be understood by focusing on the impact of income inequality on the turning point in the EKC.

The impact of income inequality on the turning point in the EKC is accounted for as income inequality lowers the existing demand for environmental degradation protection. As a result, it has been found that income inequality increases the EKC turning point. In other words, higher inequality creates a positive impact on environmental pollution (Ridzuan, 2019). This result is also in line with Magnani's suggestion. Demand for environmental protection, in Magnani's words, "willingness to pay" can be affected by income inequality. Boyce (2010) has also stated that cost-benefit analysis, which was provided earlier by himself (see Boyce (1994) for further information), basically describes the willingness to pay. The costs are created by the environmental degradation outcomes, in other words, the desire to prevent these consequences on the environment through economic activities. In order to measure this, Boyce (2010) suggests that demands for environmental protections and in-line policy implementations are created by the same concept as goods and services in a market occurs. And behind this demand, there are two major differences between individuals who create demand. These are underlined as purchasing power and political power (Boyce, 2010). Political power has the ability to affect social decisions on environmental policies directly. However, Boyce also emphasizes that political power is correlated with purchasing power and both are unequally distributed. This situation leads to a conclusion that the number of individuals (share) who hold a certain percentage in the income distribution is effective in this created environmental protection demand and therefore in environmental pressure. The income share of the top 10% is a significant measurement in order to capture this political and economic power which has a direct effect on environmental degradation. Therefore, in this thesis, one of the income inequality measurements has been selected as the income share of the top 10%. Jorgenson et al., (2017) have also emphasized that the income share of the top 10% has the ability to measure the potential effects of political outcomes in line with the possible power accumulation (see Jorgenson et al., 2017). The same perspective can be seen in Knight et al., (2017), Gosh et al., (2019), Liu et al., (2020), and Mader (2018) constructed studies which are also focusing on income share of the top 10%.

Gassebner et al., (2008) highlighted that income inequality affects environmental degradation with the ownership of the inputs that are used in production. Namely, as their study states, political power and industrial sector dynamics are dominated by the rich, and eventually, they have a voice in environmental policies. Another perspective can be drawn with policy applicability for dominance in policies. Namely, Destek (2019) has emphasized in his study that constructed for Turkey, as a result of the increase in income inequality in the short term, a restrictive policy could not be implemented against the high-income group engaged in production and consumption activities. However, this situation has been reversed for a long time, which can be attributed to the high-income segment having begun to care more about environmental sensitivity than economic enrichment with increasing wealth (Destek, 2019). This possible situation leads us to consider the desires or dominance of the high-income group in environmental policy demands. The indicated point of view can be explained by Boyce's (1994) "power-weighted social decision rule" assumption that the high-income group will have the power. Time preference is also a critical hypothesis that again emphasized Boyce's (1994) political economy of inequalities and environmental degradation. According to this hypothesis, higher income and political power inequality lead to the time rate preference for the environmental resources. Driven time preference due to increased inequality creates political insecurity in the high-income group. This insecurity can be resulted in transferring their financials and savings to another country, which means that off-set from using the environmental resources and creating a negative impact on the environment (see Boyce (1994) dictator example).

Nevertheless, what can be expected in an economy where everyone gets an equal share of potential growth? In a practical world, we can expect a positive demand for environmental protection whether there is an increase in income inequality or not. Thus, a negative impact on environmental degradation. However, this might not be the issue in a democracy where citizens can decide whether to implement environmental protection policies or not. With this viewpoint, Kempf & Rossignol (2007) constructed a study considering the median voter preference in line with the political point of view. Expenditures by the government can be committed to either promoting growth or reducing pollution in an endogenous growth economy. Income inequality comes into play here, affecting the median voter and the environmental quality. It is worth noting that median voter preference has also been issued in the literature, again by Magnani (2000) and later by Kempf and Rossignol (2007). Namely, income inequality has a direct effect on the median voter's preference. As the median voter's income level decreases –get poorer– less willing to pay for the environment will occur, and positive well-being becomes more important than the environment (Kempf & Rossignol, 2007). Magnani (2000), on the other hand, inequality leads to poorer median fragments, thereby encouraging the growth policies alternatively to environmental policy demands (Berthe & Elie, 2015). This finding also counters Boyce's (1994) assumption that democracies experience less environmental degradation due to more equally distributed power. Similarly, Kashwan (2017) has conducted a study in order to observe the role of political choice-democracy in income inequality and environmental degradation literature by using cross-national analysis for 137 countries. The results have indicated that the impact of inequality changes with the democracy strength of the countries (Kashwan, 2017). In relatively democratic countries, protected land areas decrease while the reverse is valid for the less democratic countries. However, some studies have shown that there isn't any connection between the political regimes and the possible nexus of income inequality and environmental degradation. For instance, Clement & Meunie (2010) have discussed whether different political regimes and rights affect the relationship between income inequality and environmental pollution by using the political rights index in a part of their study, yet no significant association has been found.

Borghesi (2005) has indicated that rising inequality affects the environmental policy protections, and due to increasing imbalance, higher environmental degradation occurs. Inequality can also affect social norms, which are associated with the demands for environmental protections, as emphasized by Wilkinson and K. Pickett (2010). Accordingly, a more unequally distributed income could create less accessibility and maintainability for the environmental policy demand and leading a positive relationship between income inequality and environmental degradation.

However, another perspective with a possible negative relationship between income inequality and environmental degradation can be drawn. "A less poor world, but a hotter one? " Ravallion's (1997) proposed question in one of his studies is a question that substantially underlies the negative relationship between income inequality and environmental degradation in the most essential way.

In contrast to these findings, a possible trade-off between income inequality and environmental degradation has been firstly shown empirically by Ravallion et al., (2000). According to the results of a study that found a negative relationship between income inequality and environmental indicators, a "trade-off' between income inequality and environmental degradation can be mentioned. Ravallion et al. (2000) examined the trade-off perspective in a study by using panel data analysis for 42 countries (including both developed and developing). In this particular study aggregate, carbon emissions have been traced while considering the income distribution. The results have shown that as the inequality increases in the countries and between the countries, lower carbon emissions have been observed. Hence, it concluded that governments should take into account environmental degradation when implementing policies to reduce income inequality. The result also indicated that there is also a choice between social inequality and environmental sensitivity. Policy practices should be considered in order to turn this trade-off into a win-win situation for both cases. This perspective is in line with the demands for environmental policies that can be used to decrease pollution; one significant example can be energy-efficient regulations and adhering to reducing fossil fuels. The results of this study are also associated with the demand for environmental protection. Positive income effect on the environmental protection demand indicates that rising with the income, higher-income group, and higher-income countries will demand protection for the environment. Redistribution of the income from lower to higher would worsen this effect and lead to environmental degradation since the lower-income group has less demand for the regarded policies. In the next section, one of the main findings of this study will be examined.

Adhering to the EKC theory and the possible impact of income inequality on environmental degradation, mainly contrary to Magnani's and Boyce's views, Heerink et al. (2001) also stated that there is a negative relationship between income inequality and environmental degradation. The factor that is defined as the aggregation effect in their study is more significant than the political economy point of view in the impact of income inequality on environmental degradation in the long run. The aggregation effect can be defined as a resulting non-linear relationship in the household levels due to having unevenly distributed income levels that can lead to a bias in the estimates at the EKC turning point (Heerink et al., 2001). The finding of these studies, including Ravallion (2000), simply connected with the individual income level and economic behaviour.

As we move closer to economic individual behaviour and consumption preferences in line with their income levels, another pivotal perspective in the income inequality and environmental degradation nexus literature emerges.

1.3. INDIVIDUAL ECONOMIC BEHAVIOUR

Economic behaviours of individuals cover the theoretical framework that can explain the individuals’ choices and their economic consequences in health, fiscal policy, labor market productivity, and socioeconomic and cultural areas. Economic behaviours of individuals most significantly can be seen in the environment due to possible pollution/degradation creation. Since this study focuses on the nexus between income inequality and environmental degradation, individual economic behaviour approaches form one of the focal points of the theoretical framework. Household consumption and emissions constitute a “micro behaviour” part of the literature. When discussing the relationship between income inequality and environmental degradation, several authors appealed to the idea of individual economic behaviour (Liobikienė & Daiva Rimkuvienė, 2020). It is worth noting that examining individual economic behaviour is hard to forecast (Ravallion et al., 2000). Yet, a significant point of view can be drawn for the economic behaviour of the individuals leading to aggregate environmental degradation linked with income inequality. The fundamental of this theory on the income inequality and the pollution relationship starts from the marginal propensity to emit.

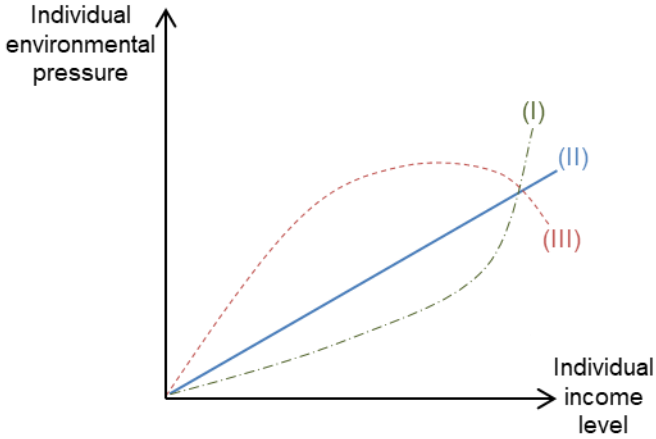
1.3.1. Marginal Propensity To Emit

Marginal propensity to emit (MPE) is one of the most significant theories underlying the possible strict relationship between income levels and emission rates. Ravallion et al. (2000) argue that MPE changes with income levels. Additionally, they emphasize that it may be the marginal propensity to emit, which becomes lower as the increasing of income, makes income inequality contribute to reducing CO_2 emissions (Ravallion et al., 2000).

Scruggs (1998) has demonstrated the theoretical framework that environmental degradation is associated with individual income levels. In compliance with the theoretical perspective presented by Scruggs, Berthe & Elie (2015) have shown the three relationships between individual income level and total environmental degradation based on Scruggs’ work.

As Berthe & Elie (2015) underlined, economic behaviours of the individuals and their consumption preferences affected by income inequality and income level have a crucial impact on aggregate consumption and related environmental degradation on the basis of "marginal preference" indicated by Scruggs (1998) study (Berthe & Elie, 2015). This presented work assumes that environmental deterioration increases as income increases and the analysis focuses on the marginal effects.

Figure 2: Relationships Between Individual Income and Environmental Pressure*



*Originally taken from Scruggs (1998), combined from Berthe & Elie's (2015) work.

As it can be seen from Figure 2 (Berthe & Ellie, 2015), Scruggs (1998) has emphasized that there are basically three relationships represented between individual income and environmental pressure. (I) emphasizes that as each individual's income increases by one unit, the environmental pressure will increase incrementally. Hence, aggregate environmental degradation will decrease as the inequality becomes a higher equal position in an economy –the proportion of the more affluent group's income decreases. In opposition, (III) situation shows that as the income level of the individuals' increases, the environmental pressure will increase in the first place. Still, after a specific turning point, it will decrease. Therefore, having a higher income inequality –more utilization of income for the richer group- creates and negative impact on the environmental pressure. (meaning that a lesser aggregate environmental degradation) The (II) slope shows that there isn't any effect of the income distribution on the environmental degradation on similar aggregate income levels (Berthe & Elie, 2015).

Here, if we look closer at each slope;

Heerink et al. (2001) have argued that redistributing the income from poor to rich will create better environmental quality, against Boyce's (1994) proposed redistribution of the income from rich to poor may improve environmental outcomes. Their study has shown that this result aligns with the (III) slope. (Figure 2.) signifying that richer households are able to prevent environmental harm by affecting their consumption and production patterns. This situation also indicates income level with the increasing income; after people reach a certain income level, environmental awareness will come into play, and people will prefer and consume eco-friendly products. Consequently, MPE decreases with the income.

The same reasoning but different aspects can be seen with the Ravallion's (2000) study discussed earlier under the political demand sub-title. Namely, the income inequality in both between and within countries leads to the same result, that is, resulting in higher MPE for the poorer and lower MPE for the higher income. Firstly, they have shown that redistribution of the income from lower-income with higher marginal propensity to emit to higher-income countries with lower marginal propensity to emit would worsen the environmental degradation. The main assumption under this finding is that MPE, the leading cause behind the environmental degradation, is lesser in richer countries than the relatively poorer countries, which implies higher inequality between these countries, decreasing the environmental impact (Ravallion et al., 2000). The study also revealed that richer households would have less MPE while the opposite is valid for the poorer households. So a redistribution within a country would also increase the environmental degradation with the economic growth. According to Liobikienė & Rimkuvienė (2020), especially in high-income countries, MPE is low for affluent groups and high for low-income groups. Therefore, redistribution of income will increase environmental degradation. The same results can be seen in different studies that are MPE decreases with the income level (see Yang et al., (2011); Zhang & Zhao, (2014)).

In poorer countries with higher income inequality, the poorer class won't be able to acquire eco-friendly products and reach out to relatively expensive eco-friendly solutions such as renewable electricity (Baležentis et al., 2020; Hao et al., 2016). This situation underlines the assumption that MPE is higher for poor individuals than for the affluent. In poorer countries where income inequality is more unequally distributed, the vast majority of the population is excluded from the carbon economy; thus, the environmental outputs to be created, access to electricity and modern energy decreases, and MPE decreases to the lowest level (Grunewald, 2017). Gassebner et al., (2008) have also discussed that the poorer class has minimum access to electricity and energy, therefore a lesser environmental degradation created by them. Another perspective can be drawn with the accumulation of wealth; as a small proportion of the population holds the technology and wealth, the consumption capacity of the low-income group decreases with the rising population of the latter group. (Baležentis et al., 2020) Therefore, as the income inequality increases and decreases income level of the poor, consumption level and related environmental degradation indicators such as greenhouse gas emissions will also decrease (Jorgenson et al., 2017).

However, some findings counter these presented works. For instance, (I) slope argues that MPE increases with the income level. The primary assumption behind this relationship has emerged with Boyce (1994). As it is discussed under the political-economic on inequality and environmental degradation concept, Boyce (1994), -later on (1999 & 2010)- has mainly advocated that power accumulation leads to inequality. Accordingly, poorer classes bear the cost of environmental degradation while richer don’t and create more pollution.

Nevertheless, Boyce didn’t explain this situation with the MPE, but the assumption behind his hypothesis was affluent groups would tend to emit more without a marginal emit perspective. However, this assumption is one of the focal points in the MPE discussions; as the income rises, MPE will also increase, and the affluent class tends to consume more while deteriorating the environment the most. In this perspective, Pattison et al., (2014) have discussed that in high-income countries with a low-income gap, an increase in the affluent group’s income level in the society would lead to higher consumption levels and, correspondingly, a greater extent of environmental degradation. Liu et al., (2020) also emphasize and provide a study with a robustness check with the Gini, P10, and Palma ratio in order to observe the impact of income inequality on household emissions. Results have indicated that income increases lead to more emission rates on the household scale in China. In compliance with these findings, Slope (I) (Figure 2.) emphasizes that as the individual income increases, the environmental pressure will increase incrementally. Therefore, one might be said that individuals tend to consume less eco-friendly products as their income level increases (Boyce, 2010; Liu et al., 2020). Hence, rising consumption of the higher income group and preferences that are shaped by the income level of the individual results in a higher MPE as the income increases. Moreover, when the relatively poorer class has a lower MPE, as the income inequality increases, the environmental degradation will also increase (Mader, 2018). Another example of this situation has been provided by Golley & Meng (2012). According to the constructed study for China with the household income and MPE aspect, MPE increases with the rising income levels. Additionally, the results of this study indicate that the possible redistribution of the income from affluent groups to poor households will decrease the environmental degradation as emission rates in the study denote. One of the most significant connections has been made by Jorgenson et al., (2017) regarding the rising MPE with income inequality. This connection has been shown with the Veblen Effect theory, which discussed in the upcoming sub-section.

1.3.2. Veblen Effect

As mentioned under the environmental protection demand concept, social norms can also play a crucial role in the consumption behaviours of the individuals by changing their consumption motives of the individuals and leading to environmental degradation. And inequality can play a vital role in these motives by having an impact on society's perception and deterioration of social norms (Nhim, 2021).

Obtaining a social status in compliance with individualism and consumerism would change the propensity of individuals to prefer eco-friendly products (Berthe & Elie, 2015). In parallel with this point of view, the Veblen Effect theory in the literature plays an essential role in the relationship between income inequality and environmental degradation, together with the MPE theory.

“Veblen effect” and “marginal propensity theories are basically associated with the economic behaviour of the individuals. Veblen (1934) was the name who constructed this particular issue that individuals in lower social classes tend to copy the consumption behaviours of higher social classes. The theory simply argues that when income is distributed more equally, the poorer class will increase their consumption of energy and carbon-intensive products as they move into the middle class (Jorgenson et al., 2017). This particular behaviour of the individuals in a society is related to the Veblen Effect, as theory suggests. This is lying under the assumption of marginal propensity to emit (demand) rises with the rising income level as Scruggs (1998) argues or power as Boyce (1994) identifies it.

The link between the Veblen effect and environmental pollution can be identified as the consumption differences between different social classes, which are related to the income level. From this point, as the income distribution gets into a relatively equal position, a higher level of emissions can occur due to the consumption behaviours of the lower social classes, which can be stated as consuming more in order to obtain a higher status in society. As the income distribution starts to get more balanced in line with the Veblen effect, the literature suggests that the poorer class who become middle class are associated with consuming less eco-friendly products, which suggests rising MPE. For a better high-income distributed situation -for instance, high-income countries- the poor class will tend to copy the eco-friendly consumption style of the richer people (Rimkuvienė and Liobikienė, 2020). This particular situation has been observed by Jorgenson et al. (2017). In this study, the link between U.S. state-level CO2 emissions (1997 to 2012) and income inequality has been examined by the researchers. In order to measure income inequality, the income share of the top 10% and Gini coefficient has been used. As a result of this study, state-level carbon emissions were found out positively related and significant with the income share of the top 10% measurement; on the other hand, the impact of the Gini coefficient on emissions was found insignificant. As the incomes of the individuals were distributed more equally, the relatively poor group increased their consumption of energy and other carbon-intensive products as they shifted into the middle class (a better income group). In compliance with the Veblen effect, the findings of this study also asserted that the lower-income group increased hours of work to maintain the visible social status in the society with the rising consumption competition with the higher-income group. Consumption competition, which raises energy consumption hence environmental degradation, is another critical perspective in the literature.

Schor (1998) has emphasized that increasing income inequality may result in greater consumption competition. Rising consumption competition in a country will most likely drive environmental degradation, as the literature suggests. As income inequality rises, consumption levels will also change, and due to these changes, the labor market will be directly affected (Bowles & Park, 2005). Jorgenson et al., (2017) presented this situation with the Veblen effect perspective on labor market dynamics. Namely, rising working hours by the lower-income group in the labor market can be observed to sustain or reach a status in the society. This situation leads to increased environmental degradation pursuant to higher consumption levels. Fitzgerald et al., (2015) used a longitudinal analysis to examine the impact of average annual working hours on aggregate energy consumption for the developed and developing countries. Findings have shown that energy consumption increased in line with the working hour's trend. Bowles & Park (2005) also examined that higher inequality leads to longer working hours, and due to longer working hours, higher CO2 consumption and emissions are observed in compliance with the Veblen perspective, meaning that low-income group increased their working hours in order to obtain a higher status in the society.

Baležentis et al. (2020) have constructed a study in order to find out that MPE and Veblen theories are capable of explaining the relationship between income inequality and consumption-based GHG emission in different income compositions in countries which is directly associated with the consumption patterns of the individuals in the countries. By using the data for 109 countries in years between 1990 to 2014, their partially linear regression and non-parametric regression models' results demonstrated a non-linear relationship between income inequality and consumption-based GHG emission per capita. The results have also shown that there might not be a direct relationship between income inequality and greenhouse gas emissions. Additionally, low-income countries with higher income inequality lead the way for the rising consumption-based carbon footprint per capita. Similarly, there are studies that discuss carbon and greenhouse gas emissions between countries based on individual consumption behaviours and the returns of income inequalities. For instance, Baloch et al., (2020) have constructed a study in order to examine the relationship between income inequality, poverty, and CO2 emissions by using Driscoll and Kraay panel data regression for 40-Sub Saharan countries. The findings of this research have shown that an increase that occurs in income inequality would increase CO2 emissions, as well. These findings emphasize that in low-income countries, higher inequality will create a higher environmental degradation, as the MPE and Veblen effect theories suggest.

Meanwhile, the Veblen effect and rising MPE with the income level also emphasizes that for the high income and middle-income countries, MPE would be higher for the poor class than the more affluent class. And with this motive, Liobikienė & Rimkuvienė (2020) have constructed a study to determine the relationship between income inequality level and consumption-based GHG emissions in different levels of economic development (income groups) by using fixed and random effects models on 126 different countries. As a result of this study, they found that economic growth is associated with the increases in the consumption-based GHG emissions for all income groups. (As most of the studies in the literature suggest). The most significant impact can be seen in the middle-low and low-income countries. For the high and middle-high-income countries, the "Veblen effect" and "marginal propensity to emit" theories' suggestions are confirmed with higher income inequality levels related to lower consumption-based emissions. On the other hand, for the low and middle-low income groups, this linkage has been found insignificant, contrary to Baležentis et al. (2020). Income inequality and climate change were found to be discordant for all different income groups. Similarly, Muris et al., (2012) have also constructed a study to examine the relationship between carbon emissions and income inequality in different countries. The issue has been discussed by using panel data analysis for 138 countries in the years between 1960 to 2008. The results show that pro-poor growth countries face a declining emission rate, as the EKC suggests. The other significant result is that high-income countries that have higher income inequality show a more reduction in carbon emissions per capita rather than more equal countries.

In different cases, a relationship was found between inequality and environmental indicators, whether they are negative or positive, as discussed earlier; in contrast to earlier findings, there are studies that have observed results contrary to the findings of these studies. In other words, it is possible to talk about an insignificant relationship between income inequality and environmental indicators in these studies. Namely, Knight et al. (2017) have constructed research to examine the impact of income inequality on CO_2 emission in high-income countries. As a result of this particular study that was built for 26 high-income counters for the years between 2000 to 2010, an insignificant relationship has been found between the Gini coefficient and emission rates. While the income share of the top 10% was found to be positively related to carbon emissions, this relationship is not a strict one, as the authors underlined. The same outcome can be seen in Mader's (2018) constructed study, which is an advanced analysis of Knight et al., (2017) and Jorgenson et al., (2017) studies that were constructed with the income share of the top 10% and Gini coefficient. By providing an extended version of these studies, Mader (2018) has underlined that there isn't any relationship between both income and social equality and environmental degradation (CO_2 emissions). Additionally, MPE was found to be equal for both affluent and poor people. Similarly, Scruggs (1998) has been shown that distributional problems didn't explain variations in environmental quality by using two different cross-sectional models; however, as it is discussed in the earlier sub-sections, this study is one of the pioneer studies with the Boyce (1994), and Scruggs (1998) underlined a possible decreasing MPE for the affluent group meaning that decreasing environmental degradation as their income increases while Boyce (1994) emphasized the opposite.

Examined studies constructed for income inequality and environmental degradation can be seen in a table format in Table 1. The dates of these particular studies range from 1994 to 2021. The most significant studies have been examined under the literature review section in compliance with the relevant theoretical aspects and possible associations between income inequality and environmental degradation. Authors, date of the studies, methods (models), the topic of the studies, variables, and samples used for the research, and lastly, the findings of these studies have been summarized in a table form. The distinctions in the studies examined were made as negative, positive, mixed, and no relationship according to their results. It is also possible to observe the relationship of each independent variable on the dependent variables in the parentheses. "(+)" stands for a positive relationship, while "(-)" is vice versa. Additionally, insignificant relationships are also represented in the parentheses.

Table 1: Literature Review Table (Overview of the reviewed studies)

Author / Date	Topic/Focus	Method	Variables/Sample	Findings
Negative Relationship				
Kusumawardani & Dewi (2020)	The impact of income inequality on carbon emissions	Autoregressive distributed lag model (ARDL)	CO_2 emissions (ton per capita) Gini **(-)**, GDP per capita **(+)**, urbanization rate **(-)** , dependency ratio **(-)** Indonesia (1975 to 2017)	There is a negative relationship between income inequality and CO_2 emissions. EKC theory has been confirmed for Indonesia. (inverted U-shaped between GDP and emission rates. Urbanization and dependency ratio has a negative impact on emission rates.
Rimkuvienė&Liobikienė (2020)	Examining the relationship between income inequality level and consumption-based Greenhouse gas emissions in different levels of economic development (income groups).	The fixed-effects and random-effects models	Consumption-based GHG emissions (the consumption-based carbon footprint)(dependent variable) GDP **(+),** Gini coefficient **(-)**, urbanization **(-) for high income (+) for the others**, education **(-)** 126 countries (low middle-middle high-high-low income countries) (1990 to 2014)	Economic growth is associated with the increases in consumption-based GHG emissions for all income groups. The most significant impact can be seen in the middle-low and low-income countries. For the high and middle-high-income countries, the “Veblen effect” and “marginal propensity to emit” theories' suggestions are confirmed with higher income inequality levels related to lower consumption-based emissions. On the other hand, for the low and middle-low income groups, this linkage has been found insignificant. Income inequality and climate change are discordant for all different income groups.

Destek (2019)	Investigating the income distribution effects on environmental pollution in Turkey	Autoregressive distributed lag model (ARDL)	Carbon emission (dependent variable) Real GDP **(+)**, energy intensity **(+)**, Gini coefficient **(-)** Turkey (1990 to 2015)	According to the results, the increase in income level and energy intensity causes environmental pollution both in the short term and in the long term. It has also been found that income inequality increases reduce environmental pollution in the long term while rising environmental pollution in the short term.
Ghosh (2019)	Impact of income inequality, household energy consumption, government expenditure, and investment on CO_2 emissions (household level).	Clemente–Montanes–Reyes unit root test (for a structural break in time series) autoregressive distributed lag model (ARDL) (linear) Granger causality	CO_2 emission household level (dependent variable) Gini index **(unidirectional)**, household energy consumption **(+)** (explanatory variables) United Kingdom (1970 to 2015)	The negative asymmetric effect of income inequality is greater in the long run than the positive impact. Unidirectional causality has been found at inequality transmission to carbon emissions. Higher-income inequality leads to less environmental degradation yet, raises savings meaning that less consumption occurs.
Ali et al., (2016)	Dynamic effects of the income inequality on carbon emissions	Autoregressive distributed lag model (ARDL)	İncome inequality **(-)** trade openness **(+)**, GDP per capita**(+)** and urbanization**(+)** 18 African countries (1984 to 2001)	There is a negative relationship between income inequality and carbon emissions. Trade openness, urbanization, and GDP per capita lead to more degradation.

Yang et al., (2011)	Relationship between income distribution and environmental pollution under different human capital stages	Panel data analysis	Income distribution (Gini) **(-)**, human capital **(-)**, technology advancement (human capital) **(-)**, industry structure **(-)** and urbanization **(+)** China (1996 to 2008)	The study has concluded with a negative relationship between environmental degradation and income inequality. The development of human capital can play a crucial role in reducing the environmental pollution. Differentials in industrial structure, scientific research, and urbanization are drivers that can affect the environment.
Borghesi (2005)	Examing the relationship between income inequality and CO_2 per capita emissions while testing the EKC curve	Panel data analysis	CO_2 emissions for per capita (dependent variable), Gini coefficient **(-)**, GDP per capita **(+)**, GDP per capita^2 **(+)** **,** GDP per capita^3**(+)** population density **(+)**, industrial share of GDP **(+)** 126 countries for years between (1988-1995)	As a result of pooled OLS Gini coefficient has a negative sign meaning that more inequality reduces the CO_2 emissions. While this situation is valid in the high-income countries, it was statistically insignificant for the low-income countries.
Heerink et al., (2001)	Relationship between income inequality and environment considering aggregation bias in environmental Kuznets curves	Time-series and pooled cross-section time series analysis	CO_2 emissions, technology, soil, and nitrogen depletion and population sanitation, the percentage reduction in forest area (dependent variable) The income per capita **(+)**, Gini **(-)** SS Africa (1961 to 1986)	There is a trade-off between environmental degradation and income equality, government policies can be effective for these issues.

Ravallion et al., (2000)	Distribution of income and carbon emissions.	Pooled and fixed effects models for panel data	Carbon dioxide emissions per capita (dependent variable) Log GDP per capita **(+)**, Gini index **(-)**, Log population size **(+)** 42 countries (including both developed and developing)	There is a trade-off between climate control and social equity. Higher inequality is associated with lower carbon emissions & Economic growth results in a higher emission.
Positive Relationship				
Baloch et al., (2020)	Examining the relationship between income inequality, poverty and CO_2 emissions.	Driscoll and Kraay regression (standard error method)	CO_2 emissions (dependent variable), Income inequality **(+)**, Poverty Index **(+)** GDP per capita **(+)**, access to electricity, population **(-)**, inflation **(+)**, economic freedom **(mixed)** (independent variable) 40 Sub-Saharan counties (2010 to 2016)	An increase that occurs in income inequality would also increase CO_2 emissions. Similarly, an increase in poverty measurements impacts environmental pollution in a harmful way.
Balezentis et al., (2020)	Impact of income inequality on consumption-based greenhouse gas (GHG) emission.	Partially linear regression Non-parametric regression	For both models (1&2), the ecological footprint per capita (dependent variable) GDP per capita **(+)**, level of urbanization (urban population) **(-)**, education attainment (enrolment rate) **(-)** , Gini coefficient 109 countries (1990 to 2014)	According to findings, a non-linear relationship between income inequality and GHG emission per capita can be observed with a "U-shape" linkage between GDP per capita and GHG emission per capita. At low-income countries with higher income inequality lead the way for the rising consumption-based carbon footprint per capita.
Ridzuan (2019)	Relationship between income inequality and SO_2 emissions while investigating EKC	Driscoll and Kraay and Fixed Effect Model	SO_2 emissions (dependent variable) Gini **(+)**, ln Urbanization **(+)**, trade Openness **(+),** lnGDP **(+)** GDPxGINI **(+)** GDP^2 **(+)**	There is a positive relationship between rising inequality and environmental degradation.
Uzar & Eyuboglu (2019)	Relationship between income inequality and CO_2 emissions in Turkey	Autoregressive distributed lag model (ARDL)	CO_2 emissions per capita (dependent variable) Gini coefficient **(+)**, GDP per capita **(+)**, financial	According to the results, it is possible the observe EKC in Turkey.

			development index (**(+) in short term)**), energy consumption per capita**(+)**, industry percentange, **(+)** urban population **(insignificant),** trade openness **(-)** Turkey (1984 to 2014)	There is also a positive relationship between Gini and carbon emissions.
Magnani (2000)	Role of environmental policy decisions at income distribution and environmental protection	Panel data analysis and Pooled Cross-Section Estimation	Public R&D Expenditures for environmental protection (dependent variable) Gini **(-)** ,GDP **(+)** OECD countries (1980 to 1991)	Moment of the income distribution plays an important role in ensuring sustainable growth in high-income countries. As the income inequality increases, lesser attention will be paid to environmental protection leading to a positive effect.
Boyce et al. (1999)	Relationship between power distribution and enviroment	Cross-sectional analysis	Environmental stress, public health, environmental policy (dependent variables) Power distribution (+) (derived from different measurements) 50 US States	Higher power inequality leads to less effective environmental policies, which will create higher environmental degradation and public health issues.
No Relationship				
Knight et al., (2017)	Relationship between income inequality and CO_2 emissions at high-income countries	Two-way fixed effects longitudinal models	GDP per capita (+), Gini (**insignificant**), the income share of top 10% (+) 26 high-income countries (2000 to 2010)	The relationship between the Gini coefficient and carbon emissions found out to be insignificant while the income share of the top 10% is positively related, yet this is not explaining a strict relationship as the authors emphasized.
Scruggs (1998)	To test whether political and economic equality results in lower levels of environmental degradation or not.	2 cross-national regression models	Water and air pollutants (dependent variable) Income **(+)**,Gini coefficient (**mostly insignificant**), S80/S20 (**insignificant)** democracy (constant), energy supply**(+)**,population density (**insignificant**)	The results show that institutions largely ignore the relationship between environmental degradation and equality. Distributional problems do not explain variations in environmental quality.

			17 industrial countries (democracies)	
Mixed Results				
Alatas&Akın (2021)	Investigating the impact of income inequality on the environmental condition by taking into account sectoral level differences	Panel data analysis	Sectoral carbon emissions: Power – buildings – transport and other sector levels (dependent variables) GDP **(+)**, urbanization **(+)**, Gini **(depends on the sector),** KOF index **(depends on the sector),** (independent variables) 28 OECD economies (1990 to 2018)	Income and income inequality are significant indicators that can explain the variations that occur in sectoral level carbon emissions. The result for the relationship is mixed; as the income inequality increases, carbon emissions for the power and building sectors rise (a positive relationship observed) while this relationship is negative for the other sectors.
Jorgenson et al., (2017)	Examining the link between U.S. state-level CO_2 emissions and income inequality using the income share of the top 10% and Gini coefficient.	Longitudinal analysis Time-series cross-sectional Prais-Winsten regression model with panel-corrected standard errors Two-way fixed effects model Generalized least squares random-effects regression	CO_2 emissions (dependent variable) Gini coefficient **(insignificant)**; (GDP) per capita by state, fossil-fuel production **(+)**,percent of population in urban areas **(+)**, population size **(+)** , income share of top 10% **(+)**, State environmentalism **(-)**, region census **(+)**, manufacturing as percent of GDP **(insignificant)** U.S. States (1997 to 2012)	State-level carbon emissions are positively related and significant with the income share of the top 10% measurement; on the other hand, the impact of the Gini coefficient on emissions is not significant. As the incomes of the individuals are distributed more equally, the relatively poor group will increase their consumption of energy and other carbon-intensive products as they shift into the middle class. (a better income group) a better inequality leads to higher emissions.
Grunewald et al., (2017)	Relationship between income inequality and carbon dioxide emissions	Panel data analysis	CO_2 emissions for per capita (dependent variable), income inequality (Gini index) **(depends on income level)** GDP per capita **(+)**, urban population, manufacturing ratio of GDP, agriculture ratio of GDP, services ratio of GDP, polity (**controlled variables results were significant)** 158 countries for years between (1980-2008)	Income level is the primary driver at the relationship of income inequality and carbon emissions per capita. Low-income and middle-income countries show a more reduction in the way of carbon emissions per capita. The opposite situation is valid for upper-middle-income and high-income countries, meaning that income inequality increases carbon emissions.

Duro (2016)	By using general distributive sustainability indexes to show a complete examination of the international equity indicator on the greenhouse gas emissions	Cross-country analysis and General Sustainability Function	General Distributive Sustainability Index (GDS) based on Gini (calculated by researchers), GHGs, and their three main sources (CO_2 –CH_4 –N_2O) **(mixed)** 140 countries (1990 to 2012)	The general distributive sustainability related to the worldwide greenhouse gases per capita has increased; however, this rise has started to decrease from 2000. Last period decrease can be associated with the rise in world mean average. Different gases and results related to them differ from each other at different indexes.
Zhang&Zhao (2014)	Finding the link between income inequality and CO_2 emissions considering regional differences.	Panel data analysis (Driscoll and Kraay, Feasible Least Square Method, PCSE, Fixed Effect)	Total CO_2 emissions (dependent variable), GDP per capita **(+)**, Gini coefficient **(mixed for different regions),** energy intensity **(+)**, the share of industry sector **(insignificant),** urbanization **(-) for a region** Regions of China (1955 to 2010)	Economic growth (income) increases China's CO_2 emissions. Income inequality impacts CO_2 emissions greater in the Eastern region than in the Western. Equally distributed income can improve the control of CO_2 emissions in developing regions while not in others.

CHAPTER 2

DATA AND METHODOLOGY

As mentioned in the previous sections, in order to examine the relationship between income inequality and environmental degradation, an unbalanced panel data set for the 28 EU countries for the 2005-2018 period is used.[3] The annual data for the greenhouse gas emissions and ecological footprint per capita were obtained from European Environment Agency (EEA) and Global Footprint Network, respectively.

Gini coefficient (Gini coefficient of equivalised disposable income), the income share of the bottom 40%, and S80/S20 ratio was gathered from the EU-SILC survey. The income share of the top 10% was collected from the World Bank, while the Palma ratio was calculated by the author. These measurements are considered as the key independent variables of this thesis.

Other independent variables (control) can be stated as real GDP per capita, manufacturing ratio to GDP (% of GDP), the proportion of the urban population, energy intensity, final energy consumption per household capita, and human capital. Real GDP per capita's data was obtained from Angus Maddison's Project Database 2021 (MPD). Data for manufacturing ratio to GDP was gathered from the World Bank's world development indicators.

The proportion of the urban population data (Annual Percentage of Population at Mid-Year Residing in Urban Areas) was taken from the UN's World Urbanization Prospects: The 2018 Revision. Annual energy intensity and final household energy consumption per capita of the countries were gathered from EEA and Eurostat, respectively. Lastly, the human capital index was obtained from the Penn World Table version 10.0. Each variable's data source (link) was provided in Appendix-3 of this thesis. A summary of the variables' abbreviations, measurement unit, and the data source is shown in Table 2.

---

[3] EEA EFTA States countries were excluded from the study. The United Kingdom, which left the EU Union in 2020, has been included in the study. Since the country was already a member of the EU in the relevant period.

Table 2: Variables of the Thesis

Full variable name	*Abbreviations*	*Measurement unit*	*Data source*
Dependent variables			
Greenhouse gas emissions per capita	GHG	Million tonnes per capita	Eurostat
Ecological footprint per capita	EF	Global hectares	Footprintnetwork
Independent variables			
Gini coefficient	Gini	Gini coefficient (scale from 0 to 100)	Eurostat
S80/S20	S82	Income quintile ratio	Eurostat
The income share of the bottom 40%	40B	Percentage share of income	Eurostat
The income share of top 10%	10T	Percentage share of income	The World Bank
Palma ratio	PAL	Ratio	By author
Real GDP per capita	GDP	Real GDP per capita in 2011$	Angus Maddison's Project
Urbanization (Proportional)	URB	Urban population (% of total)	UN World Urbanization
Manufacturing ratio to GDP	MAN	Manufacturing, value added (% of GDP)	The World Bank
Final energy consumption per capita (household)	FEC	Megajoule per capita	Eurostat
Human capital index	HC	Based on years of schooling and returns to education	Penn World Table
Energy Intensity	EI	Kilograms of oil equivalent (KGOE) per thousand euro in purchasing power standards (PPS)	Eurostat

As Table 2 above illustrates, the dependent variables of the study are greenhouse gas emissions per capita and ecological footprint per capita for the two base models. Key independent variables for each model can be stated as Gini coefficient, Palma ratio, S80/S20, the income share of the bottom 40%, the income share of the top 10%. Other controlled independent variables for each model are real GDP per capita, proportional urbanization, final energy consumption, manufacturing ratio to GDP, human capital, and energy intensity. The general regression equations are given below.

- ❖ Greenhouse gas emission per capita (1) is the dependent variable and is denoted with different equations:

(1.1): $\boldsymbol{GHG_{it} = \alpha_1 + \beta_1 GINI_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

(1.2): $\boldsymbol{GHG_{it} = \alpha_1 + \beta_1 40B_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

(1.3): $\boldsymbol{GHG_{it} = \alpha_1 + \beta_1 S82_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

(1.4): $\boldsymbol{GHG_{it} = \alpha_1 + \beta_1 10T_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

(1.5): $\boldsymbol{GHG_{it} = \alpha_1 + \beta_1 PALMA_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

- ❖ Other models constructed with Ecological footprint per capita (2) as the dependent variable with each income inequality and distribution measures for independent variables can be stated as:

(2.1): $\boldsymbol{EF_{it} = \alpha_1 + \beta_1 GINI_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

(2.2): $\boldsymbol{EF_{it} = \alpha_1 + \beta_1 40B_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

(2.3): $\boldsymbol{EF_{it} = \alpha_1 + \beta_1 S82_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

(2.4): $\boldsymbol{EF_{it} = \alpha_1 + \beta_1 10T_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

(2.5): $\boldsymbol{EF_{it} = \alpha_1 + \beta_1 PALMA_{it} + \beta_2 GDP_{it} + \beta_3 URB_{it} + \beta_4 MAN_{it} + \beta_5 HC_{it} + \beta_6 FEC_{it} + \beta_7 EI_{it} + u_{it}}$

Where "GHG" represents greenhouse gas emissions per capita, "EF" represents ecological footprint per capita for the dependent variables. For the income inequality measurements, "Gini" represents Gini coefficient, "S82" represents income quintile ratio, "PAL" represents Palma ratio, "40B" income share of the bottom 40%, and "10T" denotes income share of the 10%. "URB" presents proportional urban population, "GDP" represents real GDP per capita, "EI" denotes energy intensity, "FEC" household final energy consumption, while "MAN" represents manufacturing ratio to GDP and "HC" denotes human capital for the other independent variables.

As discussed in detail in the literature review section, the most common variable used to measure the relationship between income inequality and environmental degradation is the Gini coefficient and the environmental indicators such as CO2 emission rates. In order to provide a robustness check by providing a broader perspective, environmental degradation indicators such as greenhouse gas emissions and ecological footprint are chosen as dependent variables, while the independent variables consist of different measurements of income inequality, including the Gini coefficient. Other control variables are included in each model as independent variables influential on environmental degradation, in line with the literature.

As mentioned earlier, the environmental degradation concept that is used in this thesis refers to mainly two indicators which are greenhouse gas emissions per capita and ecological footprint per capita. Greenhouse gas emissions per capita variable measures per capita Kyoto basket of greenhouse gases, including carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and the so-called F-gases (hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride (NF3), and sulfur hexafluoride (SF6)) which provides a comprehensive measurement (Eurostat, 2022).

On the other hand, the ecological footprint per capita measures the ecological footprint divided by the total population of the countries. This indicator shows average environmental pressure of an individual, if EF per person exceeds biocapacity per person in an country, this means that the average citizen in this country demands more resources than the earh regenerates and produces more wastes than the earth can absorb. For instance, according to the Ecological Footprint Network, the biocapacity per person was 1.58 global hectares and average EF per person was 5.45 for the EU countries in 2018. This indicates that average EU citizen were demanding 3.45 times the resources and ecological services that the earth can supply[4]

For the key independent variables, starting with the Gini coefficient, the measurement has weaknesses in the way of responsiveness for the variation in the high and low income leading a low reliability at observing income inequality (Y. Liu et al., 2020). This situation leads us to consider other income inequality measurements such as income share of the top 10%, Palma ratio, the income share of the bottom 40%, and income quintile ratio, which is also known as S80/S20. Yet, still Gini coefficient is the

[4] The relevant calculation was made based on the indicator description on the ecological footprint network https://data.footprintnetwork.org/#/.

most used income inequality indicator in the literature, so it is included in the models even though the coefficient has shortcomings as well as it is in the literature.

As the literature suggests income share of the top 10% can show us the share of the highest income group in the countries and actually gives a chance to observe the accumulation of political power and wealth. Here, the underlying assumption is the top 10% is the affluent group that holds the political and purchasing power in the countries (Jorgenson et al., 2017; Knight et al., 2017; Winters & Page, 2009).

On the other hand, the income share of the bottom 40% can provide a significant perspective about the improvement of income inequality and the impact of the increase in the share of the middle-income group in the country on environmental degradation. Hence, it is expected that the relationship between the income share of the top 10% and the income share of the bottom 40% must be of different signs from each other in line with a two-sided perspective. Depending on these two variables, the Palma ratio is considered another essential independent variable in this thesis. Palma ratio is calculated by dividing the share of the highest disposable aggregate income received by the 10% of the population to the aggregate income received by the 40% of the population's bottom disposable income.[5]

S80/S20 ratio, to put it another way, the income quintile ratio is selected as a significant alternative measurement. This indicator gives the ratio of the 20% population with the highest household income in total household disposable income to 20% of the population with the lowest household disposable income in total household income (Kolluru & Semenenko, 2021).

As mentioned, by using these various income inequality measures, a robustness check can be provided. Accordingly, in line with the MPE theory, it is expected that there will be a negative relationship between income inequality and greenhouse gas emissions/ecological footprint per capita, which represents environmental degradation. Higher-income inequality levels can create a negative impact on the greenhouse gas emissions in line with the economic behaviour of the individuals. Namely, the consumption behaviours of the individuals can play a key role between these two

[5] OECD (2022), Income inequality (indicator). doi: 10.1787/459aa7f1-en (Accessed on 05 February 2022)

variables. In compliance with the Veblen effect, the lower-income groups tend to consume more in order to obtain a higher status in society. This former behaviour of the individuals, as the income is distributed more equally, can maintain so that consumption levels can increase, which is one of the most significant determinants of environmental degradation. Another perspective is that the relatively poor group can increase their consumption of energy and carbon-intensive products instead of eco-friendly products since they can not afford them. However more affluent groups have the necessary purchasing power to buy eco-friendly products. This indicates a higher MPE for the low-income group and a lower MPE for the high-income (Ali et al., 2016; Heerink et al., 2001; Liobikienė & Rimkuvienė, 2020; Mader, 2018; M. Ravallion et al., 2000; Yang et al., 2011).

As the literature suggests, economic activities are directly associated with emission levels and therefore, environmental degradation. In order to observe the economic activities, real GDP per capita has been used. As the EKC literature suggests, a positive relationship can be expected between these variables in the short-run for the developed countries; after a threshold is reached, the opposite is expected (Demir et al., 2019; Ghosh, 2019; Grunewald et al., 2017; Heerink et al., 2001; Huang & Duan, 2020). GDP is one of the essential variables considering the literature of the income inequality and environmental degradation nexus, and it is possible to observe the GDP variable in every research without exception.

Another crucial variable is the manufacturing ratio in the GDP for observing the economic activities. Industrialization is commonly associated with the increased environmental degradation. Additionally, the manufacturing industry consumes approximately 50% of the world′s energy. Therefore, it can be said that it has a significant effect on energy production and consumption (Zhao et al., 2014). The energy-intensive industries emit more greenhouse gasses, including CO2 (Zhang & Zao, 2014). In line with this situation, observing the manufacturing industry growth and energy intensity over time can show the linkage between the environmental degradation and subjected variables. Additionally, observing the final energy consumption by the households is also essential due to individual consumption behaviours, which are considered as one of the main drivers for environmental degradation. The signs of the coefficients for these variables are expected to be positive. Urbanization is also a possible driver of environmental degradation. With the increasing urban population, consumption which can be considered as a cause of environmental degradation also expected to increase. Hence, a positive relationship can be expected. In order to observe urbanization rates, proportional urban population (% of total) of the countries has been used.

Human capital is another significant variable with a possible negative impact on environmental degradation. Namely, Yang et al. (2011) has constructed a study for China for years between 1996 to 2008 in order to find the link between income inequality and environmental quality. It is found out that there is a significant negative relationship between income inequality and environmental degradation. The results also have shown that human capital has a crucial role in reducing both income inequality and environmental degradation. Additionally, the education indicator can be observed in the other studies for income inequality and environmental degradation (see Li et al., 2020; Liobikienė & Rimkuvienė, 2020). Hence, in order to observe this relationship, the human capital index has been used as an independent variable in both models. The indicator mainly measures the years of schooling and returns to education in each country (PWT 10.0).

Summary statistics of each variable can be seen in Table 3.

Table 3: Summary Statistics

VARIABLES	N	mean	sd	min	max
GINI	384	29.88281	3.907276	20.9	40.2
GHG	392	10.12959	4.001897	5	30.8
EF	364	5.425275	2.109919	2.7	15.8
GDP	392	31.22257	10.83065	11.314	64.684
EI	392	152.9889	45.17054	53.98	312.87
MAN	378	14.36629	5.04247	3.89	34.57
URB	392	72.5739	12.57484	51.533	98.001
PAL	383	1.164047	.2208654	.74427483.15	1.933333
S82	384	5.050156	1.320853	16.5	9.01
40B	384	21.5349	2.266841	19.5	26.2
10T	385	24.60831	2.248433	65.04	32.6
FEC	392	246.6251	83.26093	2	465.51
HC	392	3.219037	. 301652	.230435	3.821207
Number of countries (N)	28	28	28	28	28
Years (T)	14	14	14	14	14

In order to obtain a broader perspective on the possible income inequality and environmental degradation relationship, two base models have been constructed. It is the environmental degradation measures used as the dependent variable that distinguishes these models from each other. These indicators are greenhouse gas emission per capita for base model 1 and ecological footprint per capita for model 2.

In the empirical strategy for the panel data analysis, the validity of the Homogeneous (or pooled) model was tested with the ANOVA F test (Moulton and Randolph, (1989)). H_0: The individual and time effect panel equal to zero was tested for all i and t. According to the test results, the null hypothesis was rejected for all models. (Prob > F = 0) Accordingly, since there is an individual or time effect in the models, Breusch Pagan's (1980) Breusch-Pagan Lagrange multiplier and adjusted Lagrange multiplier tests were applied for both individual effect and time effect. In addition, Bottai's (2003) Score has been applied. According to these test results, it was seen that all models have individual effects; therefore, pooled OLS estimations was not applicable. As a result, due to the individual effect in models, the Hausman test has been applied for the fixed or random effects. Therefore, Hausman's (1978) test was applied to decide between fixed effects and random effects estimators. As heteroscedasticity and autocorrelation in the models impairs the reliability of the Hausman's test, the bootstrap Hausman test was also applied. Accordingly, the fixed-effect model in equations (1) and (2) found to be suitable (probability value is < 0.05). Afterwards, certain tests were performed for autocorrelation, heteroscedasticity, and cross-sectional dependence to use fixed and random effect models. The test results have been provided in Table 4 and Table 5.

In the case of larger T and smaller N, the Lagrange multiplier test statistic proposed by Breusch-Pagan (1980), which is used to test the cross-sectional dependency, can be used. However, in our sample, T is small (t=14 years) and N is large (N=28 countries); In the case of N>T, the Breusch Pagan (1980) test cannot be used. In this case, two semi-parametric tests suggested by Frees (2004) and the parametric test presented by Pesaran (2004) can be used to test the correlation between units (Yerdelen Tatoglu, 2021). These tests can also be used in unbalanced panel (Yerdelen Tatoglu, 2021).

The outcomes of these tests can be seen in Table 4. and Table 5. Accordingly, all of the models have a cross-sectional dependency problem. In this study, correlation cannot be ignored since it is studied with countries that are characteristically close to each other.

For the fixed-effect model, the heteroscedasticity was tested by using Modified Wald Test (Greene, 2008). As the results indicate there is also a heteroscedasticity problem.

The autocorrelation issue has been tested with the Baltagi-Wu (1999), and Bhargava et al., (1982)'s Durbin Watson tests with an AR(1) estimation – only focusing on the regarded tests whether they are smaller than 2 or not for all of the models –. The results have shown that both of the models are suffering from autocorrelation. Additionally, as the Wooldrigde (2002) Test indicates, there was an autocorrelation problem in the models (p-value is < 0.05).

Detailed information regarding the tests is provided in the Table 4. for the base model (1), which is constructed with the greenhouse gas emissions per capita as the independent variable.

Table 4: Tests - Greenhouse Gas Emissions Per Capita – Base Model (1)

Test Name	**Equation No.**				
	1.1 - GINI	**1.2 - INCOME40**	**1.3 - S80S20**	**1.4 - INCOME10**	**1.5 - PALMA**
ANOVA F	149.49	145.03	146.46	151.58	150.86
	Prob > F = 0	Prob > F = 0	Prob > F = 0	Prob > F = 0	Prob > F = 0
F - test	214.78	209.17	210.59	216.39	215.62
	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000
Breusch Pagan Lagrange Multiplier	1840.66	1855.92	1864.80	1819.11	1835.57
	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000
Adjusted Breusch Pagan Lagrange Multiplier	Prob>chibar2 = 0.0000	Prob> chibar2 = 0.0000	Prob> chibar2 = 0.0000	Prob> chibar2 = 0.0000	Prob> chibar2= 0.0000
Score test	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000
Hausman test	1084.65	66.76	43.54	32.05	217.35
	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000
Modified Wald Test	2370.44	2439.90	2254.43	3884.92	2259.57
	Prob >chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000
Pesaran's test of cross-sectional independence	6.152	6.168	6.419	6.012	6.817
	Pr = 0.0000	Pr = 0.0000	Pr = 0.0000	Pr = 0.0000	Pr = 0.0000
Frees' test	5.600>0.3826	5.800>3826	5.925>3826	4.392>3826	5.249>4325
	Q distr. (alpha 0.05)	Q distr (alpha 0.05)	Q distr (alpha 0.05)	Q distr (alpha 0.05)	Q distr (alpha 0.05)
Modified Bhargava et al. Durbin-Watson	.48956686<2	.46699463<2	.47663258<2	.48497503<2	.46819893<2
Baltagi-Wu LBI	.73508808<2	.71718381<2	.72351311<2	.71959868<2	.70719804<2
Wooldridge test	62.635	63.275	65.454	73.366	66.361
	Prob>F =0.0000	Prob>F =0.0000	Prob>F =0.0000	Prob>F =0.0000	Prob>F =0.0000

Test Name	Equation No.				
	1.1 - GINI	1.2 - INCOME40	1.3 - S80S20	1.4 - INCOME10	1.5 - PALMA
Modified wald test	2847.09 Prob>chi2 =0.0000	2825.26 Prob>chi2 =0.0000	2600.20 Prob>chi2 =0.0000	2090.32 Prob>chi2 =0.0000	2177.03 Prob>chi2 =0.0000

Detailed information regarding the tests is provided in the Table 5. for the base model (2), which is constructed with the ecological footprint per capita as the independent variable. As it can be seen, similar outcomes have been observed for the second base model with the relevant tests.

Table 5: Tests - Ecological Footprint Per Capita – Base Model (2)

Test Name	Equation No.				
	2.1 - GINI	2.2 - INCOME40	2.3 - S80S20	2.4 - INCOME10	2.5 - PALMA
ANOVA F	114.69 Prob > F = 0	113.02 Prob > F = 0	113.16 Prob > F = 0	114.35 Prob > F = 0	113.92 Prob > F = 0
F - test	152.04 Prob > F = 0.0000	149.84 Prob > F = 0.0000	149.35 Prob > F = 0.0000	151.54 Prob > F = 0.0000	150.78 Prob > F = 0.0000
Breusch Pagan Lagrange Multiplier	1403.80 Prob > chibar2 = 0.0000	1400.33 Prob > chibar2 = 0.0000	1376.58 Prob > chibar2 = 0.0000	1429.84 Prob > chibar2 = 0.0000	1405.28 Prob > chibar2 = 0.0000
Adjusted Breusch Pagan Lagrange Multiplier	Prob>chibar2 = 0.0000	Prob> chibar2 = 0.0000	Prob> chibar2 = 0.0000	Prob> chibar2 = 0.0000	Prob> chibar2= 0.0000
Score test	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000
Hausman test	29.01 Prob > chibar2 = 0.0001	28.76 Prob > chibar2 = 0.0000	29.82 Prob > chibar2 = 0.0001	28.36 Prob > chibar2 = 0.0002	29.27 Prob > chibar2 = 0.0001
Modified Wald Test	Prob >chibar2 = 0.0000	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0026	Prob > chibar2 = 0.0000	Prob > chibar2 = 0.0000
Pesaran's test of cross-sectional independence	2.906 Pr = 0.0037	2.751 Pr = 0.0059	3.006 Pr = 0.0000	2.303 Pr = 0.00213	2.666 Pr = 0.0077
Frees' test	6.272>0.4325 Q distr. (alpha 0.05)	6.062>0.4325 Q distr (alpha 0.05)	5.794>0.4325 Q distr (alpha 0.05)	5.452>0.3826 Q distr (alpha 0.05)	5.972>0.4325 Q distr (alpha 0.05)
Modified Bhargava et al. Durbin-Watson	.48712973<2	.47879961<2	.48513464<2	.50523405<2	.48992141<2
Baltagi-Wu LBI	.70528913<2	.70124989<2	.70623826<2	.72230716<2	.71032812<2
Wooldridge test	76.048 Prob>F =0.0000	78.509 Prob>F =0.0000	80.104 Prob>F =0.0000	70.875 Prob>F =0.0000	71.030 Prob>F =0.0000
Modified wald test	2847.09 Prob>chi2 =0.0000	2825.26 Prob>chi2 =0.0000	2600.20 Prob>chi2 =0.0000	2090.32 Prob>chi2 =0.0000	2177.03 Prob>chi2 =0.0000

Regarding the tests that were used for autocorrelation, heteroskedasticity, and cross-sectional dependence, the fixed-effect estimator could not be used. However, the fixed models' results have been provided for an alternative model in the Appendix-2. Accordingly, the same signs for each variable can be observed.

Hence, in order to overcome these particular issues in the constructed models (for all equations), Driscoll and Kraay's estimator has been used. Driscoll & Kraay's (1998) estimator was the most suitable for each model. In the presence of heteroscedasticity, autocorrelation, and cross-sectional dependence, each equation was estimated using the Driscoll and Kraay nonparametric variance-covariance standard error estimator, which is one of the resistant estimators.

It is worth noting that the Driscoll and Kraay estimator can be used when N>T (Yerdelen Tatoglu, 2021). Estimator performs better in small-sample and time preferences than the other alternative covariance estimators (Ridzuan, 2019). Also, the estimator is efficient while using unbalanced data dealing with the missing values in the data set (Baloch et al., 2020). Considering the regarded estimations for 28 EU countries for the period 2005-2018 (14 years) and under the heteroscedasticity, autocorrelation, and cross-sectional dependency issues, Driscoll and Kraay is a convenient estimator technique.

Heteroscedasticity, autocorrelation, and cross-sectional dependence issues are solved by correcting the standard errors for these particular issues. The estimator carries out better estimations in the presence of cross-sectional dependence, heteroscedasticity, and autocorrelation (Newton et al., 2010; Ridzuan, 2019). Therefore, Driscoll Kraay standard error fixed effects regression has been applied for both base models (dependent variables as greenhouse gas emissions and ecological footprint) with each key independent variable (income inequality measurements) and other independent variables.

CHAPTER 3

RESULTS AND DISCUSSION

Two base models have been constructed with each environmental degradation indicator as a dependent variable, while income inequality measurements (key independent variables) and other independent variables remain unchanged for both. This section addresses the results of the model estimations and discussion of the findings. In general, statistically significant estimates were obtained, the explanatory power (R^2 values) of the models seems to be satisfactory. The scatterplot graphs for each equation can be found in Appendix-4. Estimations results of the first and second group of models can be found in Table 6 and Table 7 respectively.

Table 6: First Model Regression Table (1) Greenhouse Gas Emissions Per Capita Results

Equation number	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)
	GINI	INCOME40	S80S20	INCOME10	PALMA
Inequality	-0.124**	0.165*	-0.294	-0.188*	-2.344*
	(0.0377)	(0.0680)	(0.162)	(0.0642)	(0.871)
GDP	0.148***	0.147***	0.145***	0.148***	0.147***
	(0.0327)	(0.0335)	(0.0337)	(0.0345)	(0.0336)
Manufacturing	0.0699***	0.0732***	0.0757***	0.0782***	0.0709***
	(0.0109)	(0.0103)	(0.00999)	(0.00892)	(0.0109)
Urbanization	-0.0877**	-0.0840**	-0.0865**	-0.0914**	-0.0898**
	(0.0248)	(0.0230)	(0.0220)	(0.0251)	(0.0240)
Humancapital	-7.013***	-6.981***	-6.917***	-6.836***	-7.028***
	(0.681)	(0.725)	(0.748)	(0.698)	(0.690)
Energyintensity	0.0132**	0.0125*	0.0128*	0.0145**	0.0134**
	(0.00427)	(0.00443)	(0.00434)	(0.00393)	(0.00419)
Finalenergy	0.0183**	0.0187**	0.0188**	0.0181**	0.0180**
	(0.00464)	(0.00462)	(0.00459)	(0.00478)	(0.00454)
_cons	30.62***	22.98***	27.89***	30.97***	29.91***
	(1.916)	(2.774)	(1.915)	(1.821)	(1.918)
N	371	371	371	372	370
R^2	69.22	68.40	68.40	69.22	69.20
F	278.42	251.00	411.34	246.16	206.77
F-value	significant	significant	significant	significant	significant

Standard errors in parentheses
Source: auto.dta
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Second Model Regression Table (2) Ecological Footprint Per Capita Results

Equation number	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)
	GINI	INCOME40	S80S20	INCOME10	PALMA
Inequality	-0.0479**	0.0782**	-0.161**	-0.0397*	-0.775***
	(0.0113)	(0.0192)	(0.0413)	(0.0181)	(0.169)
GDP	0.137***	0.136***	0.134***	0.137***	0.136***
	(0.0105)	(0.0106)	(0.0103)	(0.0107)	(0.0106)
Manufacturing	-0.00419	-0.00374	-0.00310	-0.000577	-0.00310
	(0.00762)	(0.00729)	(0.00737)	(0.00764)	(0.00754)
Urbanization	-0.0798***	-0.0770***	-0.0775***	-0.0784***	-0.0795***
	(0.00954)	(0.0103)	(0.0105)	(0.0102)	(0.0102)
Humancapital	-3.432***	-3.422***	-3.395***	-3.472***	-3.473***
	(0.648)	(0.653)	(0.667)	(0.639)	(0.637)
Energyintensity	0.00683**	0.00656**	0.00670**	0.00680***	0.00677**
	(0.00184)	(0.00177)	(0.00182)	(0.00150)	(0.00179)
Finalenergy	0.00263	0.00272	0.00273	0.00285	0.00266
	(0.00242)	(0.00242)	(0.00246)	(0.00250)	(0.00249)
_cons	17.80***	14.47***	16.91***	17.26***	17.38***
	(1.957)	(2.344)	(2.036)	(1.924)	(1.948)
N	344	344	344	346	344
R^2	60.72	60.35	60.63	60.04	60.48
F	1264.66	956.75	843.09	3156.62	1645.71
F-value	significant	significant	significant	significant	significant

Standard errors in parentheses
Source: auto.dta
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.1. ROLE OF INCOME INEQUALITY

According to the results of base model 1 and base model 2, there is a statistically significant relationship between environmental degradation and income inequality.

We found statistically significant negative relationship between the Gini coefficient and greenhouse gas emissions per capita (p <0.01). Namely, a one-unit rise in the Gini coefficient decreases the greenhouse gas emission per capita by 0.124. Similarly, a one-unit rise in the Gini coefficient corresponds to a decrease of 0.04 in the ecological footprint per capita ($p < 0.01$). There are studies in the literature that achieve the same result using the Gini coefficient (Kusumawardani & Dewi 2020; Destek 2019; Ali et al., 2016; Yang et al. 2011; Heerink et al., 2001; Ravallion et al., 2000). Rimkuvienė & Liobikienė (2020) on the other hand, found a negative relationship for the consumption-based greenhouse gas emissions.

The same negative relationship can be observed with the income share of the top 10% for each model. That is, a one-unit rise in the regarded indicator results in 0.188 decrease in the greenhouse gas emission per ($p < 0.05$), and -0.04 unit decrease in the ecological footprint per capita ($p < 0.05$). Similar outcomes can be seen in the literature. Namely, Gosh et al., (2019) have also shown that the income share of the top 10% is negatively affecting carbon emissions in the long run. On the contrary, Jorgenson et al., (2017) and Knight et al., (2017) emphasized a positive relationship between the income share of the top 10% and environmental degradation. Additionally, we should note that, Mader (2018) found an insignificant relationship between these two indicators.

As we move to the income share of the bottom 40%, a significant positive relationship is observed. A one-unit rise in the regarded measurement decreases the greenhouse gas emission per capita by 0.16 ($p < 0.05$). Positive effect of the variable on the ecological footprint per capita can also be seen with a rise of 0.16 ($p < 0.01$). This indicator can be interpreted as the accumulation of the income in the lower-income group; hence, the accumulation of income in the relatively lower-income groups increases environmental degradation. In other words, this outcome has been taken into account as a downward deterioration in income inequality.

From the estimation results, we can see that there is a negative relationship between the Palma ratio and the environmental degradation indicators. As this variable increases by one unit, greenhouse gas emission per capita decreases by 2.34 units ($p < 0.01$), similarly ecological footprint per capita decreases by 0.77 units ($p < 0.001$). This finding contrasts with the positive relationship result found by Liu et al. (2020).

Lastly, concerning the S80/S20 ratio, we found a negative effect on environmental degradation. As can be seen from the results, a one-unit rise in this ratio leads to a 0.16

unit decrease in the ecological footprint per capita. However the estimated coefficent is insignificant for the greenhouse gas per capita. On the other hand, it is worth mentioning that according to the first constructed fixed-effect model results (provided in Appendix-2), the relationship was negative and statistically significant.

As an overall result, according to the our findings, there is a negative relationship between income inequality and environmental degradation. This result coincides with the expected negative relationship examined in the previous sections. It also coincides with the findings in the literature. For instance, Ali et al., 2016; Borghesi, 2005; Destek, 2019; Ghosh, 2019; Heerink et al., 2001; Kusumawardani & Dewi, 2020; Liobikienė & Rimkuvienė, 2020; M. Ravallion et al., 2000; Yang et al., 2011 identified a negative relationship between income inequality and environmental degradation.

Our findings are, therefore in contrast with the studies that found a positive relationship. Specific examples for these studies that are examined in the literature review section can be stated as Baležentis et al., 2020; Baloch et al., 2020; J. Boyce, 2013; Y. Liu et al., 2020; Magnani, 2001; Ridzuan, 2019; Uzar & Eyuboglu, 2019. There are also studies that found no relationship; (Knight et al., 2017; Mader, 2018; Scruggs, 1998). On the other hand, in some studies, mixed results were obtained under different conditions such as different development levels, (Zhang & Zhao, 2014), sectors (Alatas & Akın, 2021), income levels (Grunewald et al., 2017) and pollution indicators (Duro, 2016).

We observed, the same negative relationship for different indicators, namely Gini coefficient, the Palma ratio, and income share of the top 10%, Additionally, our findings that the income share of the bottom of 40% has a positive, relationship with environmental degradation is again in line with our expectations.

S80/S20 ratio is insignificant in the first base model (greenhouse gas per capita). On the contrary, it is still statistically significant negative for the ecological footprint per capita ($p < 0.01$). Since we observe the same negative relationship between income inequality and environmental degradation for different environmental and income inequality indicators, we can say that this is a robust relationship.

As the income inequality and environmental degradation literature suggests contradictory results may be due to time preferences and models (Borghesi, 2005). Additionally, the conclusions derived from the empirical studies result from models designed for entirely different indicators of environmental degradation for different country groups. Besides, these countries' structural, economic, and political characteristics potentially impact the relationship between income inequality and environmental degradation (Lutz Sager, 2017). Therefore, variable, sample time period and modeling choices create a variation in the results of the studies in the literature. However, as discussed in the literature review, there are different theoretical explanations, on the nexus between income inequality and environmental degradation.

Consumption behaviours can differ from country to country and between income groups. In higher-income countries, higher inequality can lead to a rise in environmental degradation, as the literature suggests (Grunewald et al., 2017; Pattison et al., 2014). In this perspective, while focusing on individual consumption behaviour, Pattison et al., (2014) have discussed that in high-income countries with a low-income gap, an increase in the affluent group's income level in the society would lead to higher consumption levels and, correspondingly, a greater extent of environmental degradation.

However, the opposite situation is underlined by Rimkuvienė & Liobikienė (2020). In higher and middle-high income countries, higher inequality leads to a decreasing environmental degradation, particularlya decrease in consumption-based greenhouse gas emissions. The same reasoning with the same assumption is also emphasized by Ravallion et al., (2000). Accordingly, they have shown that MPE (marginal propensity to emit), the leading cause behind the environmental degradation, is lesser in richer countries than the relatively poorer countries, which implies higher inequality decreases the environmental impact. The study also revealed that richer households would have less MPE while the opposite is valid for the poorer households.

We can say that our results are in line with the MPE explanation. It is important to note that according to the World Bank (2018), 26 countries in the EU are in the high-income classification while remaining 2 countries which are Romania and Bulgaria, are upper-middle-income for the time period covered in the study. Hence it is clearly can be said that the sample group consists of mostly high-income and upper-middle-income countries. So, according to the literature, a negative impact on environmental degradation can be seen as the income is distributed more equally, which is the case for the EU member countries.

There are possible reasons for the regarded negative relationship that was observed from the results. One of the reasons is that the higher income groups tend to consume more eco-friendly in line with the MPE theory. A decreasing MPE assumes that as the income increases, marginal propensity to emit will decrease, meaning that a lower environmental degradation is created by higher income groups. Our findings suggest that this situation is valid for the high-income group, which is in line with the approaches of Rimkuvienė & Liobikienė (2020) and Scruggs (1998).

On the other hand, as the Veblen effect suggests, individuals in lower social classes tend to copy the consumption behaviours of higher social classes (Rimkuvienė & Liobikienė, 2020). In the positive relationship case, there is a possibility that the lower-income group can copy the eco-friendly consuming behaviours as they shift to the higher income level (i.e. income). However, our findings suggest the opposite is for the EU countries. The results indicate that the redistribution or a decrease in income inequality increases environmental degradation, which is denoted by greenhouse gas emissions per capita and ecological footprint per capita. So, as the income level increases for the poorer class' MPE will also increase. In line with the Veblen effect, this situation is attributable to the poorer class will consume more in order to obtain a better status in society (Baležentis et al., 2020; Bowles & Park, 2005; Jorgenson et al., 2017; Liobikienė & Rimkuvienė, 2020).

As the income is distributed more equally, the convergence of income to the higher income group increases the consumption levels of relatively poorer individuals compared to the unequal distribution. The lower-income groups tend to consume more to obtain a higher status in society as Veblen's theory emphasizes. Therefore, increased consumption can lead to higher environmental degradation. Additionally, the relatively poor group can increase their energy consumption and consumption of the carbon-intensive products instead of eco-friendly products due to increased incomes. So our findings imply that MPE for the higher-income groups is lower while it is higher for lower-incomecome group. Therefore, when relatively low-income individuals shift to a better income group, they still won't prefer consuming eco-friendly products. In fact, they will consume less eco-friendly goods. Namely, income inequality can affect the norms in society and related consumption motives of the individuals (Wilkinson & K. Pickett, 2010). For instance, for low-income individuals, as they shift to the middle-income group, their capacity to consume in order to obtain a higher status in the society will also increase; shifting to a certain income group won't prevent them from shifting to another, which is high-income in this example. So, higher MPE and higher environmental degradation can also be interpreted for the low-income group due to the motive of their consumption behaviours.

As it is underlined before, the Gini coefficient is insensitive to the aggregation of the upper and lower incomes (Jorgenson et al., 2017; Liu et al., 2020). Still, the results have shown that increasing income inequality which is represented by the Gini coefficient, leads to less environmental degradation. If we take a closer look at the income share of the groups in this thesis, with the income share of the top 10%, S80/S20, and Palma ratio; it is seen that the accumulation of income in the higher income group reduces environmental pollution. Although the S80/S20 is insignificant for equation 1.3, which is constructed with the greenhouse gas emissions per capita, it is significant in the ecological footprint per capita model. Regarded variable, which gives the ratio of the top 20 to the bottom 20, shows that ecological footprint per capita decreases due to the higher concentration of income in the upper-income group. The relationship between two environmental degradation indicators and the Palma ratio, is also negative. Likewise, the increase in the income share of the top 10%, which is considered as the high-income group, decreases environmental pollution. On the contrary, the increase in the income share of the bottom 40% increases the environmental degradation. It is crucial to note that the income share of the top 10% can be used for examining the possible political effects and Veblen theory, as the literature suggests (Jorgenson et al., 2017).

In this thesis, the political approach is also considered with the income share of the top 10%. The literature suggests that accumulation of wealth and political power is associated with each other and goes hand to hand (Boyce 2010; Jorgenson et al., 2017). Boyce (2010) suggests that behind the demands for environmental protection and in-line policy implementations, there are two major differences between individuals who create demand. These are specified as purchasing power and political power. Political power has the ability to affect social decisions on environmental policies directly. However, Boyce also emphasizes that political power is correlated with purchasing power and both unequally distributed. This situation leads to a conclusion that the number of individuals (share) who hold a certain percentage in the income distribution is effective in this created environmental protection demand, policy implementations, and therefore environmental pressure. So it can be said that “willingness to pay” for environmental protection is shaped by the high-income group in the societies.

Here, in fact, "willingness to pay" (which is identified by Boyce (1994) and Magnani (2001)) and "capable of paying" appear as two concepts that are inevitably related to each other. In other words, under the assumption that the sensitivity to the environment is the same in the two groups, which are low-income and high-income, the individual contribution to environmental protection is higher in the group with higher income. In parallel with this, the wealthier segment, who holds the political power, will have more power to influence environmental policies in the same scenario. Hence as we consider this situation for the EU member countries, under the assumption that the income share of the top 10% and the political power go in parallel (see Jorgenson et., 2017; Winters & Page, 2009), when the share of this group in the total income increases, greenhouse gas emissions per capita and ecological footprint per capita decreases. Ravallion et al., (2000) underline this situation as a positive income effect on the environmental protection demand, which increases with the income levels of the individuals. Accordingly, the higher-income group will demand protection for the environment as their income level increases. Redistribution of the income from lower to higher would worsen this effect and lead to environmental degradation since the lower-income group has less demand for the regarded policies.

In another scenario, according to Magnani (2000), the increase in income inequality is interpreted as minimizing environmental concerns. For example, in a consumption movement made for the continuation of vital activities, the harm that the individual will cause to the environment is secondary. In this case, increasing income inequality also triggers environmental degradation. This means a positive relationship. However, the high-income group can reverse increasing environmental degradation. But does this apply to all countries? The answer to this question may be only in high-income countries. For instance, if we consider the EU countries, most of the countries are developed or developing countries that fall into the high-income group. In this country group, there is an overall energy consumption reduction and emission reduction target. Concrete steps are taken to reduce damage to the environment, such as the European Green Deal and EU Circular Economy Action Plan, also reveal the political will to combat environmental degradation. Policy implementations can be made to make energy consumption environmentally friendly and to develop the sectors in this direction. For instance, the EU countries have a target of decreasing the emission rates by 40% in 2030 and 80% in 2050 (Sterpu et al., 2018). Environmental policies and the demand for the environmental protection is crucial to reach tthis target. This study's findings underline that the demand for enviromental protection may come from high-income groups, as they hold the political power.

Factor ownership can provide another perspective. Accordingly, the high-income group also holds the inputs that create pollution (Gassebner et al., 2008). In this case, it may have been possible for the high-income group to prefer eco-production and restrictive related energy consumption, which will decrease environmental degradation. Gassebner et al., (2008) has emphasized that income inequality affects environmental degradation with the ownership of the inputs that are used in production.

3.2. ROLE OF INCOME

Another reason for the presented negative effect of income inequality on environmental degradation is connected with the rising demand and economic growth as income is distributed more equally. Accordingly, redistribution of income also leads to rising demand of the households (Ravallion et al., 2000). Similarly, economic growth increases as the income inequality decrease in the OECD countries –covering 24 of the EU member countries out of 28 used in this thesis. (Cingano, 2014) Economic growth is directly associated with environmental degradation and causes rising pollution rates in the short run, as the EKC theory emphasizes. (Borghesi, 2005; Destek, 2019; Kusumawardani & Dewi, 2020; Zhang & Zhao, 2014) In compliance with the economic growth perspective, the constructed models also revealed a positive impact of real GDP per capita on the greenhouse gas emissions per capita and ecological footprint per capita. That is, a one-unit rise in the real GDP per capita leads to an increase in the greenhouse gas emissions per capita by ranging from 0.145 to 0.148 units for all equations ($p < 0.001$). Likewise, a unit rise in the real GDP per capita leads to an increase in the ecological footprint per capita by 0.134 to 0.137 for all equations ($p < 0.001$). The literature suggests that there is a strict positive relationship between income levels and environmental degradation. As the income level increases, environmental degradation also increases in line with the consumption levels of the individuals. It is worth noting that the findings in the literature regarding this relationship consist mostly of CO2 emissions and greenhouse gas emissions as indicators of environmental degradation.

3.3. ROLE OF ENERGY AND MANUFACTURING

As can be seen from the results, there is a significant positive but low impact of final household energy consumption on the greenhouse gas emission by capita, a one-unit rise in the final energy consumption increases the dependent variable by 0.018 for all equations in the first base model. In the same model, the effect of energy intensity is found to be significant and positive. A one unit increase in the energy intensity increases the greenhouse gas emission per capita between 0.0025 and 0.0145 units. These findings are in line with some studies in the literature that found a positive relationship between different environmental degradation variables and energy intensity (Destek, 2019; Q. Liu et al., 2019; Zhang & Zhao, 2014) and final energy consumption per capita (Ghosh, 2019; Uzar & Eyuboglu, 2019).

We found that the effect of final energy consumption is insignificant in the second base model. However, energy intensity has a significant positive effect on EF per capita. This shows that the impact of household energy consumption and energy intensity on the environment is low in EU countries. We can also attribute this situation to the countries' eco-friendly energy composition and certain energy policies that have actively been used by the EU member countries.

The manufacturing ratio, on the other hand, shows a significant positive impact on the greenhouse gas emissions per capita. As the manufacturing ratio in the GDP increases by one unit greenhouse gas emissions per capita increase by 0.07 for all equations. However, the impact of the variable is insignificant for the ecological footprint per capita. This might be due to the very indirect effect of this variable on EF.

This result is in line with the expectation that the relevant coefficient is positive. The positive relationship between the manufacturing industry and emissions can also be associated with the increases in energy consumption and intensity since the manufacturing industry is one of the sectors with the highest energy comsumption.

3.4. ROLE OF HUMAN CAPITAL

As our estimation results indicate, there is a statistically significant negative relationship between environmental degradation and human capital. The first base model's findings show that a one-unit rise in the human capital decreases the ecological footprint per capita by 3.4 ($p < 0.001$), while greenhouse gas emission per capita decreases between 6.8 and 7.0 ($p < 0.001$). These results are consistent with Baležentis et al., (2020); Li et al., (2020); Liobikienė & Rimkuvienė, (2020); Yang et al., (2011). These results reveal that there is a large negative impact of the human capital index on environmental degradation.

We can say that increasing environmental awareness in parallel with human capital can play a key role in reducing environmental degradation as the literature suggests. As the education level increases, which is represented by the human capital, a higher level of environmental concern and related eco-friendly consumption can be obtained (Kim & Go, 2020; Liobikienė & Rimkuvienė, 2020; Zhao et al., 2014).

This finding is also in accordance with the MPE theory. As the education level increase, individuals are expected to have a more eco-friendly lifestyle and be more concerned about environmental degradation. This situation will lead to a lower MPE for the more educated individuals while the opposite is valid for relatively low-income individuals who have a lesser education level (Stryzhak, 2020). The same outcome can also be seen in Liobikienė & Rimkuvienė’s (2020) study. Their study has revealed that MPE theory and human capital are associated while observing the inequality and degradation nexus. The greater education level represented by human capital is creating a negative effect on consumption-based greenhouse gas emissions in high-income countries. Kim & Go,

(2020) also emphasized that the negative effect of human capital on environmental degradation works in conjunction with policy implementations.

3.5. ROLE OF URBANIZATION

According to results of the base model 1, as the proportional urbanization in the EU countries rises as one unit, greenhouse gas emission per capita decreases by 0.08 to 0.09 ($p < 0.01$)). Similarly, an increase in proportional urbanization decreases ecological footprint per capita by 0.07 ($p < 0.01$)). These results indicate that there is a negative relationship between urbanization and environmental degradation in the EU countries in the regarded time interval (2005 to 2018). When we compare this result with the literature, it is possible to see studies that came up with the same result. A negative relationship between urbanization and environmental is identified in studies such as; Baležentis et al., 2020; Baloch et al., 2020; Kusumawardani & Dewi, 2020; Liobikienė & Rimkuvienė, 2020; Koengkan & Fuinhas, 2021; Masud et al., 2018. However, some other studies have found a positive relationship between urbanization and environmental degradation (Ali et al., 2016; Borghesi, 2005; Jorgenson et al., 2017; Ridzuan, 2019; Yang et al., 2011).

A possible explanation for this controversial result in the literature can be using different country groups. For instance, Koengan & Fuinhas (2021) studied the relationship between gender inequality and CO_2 emissions for the EU countries. They also found a negative relationship between urbanization and CO_2 emissions. Liobikienė & Rimkuvienė (2020) also came up with the same negative relationship result while examining the nexus between income inequality and consumption-based greenhouse gas emissions. Their findings pointed out that only in high-income countries this negative relationship was observed. Considering the sample, our findings are consistent with their study.

On the other hand, one of the specific studies that found a positive relationship between urbanization and environmental degradation is Ali et al., (2016). In this study, a sample that covers 18 African countries was used to examine the relationship between income inequality and environmental degradation.

Poumanyvong & Kaneko (2010) explained this findings by differences in development. By focusing on the energy usage and emission rates, their findings show that the impact of urbanization on the environment is more intense, especially for the middle-income group rather than others. As a result, a positive relationship was found between urbanization and environmental degradation. Baležentis et al., (2020) underlined that the possible structural differences regarding consumption and economy could be associated with migration (Baležentis et al., 2020).

It is possible to associate this negative relationship with the MPE approach. The more affluent groups are concentrated in the urban parts of the countries, and individuals in these groups have lesser MPEs. On the other hand, relatively less affluent groups consisting of individuals that have higher MPEs live in rural territories. Liobikienė & Rimkuvienė (2020) has also emphasized this situation. Additionally, the rural areas can be significant emitters based on land usage and related implementations. (Pezzagno et al., 2020). Urbanization can also increase the usage of public goods in compliance with the possible features such as eco-friendly products, lifestyle, and technology which will eventually lead to a decrease in the overall environmental degradation (Hao et al., 2016). Koengkan & Fuinhas (2021) has emphasized that the regarded negative relationship for the EU countries can be associated with energy efficiency and environmental regulations. According to them, environmental regulations that occur in urban areas such as usage of renewable sources, energy efficiency in transportation, alternative energy sources, and industrial changes create a downsized impact on the environment, especially for the urban areas in the EU. The regulations also cover the individual consumption behaviors in the urban areas, eco-friendly product composition (banning single-use plastics, etc.), use of the public transport individually, and reducing the possible energy intensive consumption can be significant examples. This result is also consistent with our findings; the minor or insignificant energy intensity and household consumption differences that occur in EU countries and accumulation of the income in the high-income group which is residents of the urban areas can be one of the causes of lower environmental degradation.

CONCLUSION

In this thesis, income inequality and environmental degradation, which are of great importance for human beings and our planet, are brought together. There is a growing literature that examines the relationship between income inequality and environmental degradation; nevertheless, consensus on the regarded relationship between these two crucial concepts is still be lacking. In EU member countries, it is possible to observe the rising income inequalities while decreasing emission rates. Additionally, the literature that covers the EKC theory, political point of view, and economic behaviour of individuals has shown a possible relationship between income inequality and environmental degradation. This situation has driven us to examine whether there is a strict relationship between income inequality and environmental degradation or not in the regarded countries.

In order to examine the possible relationship, we used panel data analysis for 28 EU member countries for the years between 2005 and 2018. In the analysis we used greenhouse gas emissions per capita and ecological footprint per capita as dependent variables for the environmental degradation in two base models (5 equations for each). Both base models use different income inequality indicators as key independent variables: Gini coefficient, income share of the bottom 40%, S80/S20 ratio, the income share of the top 10%, and Palma ratio. Other independent variables selected in accordance with the literature are real GDP per capita, manufacturing ratio, energy intensity, final household energy consumption per capita, urbanization, and human capital.

As a result of our estimations, a negative relationship was found between income inequality and environmental degradation, which is represented by greenhouse gas emission per capita and ecological footprint per capita. According to this relationship, increased income inequality can be associated with less environmental degradation. This outcome was supported by different measurements of income inequality, and a robustness check has been provided for the nexus.

Our results revealed a trade-off between income inequality and environmental degradation. As is known, income inequality within the scope of sustainable development is as an important problem as environmental degradation. In this case, the policy practices to be implemented should reduce income inequality on the one hand, and reduce environmental degradation on the other. An important policy application to achieve this status can be carbon pricing. Since the high-income group also holds the inputs that create pollution (Gassebner et al., 2008), carbon pricing for the polluting factors can provide tax revenue for the government. This revenue can be used to decrease income inequality through financial support channels. However, carbon pricing has difficulties in practice, and solely financial support for the low-income group may be insufficient. A broader perspective on the social plane must be drawn to decrease income inequality.

Individuals in the low-income group may be more inclined to imitate the environmentally friendly consumption behaviours of people in the high-income group because they want to move to a higher income group as a social status which can be the possible case for the EU countries. Hence, changing the product composition is one way to obtain this, yet our results have shown that only the rising income share of the high-income group creates a negative impact on the greenhouse gas emissions per capita and ecological footprint per capita. This situation can be attributable to environmental concern differences and environmental policy demand-implementations. As Scruggs (1998) demonstrated, individual economic behaviour can create an aggregate impact on environmental degradation, which leads us to a better understanding of this thesis outcome. The consumption behaviours and preferences of the individuals can play a key role between these two variables in line with the MPE theory. The political point of view also indicates that the accumulation of income and political power has a linkage. Political power that can prevent or overcome environmental degradation by policy implementations is crucial.

Another perspective can also be mentioned regarding the environmental concern concept. Even though it is assumed that the more affluent individuals and poorer individuals have the same concern for the environmental issues, the more affluent individuals will be able to reach eco-friendly products easier (Dunlap & York, 2008;

Saari et al., 2021). Therefore, policy practices should be ensured that the lower income segment can also access to these product groups with increasing income levels. As the income level goes on, the income distribution will converge to an equal position. So relatively poorer groups can be able to acquire eco-friendly goods, and environmental degradation can decrease in compliance with this situation. The key point here is to ensure that the relatively low-income group prefers environmentally friendly products when they move to a higher-income group to reduce income inequality. In other words, a policy practice should be followed to reduce the Veblen effect. The way to achieve this is to increase environmental awareness. It is known that there is a positive relationship between environmental awareness and education level. This is supported by the negative relationship we found between human capital denoted by education level and environmental degradation. Another supportive result is the higher education level of the high-income segment and the lower MPE for this group. MPE is relatively high for the low-income group, and this group’s education level is low. The policy of increasing the education level for this group should be followed. As the education level of low-income groups increases, their environmental awareness can also increase. Rising skill levels due to education can also create a positive impact on income inequality. Thus, both environmental degradation and income inequality can be reduced.

Technological change and innovations can improve living standards, and enchant sustainable production and consumption. Creating application areas of green technology so that every income level can benefit may be another key point in reducing environmental degradation. In particular, the negative relationship between urbanization and environmental degradation, which we obtained as a result of our research, points to this situation. The presence of recycling, waste treatment, and renewable energy plants, which are widely used in EU member countries, especially in urban areas, reduces environmental degradation. Establishing such applications for low-income groups living in rural areas is one of the important steps that can be taken. However, the high costs and implementation of these technologies should also be considered.

The strong relationship between human capital and environmental degradation emerges as an important outcome of this thesis. Increasing educational programs, including environmental awareness training, for low-income groups, can be considered as a policy practice. The main reason for such practice is that the increase in the human capital of these groups can reduce both income inequality and environmental degradation.

Another result of this thesis is that there is a positive relationship between real GDP capita and environmental degradation. As the real GDP per capita, which indicates countries' economic growth and economic power, increases, rising emission rates, in other words, environmental degradation is observed. Equal or unequal distribution of this income may also have different consequences in terms of environmental degradation. Although this is an expected result in accordance with the literature, in relation to income inequality, in which income segment that income accumulates in countries has an impact on environmental degradation.

In this thesis, there were some limitations. Firstly, if we had variables on a household basis, a more detailed examination could be performed on the relationship between income inequality and environmental degradation. Another limitation was if there were data for variables other than the income share of the top 10% related to environmental protection policy that could affect environmental degradation, considering these variables in the models would have contributed to explaining the corresponding relationship. Moreover, the existence of a variable such as environmentalism, by which we can measure environmental concern and awareness as the literature emphasizes, could also be used for a more detailed explanation.

Future research can be constructed with the same indicators that have been used in the thesis for different country groups in order to obtain an individual approach to income inequality and environmental degradation. A broader perspective can be obtained by focusing on unique sample groups that have different income levels and environmental regulations. Policy targets may be reconsidered, especially for high-income countries, since the results have been shown for the EU member countries. For instance, as it is known, one of the United Union's sustainable development goals emphasizes that there is an aim of reaching an income growth on the bottom 40% at a higher rate than the national average (UN, 2021). However, our findings suggest that as the income share of the bottom 40% increases, environmental degradation rises in line with the consumption behaviors and environmental policy preferences of the individuals for the EU member countries. Therefore, it is possible to observe a trade-off between income inequality and environmental degradation. As mentioned, human capital has a strict negative impact on environmental degradation. Future research should consider the human capital (education), income inequality, and environmental degradation interactions thoroughly. This interaction may be the key to a low inequality, low environmental degradation society.

BIBLIOGRAPHY

Abhijit V. Banerjee, Esther Duflo. (2019). Good Economics for Hard Times, *PublicAffairs*, pp. x + 402., ISBN 978-1-5417-6287-9.

Ali, H. S., Hassan, S., & Kofarmata, Y. I. (2016). Dynamic impact of income inequality on carbon dioxide emissions in Africa: New evidence from heterogeneous panel data analysis. *International Journal of Energy Economics and Policy*, *6*(4), 760–766.

Alataş, S. & Akın, T. (2021).The Impact of Income Inequality on Environmental Quality: A Sectoral-Level Analysis.

Baležentis, T., Liobikienė, G., Štreimikienė, D., & Sun, K. (2020). The impact of income inequality on consumption-based greenhouse gas emissions at the global level: A partially linear approach. *Journal of Environmental Management*, *267*(December 2019). https://doi.org/10.1016/j.jenvman.2020.110635

Baloch, M. A., Danish, Khan, S. U. D., Ulucak, Z. Ş., & Ahmad, A. (2020). Analyzing the relationship between poverty, income inequality, and CO2 emission in Sub-Saharan African countries. *Science of the Total Environment*, *740*. https://doi.org/10.1016/j.scitotenv.2020.139867

Baltagi, B. H. and P. X. Wu. (1999). Unequally spaced panel data regressions with AR(1) disturbances. Econometric Theory 15: 814–823.

Berthe, A., & Elie, L. (2015). Mechanisms explaining the impact of economic inequality on environmental deterioration. *Ecological Economics*, *116*, 191–200. https://doi.org/10.1016/j.ecolecon.2015.04.026

Borghesi, S. (2005). Income inequality and the environmental Kuznets curve. *Environment, Inequality and Collective Action*, 32–50. https://doi.org/10.4324/9780203481509

Bowles, S., & Park, Y. (2005). Emulation, inequality, and work hours: Was Thorsten Veblen right? *Economic Journal*, *115*(507), 397–412. https://doi.org/10.1111/j.1468-0297.2005.01042.x

Boyce, J. (2013). Power Distribution, the Environment, and Public Health. *The Political Economy of the Environment*, *29*, 127–140. https://doi.org/10.4337/9781843766971.00012

Boyce, J. K. (2010). Equity and the Environment. *The Eletronic Library*, *34*(1), 1–5.

Bottai, M. (2003). Confidence regions when the fisher information is zero. Biometrika, 90(1), 73-84, https://doi.org/10.1093/biomet/90.1.73

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The review of economic studies*, *47*(1), 239-253.

Bhargava, A., Franzini, L., & Narendranathan, W. (1982). Serial Fixed Correlation and Effects the Model. *Review of Economic Studies*, *49*(4), 533–549. http://www.jstor.org/stable/2297285

Cingano, F. (2014). Trends in Income Inequality and its Impact on Economic Growth. *OECD Social, Employment, and Migration Working Papers*, *163*, 0_1,5-59. https://doi.org/http://dx.doi.org/10.1787/5jxrjncwxv6j-en

Clement, M., & Meunie, A. (2010). Is Inequality Harmful for the Environment? An Empirical Analysis Applied to Developing and Transition Countries. In *Review of Social Economy* (Vol. 68, Issue 4). https://doi.org/10.1080/00346760903480590

De Bruyn, S. M., Van Den Bergh, J. C. J. M., & Opschoor, J. B. (1998). Economic growth and emissions: Reconsidering the empirical basis of environmental Kuznets curves. Ecological Economics, 25(2), 161–175. https://doi.org/10.1016/S0921-8009(97)00178-X

Demir, C., Cergibozan, R., & Gök, A. (2019). Income inequality and CO2 emissions: Empirical evidence from Turkey. *Energy and Environment*, *30*(3), 444–461. https://doi.org/10.1177/0958305X18793109

Destek, M. A. (2019). *Türkiye ' de Gelir Dağılımının Çevre Kirliliği Üzerindeki Etkileri Üzerine Bir İnceleme An Investigation on the Impact of Income Distribution on Environmental Pollution*. *18*, 1477–1488.

Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics*, *80*(4), 549–559. https://doi.org/10.1162/003465398557825

Dunlap, R. E., & York, R. (2008). The globalization of environmental concern and the limits of the postmaterialist values explanation: Evidence from four multinational surveys. *Sociological Quarterly*, *49*(3), 529–563. https://doi.org/10.1111/j.1533-8525.2008.00127.x

Duro, J. A. (2016). Intercountry inequality on greenhouse gas emissions and world levels: An integrated analysis through general distributive sustainability indexes. *Ecological Indicators*, *66*, 173–179. https://doi.org/10.1016/j.ecolind.2016.01.026

Doğaner Gönel, Feride (2016). Kalkınma Ekonomisi, 3. Baskı, *Efil Yayınevi*, Ankara ISBN: 978-605-4334-45-2

Frees, E. (2004) Longitudinal and Panel Data: Analysis and Applications in the Social Sciences. *Cambridge University Press*, New York. https://doi.org/10.1017/CBO9780511790928

Fitzgerald, J. B., Jorgenson, A. K., & Clark, B. (2015). Energy consumption and working hours: a longitudinal study of developed and developing nations, 1990–2008. *Environmental Sociology*, *1*(3), 213–223. https://doi.org/10.1080/23251042.2015.1046584

Gassebner, M., Gaston, N., & Lamla, M. J. (2008). Relief for the environment? the importance of an increasingly unimportant industrial sector. *Economic Inquiry*, *46*(2), 160–178. https://doi.org/10.1111/j.1465-7295.2007.00086.x

Ghosh, S. (2019). Environmental Pollution, Income Inequality, and Household Energy Consumption: Evidence from the United Kingdom. In *Journal of International Commerce, Economics and Policy* (Vol. 10, Issue 2). https://doi.org/10.1142/S179399331950008X

Golley, J., & Meng, X. (2012). Income inequality and carbon dioxide emissions: The case of Chinese urban households. *Energy Economics*, *34*(6), 1864–1872. https://doi.org/10.1016/j.eneco.2012.07.025

Grunewald, N., Klasen, S., Martínez-Zarzoso, I., & Muris, C. (2017). The Trade-off Between Income Inequality and Carbon Dioxide Emissions. *Ecological Economics*, *142*, 249–256. https://doi.org/10.1016/j.ecolecon.2017.06.034

Grunewald, N., Klasen, S., Martínez-Zarzoso, I., & Muris, C. (2012). Income Inequality and Carbon Emissions. *SRRN*, http://dx.doi.org/10.2139/ssrn.2013039

Greene, W.H. (2008). Econometric Analysis, 6th ed. *Upper Saddle River*, NJ: Prentice Hall.

Hao, Y., Chen, H., & Zhang, Q. (2016). Will income inequality affect environmental quality? Analysis based on China's provincial panel data. *Ecological Indicators*, *67*, 533–542. https://doi.org/10.1016/j.ecolind.2016.03.025

Hannah Ritchie, Max Roser. (2020) - "CO_2 and Greenhouse Gas Emissions". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions' [Online Resource]

Hausman, J. (1978) Specification Tests in Econometrics. *Econometrica,* 46, 1251-1271. https://doi.org/10.2307/1913827

Heerink, N., Mulatu, A., & Bulte, E. (2001). Income inequality and the environment: Aggregation bias in environmental Kuznets curves. *Ecological Economics*, *38*(3), 359–367. https://doi.org/10.1016/S0921-8009(01)00171-9

Huang, Z., & Duan, H. (2020). Estimating the threshold interactions between income inequality and carbon emissions. *Journal of Environmental Management*, *263*(February), 110393. https://doi.org/10.1016/j.jenvman.2020.110393

IPCC. (2021). Technical Summary. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. In *Climate*

Change 2021: The Physical Science Basis.

Jorgenson, A., Schor, J., & Huang, X. (2017). Income Inequality and Carbon Emissions in the United States: A State-level Analysis, 1997–2012. *Ecological Economics*, *134*, 40–48. https://doi.org/10.1016/j.ecolecon.2016.12.016

Kashwan, P. (2017). Inequality, democracy, and the environment: A cross-national analysis. *Ecological Economics*, *131*, 139–151. https://doi.org/10.1016/j.ecolecon.2016.08.018

Kempf, H., & Rossignol, S. (2007). Is inequality harmful for environment in a growing economy? *Economics and Politics*, *19*(1), 53–71. https://doi.org/10.1111/j.1468-0343.2007.00302.x

Kim, D., & Go, S. (2020). Human capital and environmental sustainability. *Sustainability (Switzerland)*, *12*(11), 1–14. https://doi.org/10.3390/su12114736

Knight, K. W., Schor, J. B., & Jorgenson, A. K. (2017). Wealth Inequality and Carbon Emissions in High-income Countries. *Social Currents*, *4*(5), 403–412. https://doi.org/10.1177/2329496517704872

Koengkan, M., & Fuinhas, J. A. (2021). Is gender inequality an essential driver in explaining environmental degradation? Some empirical answers from the CO2 emissions in European Union countries. *Environmental Impact Assessment Review*, *90*(May). https://doi.org/10.1016/j.eiar.2021.106619

Kolluru, M., & Semenenko, T. (2021). Income Inequalities in EU Countries: Gini Indicator Analysis. *Economics*, *9*(1), 125–142. https://doi.org/10.2478/eoik-2021-0007

Kusumawardani, D., & Dewi, A. K. (2020). The effect of income inequality on carbon dioxide emissions: A case study of Indonesia. *Heliyon*, *6*(8), e04772. https://doi.org/10.1016/j.heliyon.2020.e04772

Kuznets S. (1955). Economic growth and income inequality, Am Econ Rev 45(1):1–28

Li, B., Cheng, S., & Xiao, D. (2020). The impacts of environmental pollution and brain drain on income inequality. *China Economic Review*, *62*(May), 101481. https://doi.org/10.1016/j.chieco.2020.101481

Liobikienė, G., & Rimkuvienė, D. (2020). The role of income inequality on consumption-based greenhouse gas emissions under different stages of economic development. *Environmental Science and Pollution Research*, *27*(34), 43067–43076. https://doi.org/10.1007/s11356-020-10244-x

Lin, D.; Hanscom, L.; Murthy, A.; Galli, A.; Evans, M.; Neill, E.; Mancini, M.S.; Martindill, J.; Medouar, F.-Z.; Huang, S.; Wackernagel. (2018). M. Ecological Footprint Accounting for Countries: Updates and Results of the National Footprint

Accounts, Resources 2018, 7, 58. https://doi.org/10.3390/resources7030058

Liu, Q., Wang, S., Zhang, W., Li, J., & Kong, Y. (2019). Examining the effects of income inequality on CO2 emissions: Evidence from non-spatial and spatial perspectives. *Applied Energy*, *236*(February 2018), 163–171. https://doi.org/10.1016/j.apenergy.2018.11.082

Liu, Y., Zhang, M., & Liu, R. (2020). The impact of income inequality on carbon emissions in china: A household-level analysis. *Sustainability (Switzerland)*, *12*(7), 1–22. https://doi.org/10.3390/su12072715

Mader, S. (2018). The nexus between social inequality and CO2 emissions revisited: Challenging its empirical validity. *Environmental Science and Policy*, *89*(April), 322–329. https://doi.org/10.1016/j.envsci.2018.08.009

Magnani, E. (2000). The Environmental Kuznets Curve, environmental protection policy and income distribution. School of Economics, The University of New South Wales, Sydney NSW 2052, Australia, https://doi.org/10.1016/S0921-8009(99)00115-9

Magnani, E. (2001). The Environmental Kuznets Curve: Development path or policy result? *Environmental Modelling and Software*, *16*(2), 157–165. https://doi.org/10.1016/S1364-8152(00)00079-7

Masud, M. M., Kari, F. B., Banna, H., & Saifullah, M. K. (2018). Does income inequality affect environmental sustainability? Evidence from the ASEAN-5. *Journal of the Asia Pacific Economy*, *23*(2), 213–228. https://doi.org/10.1080/13547860.2018.1442146

Moulton, B.R. and W. C. Randolph (1989). Alternative tests of the error component model. Econometrica, 57, 685-693.

Newton, H. J., Baum, C. F., Beck, N., Cameron, a C., Epstein, D., Hardin, J., Jann, B., Jenkins, S., & Kohler, U. (2010). The Stata Journal. *Stata Journal*, *10*, 288–308. https://doi.org/The Stata Journal

Nhim, T. (2021). *Self-governance of water resources under climate change : Insights from Cambodia Tum Nhim*.

Pattison, A., Habans, R., & Clement, M. T. (2014). Ecological Modernization or Aristocratic Conservation? Exploring the Impact of Affluence on Carbon Emissions at the Local Level. *Society and Natural Resources*, *27*(8), 850–866. https://doi.org/10.1080/08941920.2014.911996

Patnaik, R. (2018). Impact of Industrialization on Environment and Sustainable Solutions - Reflections from a South Indian Region. *IOP Conference Series: Earth and Environmental Science*, *120*(1). https://doi.org/10.1088/1755-1315/120/1/012016

Pezzagno, M., Richiedei, A., & Tira, M. (2020). Spatial planning policy for sustainability: Analysis connecting land use and GHG emission in rural areas. *Sustainability (Switzerland)*, *12*(3), 1–15. https://doi.org/10.3390/su12030947

Poumanyvong, P., & Kaneko, S. (2010). Does urbanization lead to less energy use and lower CO2 emissions? A cross-country analysis. *Ecological Economics*, *70*(2), 434–444. https://doi.org/10.1016/j.ecolecon.2010.09.029

Ravallion, M., Heil, M., & Jalan, J. (2000). A less poor world, but a hotter one? Carbon emissions, economic growth and income inequality. *Oxford Economics Papers*, *52*(4), 651–699. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.197.5682&rep=rep1&type=pdf

R. Wilkinson and K. Pickett (2010), The Spirit Level: Why Equality is Better for Everyone. London: Penguin. £9.99, pp. 347, pbk. *Journal of Social Policy*, *42*(4), 840–842. https://doi.org/10.1017/s0047279413000366

Ridzuan, S. (2019). Inequality and the environmental Kuznets curve. *Journal of Cleaner Production*, *228*, 1472–1481. https://doi.org/10.1016/j.jclepro.2019.04.284

Saari, U. A., Damberg, S., Frömbling, L., & Ringle, C. M. (2021). Sustainable consumption behavior of Europeans: The influence of environmental knowledge and risk perception on environmental concern and behavioral intention. *Ecological Economics*, *189*(April). https://doi.org/10.1016/j.ecolecon.2021.107155

Schor, J. (1998). Time, Labour and Consumption: Guest Editor's Introduction. *Time & Society*, *7*(1), 119–127. https://doi.org/10.1177/0961463X98007001007

Scruggs, L. A. (1998). Political and economic inequality and the environment. *Ecological Economics*, *26*(3), 259–275. https://doi.org/10.1016/S0921-8009(97)00118-3

Sterpu, M., Soava, G., & Mehedintu, A. (2018). Impact of economic growth and energy consumption on greenhouse gas emissions: Testing environmental curves hypotheses on EU countries. Sustainability (Switzerland), 10(9). https://doi.org/10.3390/su10093327

Stryzhak, O. (2020). The relationship between education, income, economic freedom and happiness. *SHS Web of Conferences*, *75*, 03004. https://doi.org/10.1051/shsconf/20207503004

The International Trade Centre, E. commission. (2019). The European Union market. *The European Union Market for Sustainable Products: The Retail Perspective on Sourcing Policies and Consumer Demand*.

UN. (2021). *SDG indicator metadata: Indicator 12.4.1*. 1–6. https://unstats.un.org/sdgs/metadata/

Uzar, U., & Eyuboglu, K. (2019). The nexus between income inequality and CO2 emissions in Turkey. *Journal of Cleaner Production*, *227*, 149–157. https://doi.org/10.1016/j.jclepro.2019.04.169

Veblen T. (1934). Theory of the leisure class, Modern Library, New York

Winters, J. A., & Page, B. I. (2009). Oligarchy in the United States? *Perspectives on Politics*, *7*(4), 731–751. https://doi.org/10.1017/S1537592709991770

Wooldridge, J. M. (2002). Econometric Analysis of Cross Section and Panel Data. *Cam-bridge*, MA: MIT Press.

Yang, J., Yang, Z. K., & Sheng, P. F. (2011). Income distribution, human capital and environmental quality: Empirical study in China. *Energy Procedia*, *5*, 1689–1696. https://doi.org/10.1016/j.egypro.2011.03.288

Yerdelen Tatoğlu, F. (2020). İleri Panel Veri Analizi: Stata Uygulamalı. *Baskı, İstanbul, Beta Yayınları*.

Yerdelen Tatoğlu, F. (2020). Panel Veri Ekonometrisi: Stata Uygulamalı. *Beta Yayınevi*.

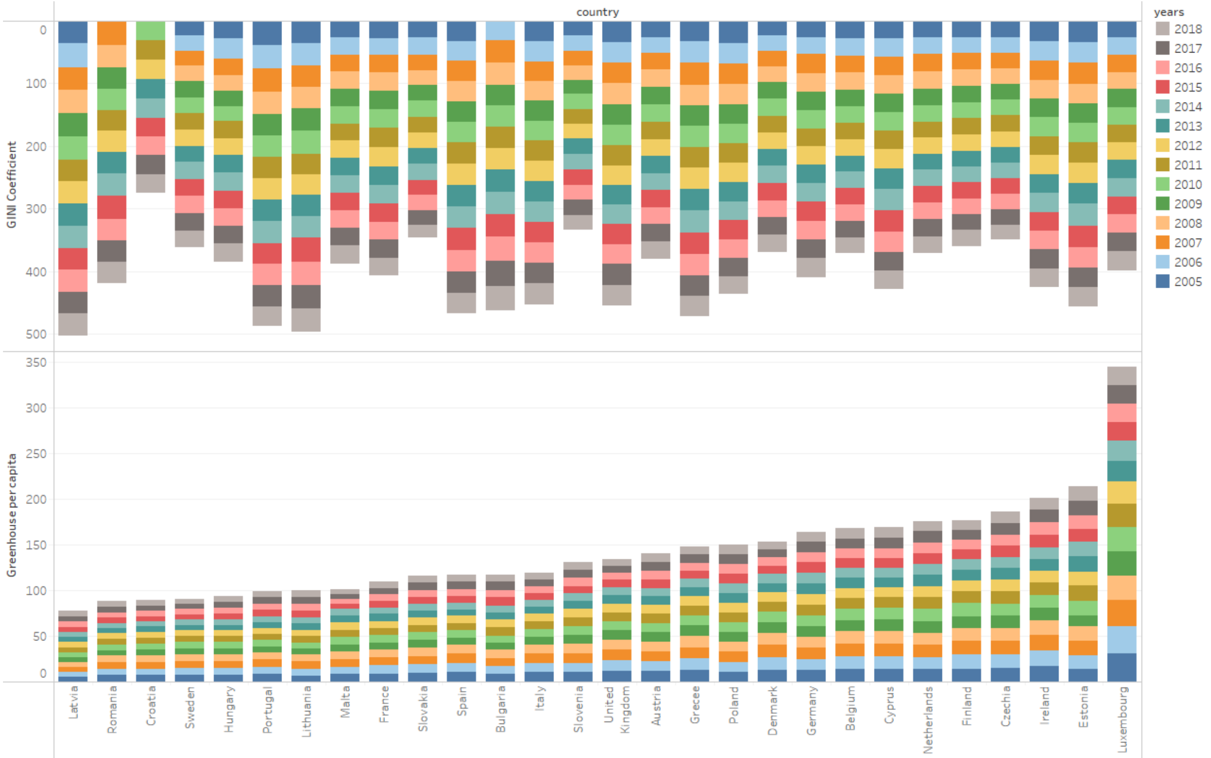
Zhang, C., & Zhao, W. (2014). Panel estimation for income inequality and CO2 emissions: A regional analysis in China. *Applied Energy*, *136*, 382–392. https://doi.org/10.1016/j.apenergy.2014.09.048

Zhao, H. H., Gao, Q., Wu, Y. P., Wang, Y., & Zhu, X. D. (2014). What affects green consumer behavior in China? A case study from Qingdao. *Journal of Cleaner Production*, *63*, 143–151. https://doi.org/10.1016/j.jclepro.2013.05.021

Zhao, Y., Ke, J., Ni, C. C., McNeil, M., Khanna, N. Z., Zhou, N., Fridley, D., & Li, Q. (2014). A comparative study of energy consumption and efficiency of Japanese and Chinese manufacturing industry. Energy Policy, 70, 45–56. https://doi.org/10.1016/j.enpol.2014.02.034

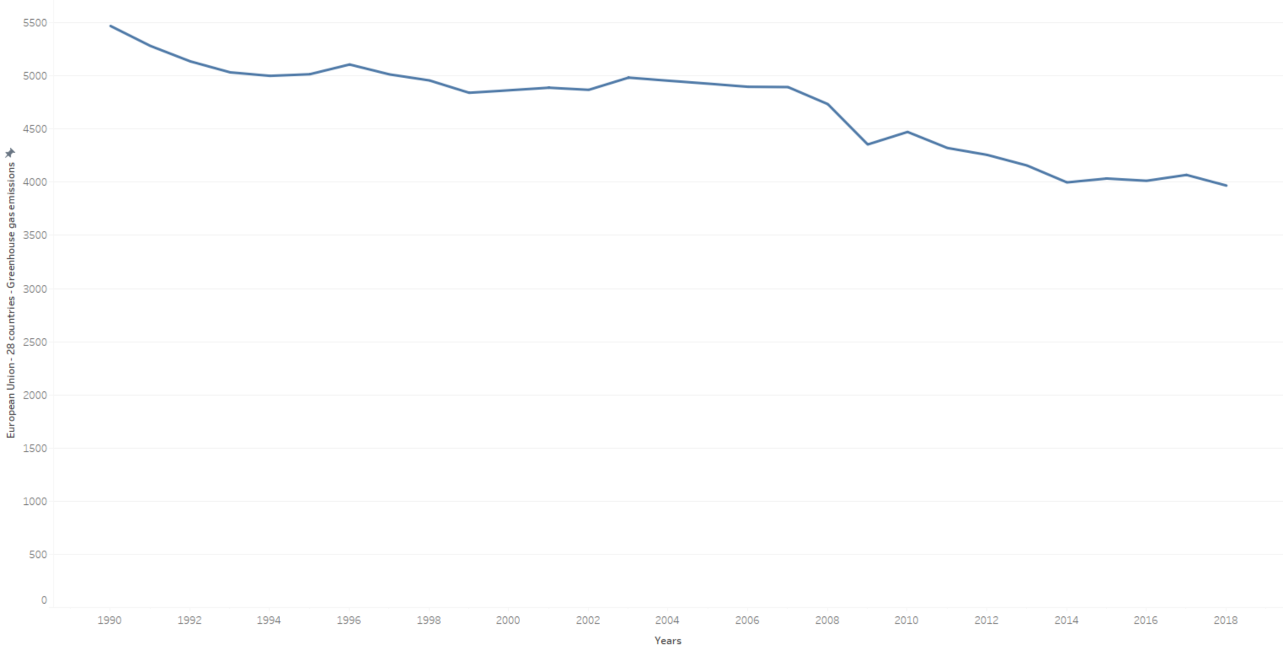
APPENDIX 1. INEQUALITY AND THE ENVIRONMENTAL SITUATION IN THE EU-28

Greenhouse gas emisson per capita - GINI Coefficient



Gini as an attribute and greenhgpc as an attribute for each country. Color shows details about years.

Greenhouse gas emissions (1990 to 2018)



The trend of sum of European Union - 28 countries (2013-2020) for TIME.

APPENDIX 2. FIXED EFFECT FINDINGS

Alternative: First Model Fixed Effect (1) Greenhouse gas emissions per capita

Equation number	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)
	GINI	INCOME40	S80S20	INCOME10	PALMA
Inequality	-0.124***	0.165**	-0.294**	-0.188***	-2.344***
	(0.0304)	(0.0611)	(0.109)	(0.0418)	(0.562)
GDP	0.148***	0.147***	0.145***	0.148***	0.147***
	(0.0241)	(0.0245)	(0.0245)	(0.0240)	(0.0241)
Manufacturing	0.0699**	0.0732**	0.0757**	0.0782**	0.0709**
	(0.0251)	(0.0255)	(0.0254)	(0.0248)	(0.0250)
Urbanization	-0.0877	-0.0840	-0.0865	-0.0914	-0.0898
	(0.0467)	(0.0473)	(0.0473)	(0.0465)	(0.0467)
Humancapital	-7.013***	-6.981***	-6.917***	-6.836***	-7.028***
	(0.913)	(0.925)	(0.926)	(0.896)	(0.912)
Energyintensity	0.0132***	0.0125***	0.0128***	0.0145***	0.0134***
	(0.00328)	(0.00332)	(0.00332)	(0.00322)	(0.00328)
Finalenergy	0.0183***	0.0187***	0.0188***	0.0181***	0.0180***
	(0.00250)	(0.00253)	(0.00253)	(0.00248)	(0.00250)
_cons	30.62***	22.98***	27.89***	30.97***	29.91***
	(4.150)	(4.288)	(4.110)	(4.136)	(4.101)
N	371	371	371	372	370
Adj R^2	0.662	0.653	0.653	0.662	0.662
AIC	778.5	788.3	788.3	777.1	774.5
BIC	809.8	819.6	819.6	808.4	805.8

Alternative: First Model Fixed Effect (2) Ecological footprint per capita

Equation number	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)
	GINI	INCOME40	S80S20	INCOME10	PALMA
Inequality	-0.0479**	0.0782*	-0.161**	-0.0397	-0.775**
	(0.0162)	(0.0322)	(0.0564)	(0.0217)	(0.296)
GDP	0.137***	0.136***	0.134***	0.137***	0.136***
	(0.0136)	(0.0137)	(0.0137)	(0.0137)	(0.0136)
Manufacturing	-0.00419	-0.00374	-0.00310	-0.000577	-0.00310
	(0.0131)	(0.0131)	(0.0130)	(0.0131)	(0.0131)
Urbanization	-0.0798**	-0.0770**	-0.0775**	-0.0784**	-0.0795**
	(0.0254)	(0.0255)	(0.0254)	(0.0255)	(0.0255)
Humancapital	-3.432***	-3.422***	-3.395***	-3.472***	-3.473***
	(0.516)	(0.519)	(0.518)	(0.510)	(0.517)
Energyintensity	0.00683***	0.00656***	0.00670***	0.00680***	0.00677***
	(0.00177)	(0.00177)	(0.00177)	(0.00174)	(0.00177)
Finalenergy	0.00263*	0.00272*	0.00273*	0.00285*	0.00266
	(0.00129)	(0.00130)	(0.00129)	(0.00129)	(0.00249)
_cons	17.80***	14.47***	16.91***	17.26***	17.38***
	(2.274)	(2.355)	(2.231)	(2.294)	(2.262)
N	344	344	344	346	344
R^2	0.565	0.561	0.564	0.558	0.563
AIC	238.2	241.3	238.9	244.3	240.3
BIC	268.9	272.0	269.7	275.1	271.0

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

APPENDIX 3. COUNTRY LIST & DATA SOURCES

Country List (EU-28)

Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom (former EU member).

Data Sources

Greenhouse gas emissions per capita: https://ec.europa.eu/eurostat/databrowser/view/T2020_RD300/default/table

Ecological footprint per capita: https://data.footprintnetwork.org/#/

GINI coefficient: https://ec.europa.eu/eurostat/databrowser/view/ILC_DI12__custom_764134/default/table

S80/S20: https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

Income share of the bottom 40%: https://ec.europa.eu/eurostat/databrowser/product/view/ILC_DI01

Income share of top 10%:

https://data.worldbank.org/indicator/SI.DST.10TH.10

Real GDP per capita: https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2020

Urbanization (Proportional): https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

Manufacturing ratio to GDP:

https://data.worldbank.org/indicator/NV.IND.MANF.ZS

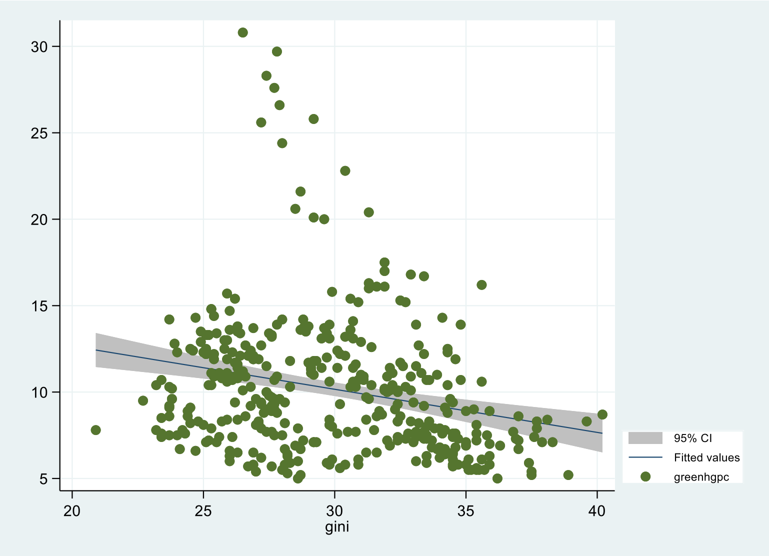
Final consumption - other sectors - households - energy use per capita: https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_ESC__custom_2085190/default/table

Human capital index: https://www.rug.nl/ggdc/productivity/pwt/

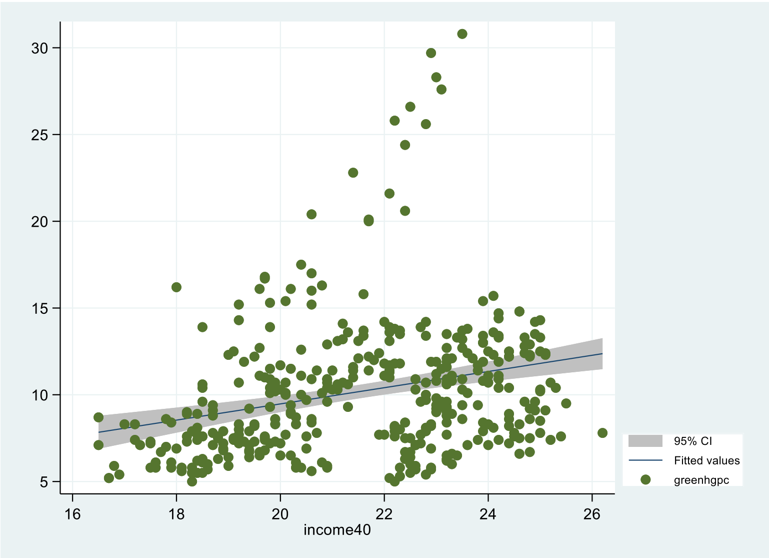
Energy intensity: https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_EI__custom_2100130/default/table

APPENDIX 4. SCATTERPLOT GRAPHS

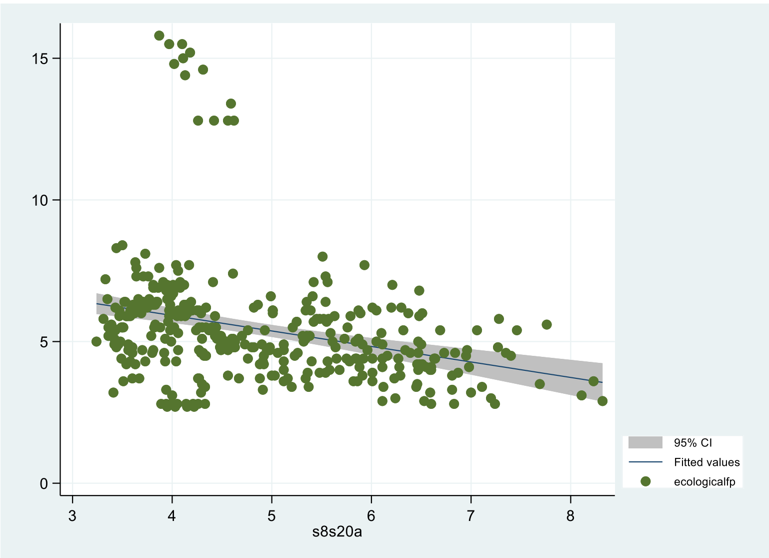
MODEL 1: Greenhouse Gas Emissions – Gini – Equation (1.1)



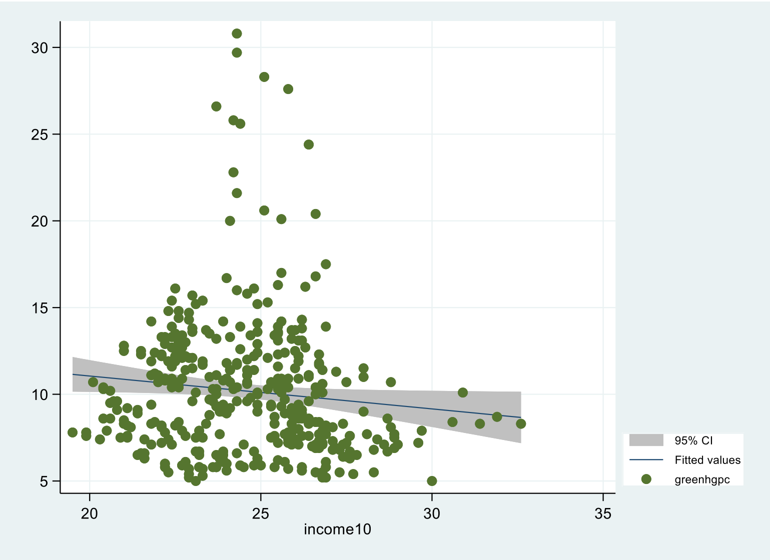
MODEL 1: Greenhouse Gas Emissions – Income 40 – Equation (1.2)



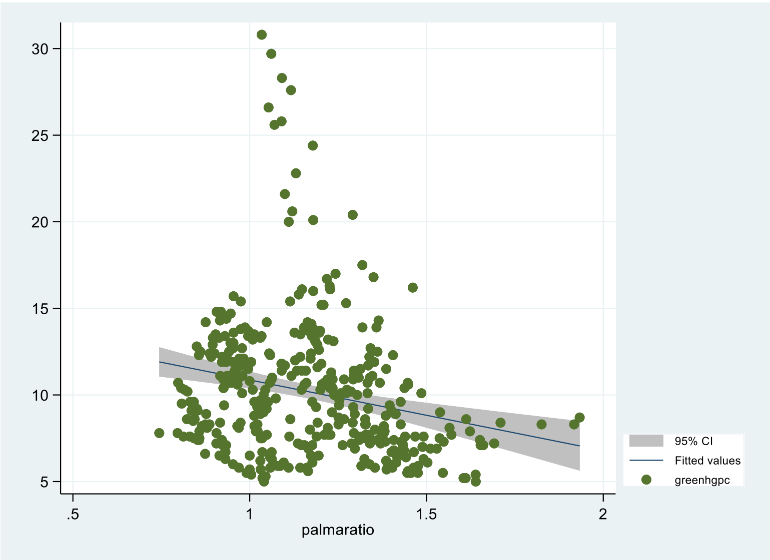
MODEL 1: Greenhouse Gas Emissions – S80/S20 Ratio – Equation (1.3)



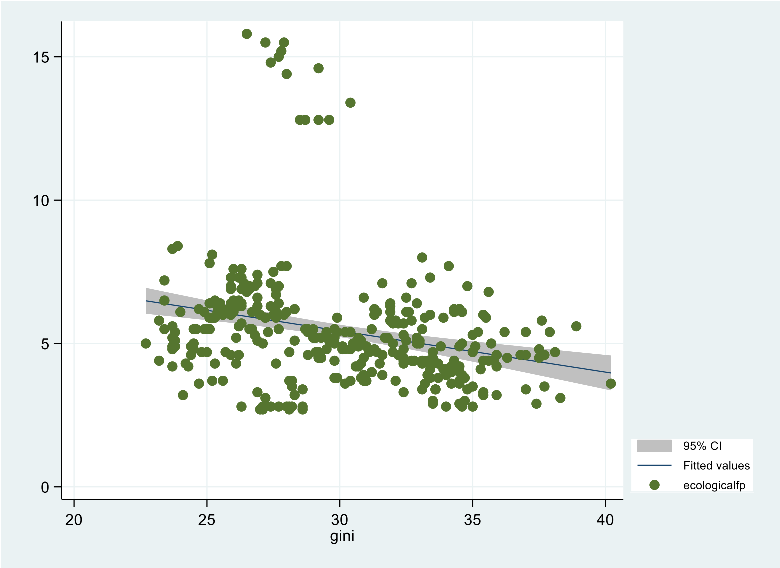
MODEL 1: Greenhouse Gas Emissions – Income 10 – Equation (1.4)



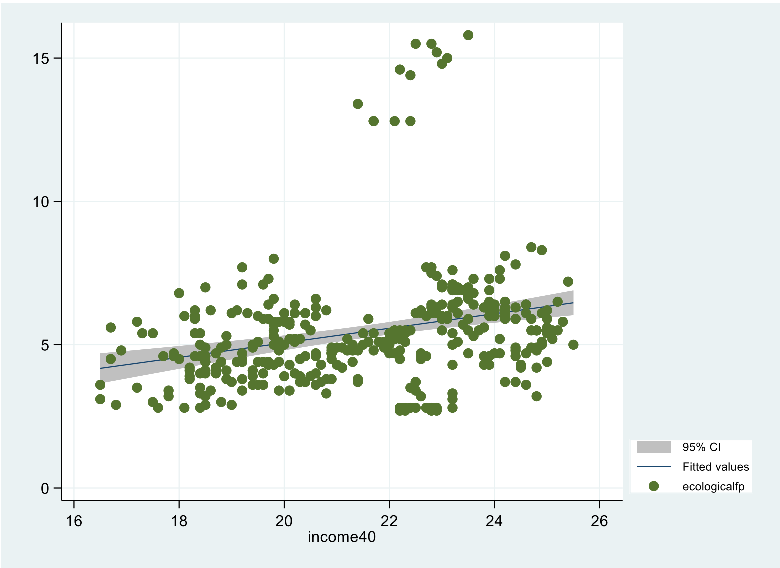
MODEL 1: Greenhouse Gas Emissions – Palma Ratio – Equation (1.5)



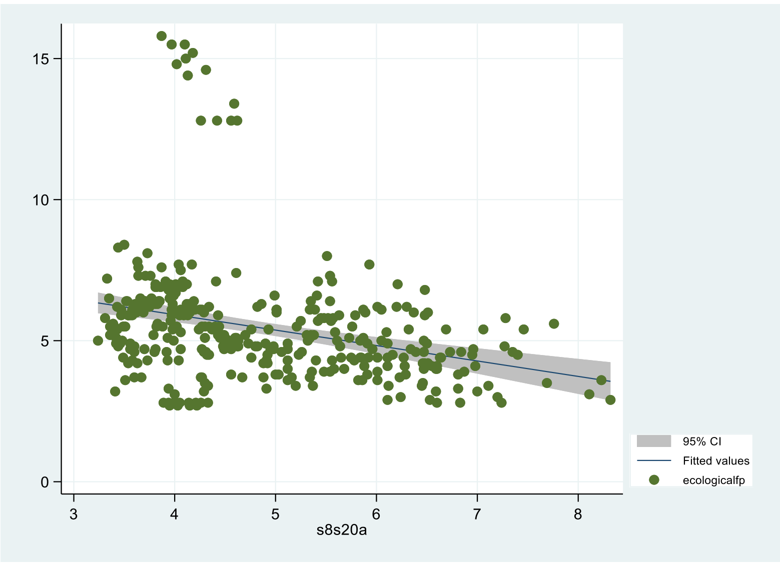
MODEL 2: Ecological Footprint – Gini – Equation (2.1)



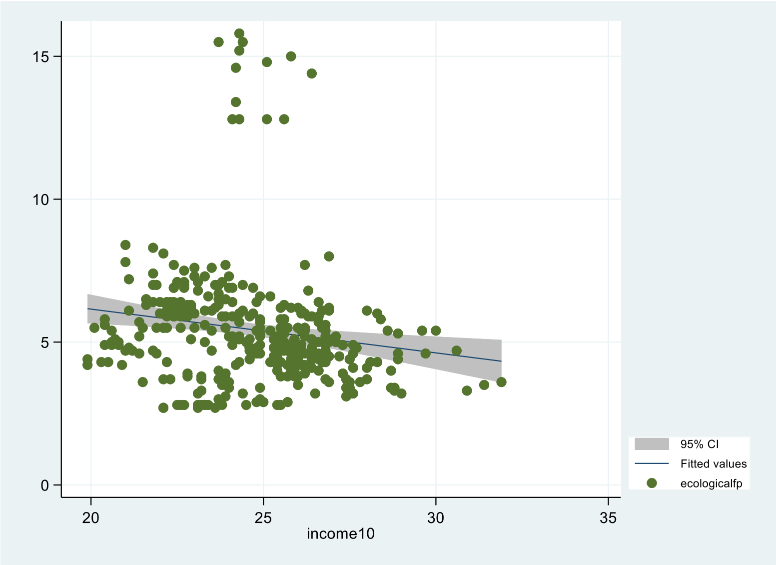
MODEL 2: Ecological Footprint – Income 40 – Equation (2.2)



MODEL 2: Ecological Footprint – S80/S20 Ratio – Equation (2.3)



MODEL 2: Ecological Footprint – Gini – Equation (2.4)



MODEL 2: Ecological Footprint –Palma Ratio– Equation (2.5)